A SRI position paper on the key critical issues before 2030

A necessary mid-term actualization, 2,5 years after the 3rd SRI World Congress

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1 Premises

1.1 Justification of this paper

2030 is considered, by many, as a key year. The United Nations Agenda for Sustainable Development was conceived in 2015, with 2030 as a deadline for the achievement of 17 Sustainable Development Goals, specifically designed to overcome the social and environmental issues that are threatening civilization, putting it at risk of a catastrophic irreversible implosion. Natural threats such as asteroid impacts, solar flares, super volcanoes, and ice ages shall be considered too. The SRI 3rd World Congress, in July 2021, identified the kick-off of civilian space development before 2030 as the key factor to relaunching social growth at all levels, reversing multiple crises, and rekindling hope in the future, an essential condition for civilization survival and further progress[6]. We conceived then, as a logical follow-up, what we have called the 18th SDG[1], to be added to the U.N. 2030 Agenda: "Space for All, a civilian-led space development, on Earth and beyond."[2]

The Space 18th SDG clearly indicates space development as the essential sustainable development goal, without which all of the existing 17 SDGs may represent just another unfeasible utopia. The 18th SDG should then be considered a universal social goal, to be communicated to, and well supported by civil society and public opinion.

While we are en route to the middle of the 2020-2030 decade, several old and new obstacles are already at work, in our terrestrial global society, questioning the achievement of the 18th SDG: short-sighted Earth-bounded strategies, business-as-usual, underestimation of risks, noxious use of certain technologies, Earth-bounded blind ecologism, a new-colonialist approach to cosmic resources, and a devastating increase of wars and conflicts.

This paper mainly focuses on the urgent kick-off of civilian space development and the many criticalities that may prevent such an epochal process from taking off before 2030. All of the themes discussed in this paper are analyzed concerning the critical significance of such a process.

1.2 Design inputs

Item	title	where	author(s)	date
DI.01	Who wants to live on planet Trantor? (why we are against space colonialism) – newsletter[3]	SRI Open Forum	A. V. Autino	30 June 2023
DI.02	Thread arose from the above[4]	SRI Open Forum	several	30.06 ÷ 11.07 2023
DI.03	Abstract for a Space 18th SDG[5]	SRI website	A. V. Autino	04 April 2023
DI.04	The 3rd SRI World Congress Final Resolution[6]	SRI 2021 website	Congress	30 June 2021
DI.05	Is the 2030 Agenda for Sustainable Development still important for the United Nations? (are we close to a psychohistory cusp?)[7]	SRI Open Forum	A. V. Autino	14 August 2023

1 "The 18th Sustainable Development Goal" https://spacerenaissance.space/the-18th-sustainable-development-goal/
2 https://space18thsdg.space/
3 Autino, A.V. "Who wants to live on planet Trantor? (why we are against space colonialism)" https://spacerenaissance.space/who-wants-to-live-on-planet-trantor-why-we-are-against-space-colonialism/
4 https://groups.google.com/g/sri-open-forum/c/ye9pn4-xG-Q?hl=en
5 https://spacerenaissance.space/the-18th-sustainable-development-goal/
6 https://2021.spacerenaissance.space/wp-content/uploads/2021/07/Final-Resolution-Final-approved.pdf
7 https://spacerenaissance.space/is-the-2030-agenda-for-sustainable-development-still-important-for-the-united-nations-are-we-close-to-a-psychohistory-cusp/

2 The 21st Century's socio-economic Paradigm

2.1 Space settlement vs. a space new Colonialism

A largely shared position, within the space community, is that space resources will be gathered by automated machines, brought onto Earth, and used for further industrial development on Earth's surface. Such a position might be named as a new colonialism, and it is utterly mistaken, for several reasons.

The argument around space colonialism includes at least two main topics:

1) the colonialist strategy and practice, in itself
2) and the terminology

Regarding terminology, we owe a preliminary note that colonialism, colonization, and colonies are not just different words, but are different concepts.

Historically a reference to colonization typically describes appropriation or invasion of territory. It also may refer to cultural colonization, subjugation of one society to another, or assimilation. "Colonization" is the divestment of one society in favor of a more dominant group. Human history is replete with examples, including the 17th-Century trans-continental exploration and the ensuing 19th-Century national colonization, the vanguard of the Industrial Revolution. Colonization has been the primary force in shaping our modern society. The idea of colonization can be associated with past activities often to the detriment of existing populations. The term "settlement" better applies to our scope and ideals.

There is another meaning to the term colonization, which is the biological one. Some colonies of bacteria, plants, or even animals might migrate from one location and establish tenure in alternative sites. In this sense "space colonization" clearly refers to human colonization, the potential to establish collective human settlements, outside Earth. Space colonization has not to be an exclusionary nationalistic endeavor. Then how will it be defined? Rick Tumlinson, Founder of the EarthLight Foundation, puts it this way, "expanding the domain of life"[8]. The human colonization of space has become something far greater than a national enterprise, it may be seen as a transnational event, the moment of engagement for the entirety. Such a valuable dynamic allows us to start to move beyond the context of "colonization" as being an invasive national venture, towards the inclusive concept of "space settlement" as an inclusive biological medium, the actual colonization of outer space by humankind.

An integrated worldview is very possible, but it requires foresight and planning, collaborative space venture for settlement is feasible but uncertain. We need to shore up the space-faring paradigm and ensure that the human colonization platform remains an open invitation, an engagement that is fully available to all participants, space agencies around the world, private companies, scientists and individuals, and all national governments in all places. We have means and methods, and the 18th SDG Space 4 All will ensure that our short-term outlooks will meet the long-term view. A phase of integrated international dialog is essential. This suitable role should develop through the UN COPUOS, its Subcommittees, and Working Groups.

Should space resources be used on Earth? This "party" argues that mankind should not necessarily expand into space, but focus only on using space resources to sustain further development on Earth's surface. The propositions range from the lower cost of robotic mining to higher safety issues, the objective is to avoid sending humans or building space habitats, and these various topics also include earthly business perspectives. Such a position could be termed a new colonialism, and it is utterly mistaken, for several reasons.

There is no doubt that space is already giving back many benefits, mainly to the people of the industrial world. The question now is as follows: will space bring much more benefit to all the Peoples of Planet Earth? Will such a perspective be realized by bringing space resources to Earth's surface, or through favoring an incremental process of migration, for all our earthly generations who would wish to venture?

Historically, colonialism was mostly predicated on a simple "rob and take home" concept[9][10]. However, in the solar system, there are no communities of native intelligent beings, therefore we would not be stealing

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8 EarthLight Foundation https://earthlightfoundation.org/

9 Autino, Adriano V. -- "Who wants to live on Planet Trantor? (Why we are against space colonialism)", SRI Newsletter June 30 2023 https://spacerenaissance.space/who-wants-to-live-on-planet-trantor-why-we-are-against-space-colonialism/

10 During the first colonialist age, superpowers of the era would send their agents overseas to obtain precious goods at very low prices, and to bring those goods back to their home countries, selling them at very high prices (today, such practices are far from being obsolete!). Such casual policies were typically socially detrimental, especially when they boosted the use of drugs, e.g., stimulating opium dependence in several Chinese provinces. In many cases, colonialist policies have led to conflicts and wars, to

anything from anyone. The essential objective of colonialism was to take valuable resources and bring them home. In this case, to take resources from the Moon, asteroids, and Mars, and bring them to Earth's surface – why then would such a process be harmful?

Space colonialism implies both a dangerous and harmful undertaking for several reasons.

Firstly, our planet is now subject to very high pressure: eight billion humans, a majority of which are still on their way toward modern industrial development, are subjecting the natural environment of our mother planet to unbearable stress, consuming more natural resources than naturally available assets. Retrieving raw materials from outside the Earth might mitigate certain resource shortages. Yet this would unavoidably also increase environmental issues. More material resources would also imply an increased volume of industrial processing and production. If that takes place inside Earth's atmosphere, several key indicators would signal a dramatic worsening, i.e. energy demands, the thermal burdens inside our atmosphere, enhanced environmental pollution, and CO2 production – just to mention some of the more relevant factors.[11][12]

Secondly, the resources obtained from space and brought to Earth's surface would be taken from unborn space communities, who would not then be able to utilize their territorial resources for their sacrosanct right to develop – also because the predatory strategies of space colonialists would be based mainly on automated machines – not upon the work of human miners. Given the growing use of artificially intelligent machines, the role and future of human space settlers would be lost. Where are those people now? They are our children and nephews, who do not find space and opportunities for social growth on Earth. They are the billions living in emerging countries, who are now migrating to "advanced" countries, only to encounter "post-industrial" societies, where civil rights are increasingly questioned by the trend to unemployment and an increasing regression to slavish working conditions.

So, we at Space Renaissance International, and the majority of the international space community, since the SRI Second World Congress have abandoned the terminology of "space colonists". Not only we don't like the word in recalling ominous historical periods, but we are opposed to the central concept of space colonialism. The concepts of Civilian Space Development, and Universal Space Settlement, have nothing to do with space Colonialism.

The space colonization concepts actively promote the use of In-Situ Space Resources (ISRU) to develop space infrastructures, establishing facilities for the benefit of the incoming space communities in Earth orbit, or across cis-lunar space, around Mars orbit, towards the Asteroid Belt, and beyond, to Jupiter's Moons, and the entire Solar System. Mining the Moon and the near-earth asteroids will be essential from the very beginning of the expansion, to produce propellant in space. Using ISRU will avoid excessive Earth launches and the export of large but essential infrastructure resources from Earth, while dramatically decreasing the cost of space missions.

Last, but not least, expanding human civilization outside Earth through an expansive paradigm, our home planet will progressively become a beautiful natural garden, while the immense solar system economy to come will generate financial resources, funding unique widescale enterprises on Earth's surface, mainly: agricultural, touristic, naturalistic, educational, spaceport infrastructures, and scientific centers.

2.2 Civilian-led space development and Civilization expansion into Outer Space as a Strategic Priority

We need to re-summarize the primary rationales behind the civilization's expansion into outer space, and the urgency to kick off this process.

ensure control over certain regions. In most cases, nothing positive remained for the colonized populations, since colonialist behaviors primarily engaged populations with a culture based on robbery and exploitation – not necessarily a culture to advance civil rights. Regarding the "new world", America's two continents, colonialists have certainly invaded these territories, stealing lands and natural resources from native inhabitants, and exterminating such populations by any means. During the last age of colonialism, up to the 20th Century, the practice of depredation has continued, in many cases retarding or preventing the development of colonized countries, notwithstanding the abundance of natural riches, from which native peoples could never benefit.

11 In his famous trilogy of The Foundation, Isaac Asimov describes a planet, Trantor, fully covered by artificial buildings, iron, and cement, where biological nature has been eliminated. It is an extreme metaphor, yet representative of what planet Earth might eventually become, should we keep the terrestrial system closed, yet keep on bringing external resources to be processed and used on its surface.

12 Asimov, I. – "Foundation, Foundation and Empire, Second Foundation" https://www.amazon.com/Foundation-3-Book-Bundle-Empire-Second-ebook/dp/B09KZ8SNS6/

The main proposition, underlying the basis of the Space 18th SDG, is that our civilization should begin developing elsewhere, and not just on planet Earth's surface. Limited resources and environmental crises are driving civilizations' expansion into outer space.

Supporters of the closed world perspective might argue that there are enough resources on Earth, and that "it would be enough that everybody" were to accept reducing their consumption and lifestyle to solve the problem. So, through such a criteria humanity should and would remain confined on the bottom of the Earth's gravitational well. Apart from the necessarily coercive part of that paradigm -- there's no way to get "everybody" doing anything without authoritarian means -- what such closed-world supporters neglect to indicate is that humanity would then de-grow, on all the meaningful KPIs [13]: numeric, industrial, cultural, scientific, technological, and ethical.

The many supporters of a “no rush” current, believe that humanity has plenty of time to expand into outer space. This is utterly wrong since our civilization is nowadays close to a critical psycho-historic cusp[14]. The current global crisis is demonstrated as both a political and a philosophical issue. A further analysis is laid out in a chapter (see Chapter 4), included in this document.

2.2.1 Recycle and quality

Primary resources may certainly be recycled, within a better-shaped and properly designed Circular Economy. Planet Earth might be considered a giant Circular System, in which any single atom has already been recycled an infinite number of times. “Bread and fish” can indeed be multiplied, by science. Yet, each time we achieve a multiplied number of products from the same amount of input materials, the quality of products loses some degree of original integrity. Anybody who tasted milk half a century ago could assess the difference from today’s industrially produced milk. A growing society needs continually growing space and resources, and more ground for agriculture and farming, properly to achieve what everybody seems to desire, and every advertisement mendaciously promises: a “natural” taste. Such an immediate concept can be uniformly extended to any aspect of civilian life. A better-organized Circular Economy might recycle all resources, to a certain extent, but not indefinitely and forever, for any number of beings. Space communities will certainly use total recycling techniques, yet they will have to take into account quantitative parameters, establishing careful and accurate algorithms, in regulating the addition of new materials and infrastructures, when the growth of the community requires it. Mother Earth also owns a natural built-in algorithm of that type. Such an algorithm is now suggesting the limitation of the size of populations living on the planet. By expanding into space, humanity preserves the possibility to respect the Earth’s population criteria while avoiding accepting the cruel law of de-growth. Even so, by achieving new space and material resources, we will obtain the possibility to re-create, in space, that “natural” environment that might not be so readily available on Earth.

2.2.2 No limits in space

The vision for space habitats is indeed spectacular! In space there will be no limitations: when original farming infrastructures are needed, no need for further consumption of soil, the scarification of forests, or expropriation of ground from other countries: just mine some more asteroids and cometoids, extract basic raw materials, build the new orbital infrastructure, and start fertilizing!

We will be doing nothing more than what nature has done for billions of years: cross-fertilizing our planet with asteroid and cometoids materials, shaping so the terrestrial environment to sustain life. We will do the same on artificial infrastructures built in the solar system, taking the materials directly from asteroids and cometoids. In this sense, we might say that building in space is not just the best humanist strategy, but the best *ecologist* strategy too, because it will allow wildlife on Earth to progressively get some territories back. At the same time, it will only in a small portion modify the natural environment on planets and moons, in case we want to attribute a value to this aspect.

However, recycling, circular economy, and critical non-invasive techniques and methodologies are extremely useful, both on Earth and in space. Furthermore, in space, we will learn these techniques far better and develop such important technologies in a far more advanced and effective way. Even so, we should probably dismiss

13 KPI = Key Performance Indicator

14 Isaac Asimov defines an “historic cusp” a dangerous critical passage, in which many social factors comes to concur to key breaking point in history, according to psychohistory (see the already mentioned “The Foundation” trilogy)

the illusion that a circular economy can solve the global crisis if it is confined inside the boundaries of Planet Earth.

2.2.3 Against further expansion on planet Earth’s surface

The option of further expansion on planet Earth, through claiming any extreme environments, such as deserts, seas, and cold areas, is not an alternative to the de-growth strategy. It could only delay by some years or decades, the inevitable crash against the bars of the cage. Choosing such an option would deliver to humanity yet another illusion, deflecting many good-willing people from the effort of expansion into outer space.

In particular, from the environmental point of view, we shall never invade, or appropriate the seas. The sea is the green lung generating oxygen on planet Earth. From the sea originates the terrestrial water cycle, bringing snow to the mountains and thus fresh water everywhere. We will have to properly study such a mechanism, to reproduce it in space! But then we may not even have such a realistic expectation, should the oceanic structure be compromised. The sea is inhabited by a huge number of life forms, many of which these still unknown. The entire sea environment should be considered a natural park, to be kept unspoiled and wild, as much as possible. The only way to achieve that is by choosing the space option, for our necessary growth.

2.2.4 An expansion strategy, for the sake of freedom, against the Armageddon psychosis

To summarize the perspective currently available, long-term earthly options will only allow limited further growth in the closed world since they would increase pressure and the risk of civilization implosion.

Choosing to develop outside Earth is fundamentally a choice of freedom, because we don’t want big or small minorities to be constrained to adopt any lifestyle. We want to remark that even psychological pressure is a means of coercion: making people feel diverse and inadequate is violence, though not a physical one. People shall be free to live as they like, of course observing the law and human rights. Only by expanding into space humanity can now pursue this goal.

SRI recommends the setup and adoption of a coherent global strategy, focused on the necessary provisions to favor civilian space development as a smooth and inclusive social process, marking significant first steps before 2030. That includes scientific, technological, policy, and legal undertakings, as we discuss in other sections of this paper.

2.3 Lessons learned by Elon Musk: Work with the technologies we have, making them better

From the point of view of methodology, such important lessons have not been acknowledged enough.

Many were surprised when Elon Musk, and his team at Space X, launched reusable rockets. For 40 years the space advocacy community has discussed the need for reusable launch vehicles, to bring down the cost of transportation from Earth to orbit. Almost all of these discussions focused on reusable Single-Stage-To-Orbit machines (SSTO) and complained because such a technology was not yet available. Elon Musk properly resolved the issue, announcing what might be called a “Columbus egg”, a brilliant yet logical idea: if we cannot yet build single-stage transportation directly to orbit, let’s take both stages back down to Earth's surface for reuse. Such a simple and realistic strategy is already downsizing the cost to orbit, making the old monopoly of expendable rockets obsolete.

Why had nobody thought about a similar solution before? No doubt that Elon is a genius. Yet maybe we can learn something here: first, he owns both a vision and deep humanist values; second, he has a method.

It is not easy to outreach the contribution of Elon Musk. He is often seen as a very rich eccentric, and his purpose for building colonies on Mars is just one of his “crazy ideas”.

Of course – while expressing our appreciation for what Musk is doing in the domain of the space industry and undertaking – we don’t want to express any assessment, positive or negative on other aspects of his life, choices, and public positions, in the domains of politics, personal behaviors or other non-space businesses. We just aim to underline some useful methodology lessons, that we may learn from observing Elon’s practice in the space domain.

2.3.1 The importance of having a vision, and goals

What is the difference between Space X and NASA? Why has Elon Musk achieved meaningful goals in a few years, while NASA is still “experimenting” with zero gravity, more than 50 years after the Apollo missions on the Moon? And how did John F. Kennedy lead humanity to the Moon in 10 years, while NASA has been almost in stasis for 50 years after that point? The answer is clear: JFK had a clear goal, to win the race to the Moon vs. Russia. Elon Musk is also animated by a deep humanist philosophy and has a goal that is coherent with that vision: to make humankind a multi-planetary species. Elon's extensive entrepreneurial history is targeted at achieving such a significant objective, as soon as possible. NASA's mission statement clearly describes space science and space exploration, but human space settlement is not necessarily envisioned as the genuine purpose.

2.3.2 The imperative to reduce launch costs

In working with public money, space agencies may not feel the need to reduce costs, while their suppliers, traditional aerospace corporations may not have any interest in reducing the cost of space launch. In the earlier aerospace captive market, the-higher-the-cost—the-higher-the-profit equation, held true for traditional big suppliers. Space X, as a startup venture, had only one way to crack this monopoly and enter the previously closed market: reducing the launch cost. Success in reducing the launch cost would foster low-cost access to space, a key condition to allow private companies to enter the market, opening the high frontier, and kicking off space settlement. Such a goal was perfectly in tune with Elon Musk's philosophy and goals.

2.3.3 Try, learn by errors, correct, retry

Despite the relevance of this methodological subject, there's basically nothing new in Elon Musk's practice. He simply applies the classic scientific method. An understanding of fundamental methodologies will pose the difference between scientific experiments and technological projects. Designers of technological projects will try to meticulously identify all the user's requirements before starting a design, according to the quality standards of their industrial sector. Whereas scientists often don't have clear requirements for an experiment: they just have an idea, an intuition, which they want to demonstrate if it is true, or not. They build a prototype, with a goal to start experimenting as soon as possible. From the outcome of each experiment, they learn what didn't work, and what to do to improve the prototype, toward the next test. We could say that the technology project method relies more on specific requirements, in the classic V model (requirements / development / test, see Figure 2), while scientific projects work more according to a circular model (see Figure 1), and focus more on testing proceeding from a seed idea to more and more refined test models.

Joe Pappalardo at National Geographic wrote: "The cultural differences between traditional NASA engineering and SpaceX are on stark display at each test flight. Traditional development programs design to perfection before testing to validate. The mantra at SpaceX is a lot different: Build. Test. Break. Repeat. Among the flaming wreckage, Elon Musk's company has made more engineering progress than any competitor or government-funded space program."[15]

[15] Pappalardo, Joe – "Second SpaceX megarocket launch ends with another explosion. What happens next?" National Geographic https://www.nationalgeographic.com/science/article/spacex-starship-rocket-reaches-key-milestone-then-explodes

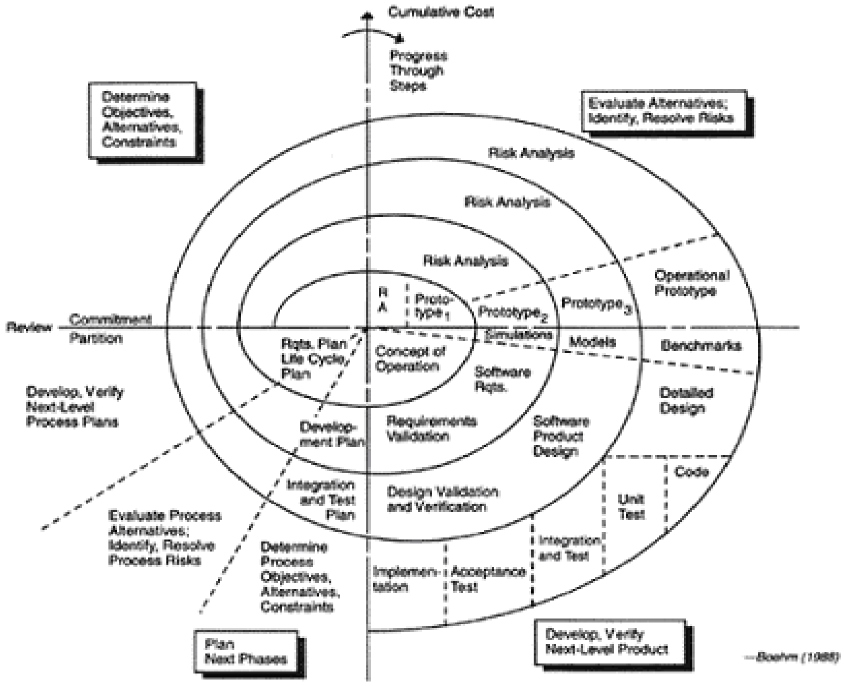

Figure 1. The reiterative scientific design method

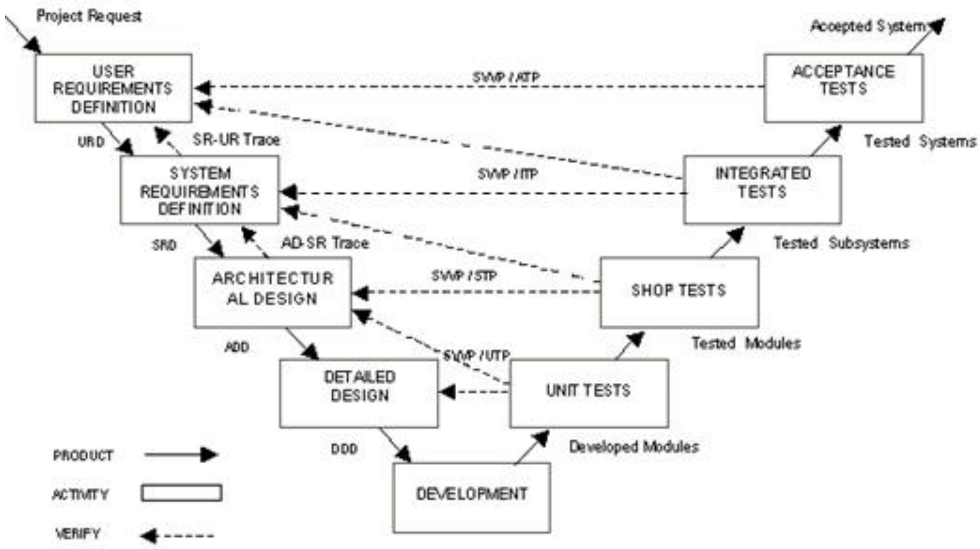

Figure 2. The technology project life cycle

2.3.4 Making the existing technologies better

Several projects developed by space agencies have been based on non-existing technologies or even science-fiction technologies. A typical case was NASA X33.[16] Various critics of the time wrote that everyone knew the X33 would never fly, and that the project was initiated just to demonstrate that Single Stage To Orbit RLVs and low-cost access to space are not possible, with the goal of maintaining the government's domain on space, keeping private ventures out of the market.

Elon Musk decided to solve the problem of low-cost access to space by optimizing existing technologies, rather than inventing new technologies, and learning from try and test failures, and from the failures of the past.

16 The Lockheed Martin X-33 was a technology demonstrator suborbital spaceplane, developed in the 1990s, in view of the VentureStar orbital spaceplane, a next-generation, commercially operated reusable launch vehicle. X-33 would flight-test a range of (futuristic) technologies needed for Single-Stage-To-Orbit Reusable Launch Vehicles (SSTO RLVs). Several failures caused NASA to cancel the project. Lockheed Martin X-33, Wikipedia, https://en.wikipedia.org/wiki/Lockheed_Martin_X-33

Firstly, he acknowledged that an SSTO technology is not feasible, yet. Or, at least, it is very hard to achieve and could require a long time[17]. Musk also knows that we don't have such a long time and that the launch window could close soon for humanity to start expanding into outer space, owing to environmental and political pressures. A quicker solution was needed, to achieve a meaningful downsizing of the launch cost, as the primary and immediate goal. Why not reuse the first stage of any launcher? So, Falcon 9 was born and proven in 2015. Nowadays that ingenious choice proved highly successful, and Space X currently holds 70% of the launchers' global market.

Yet another significant issue has been hindering the growth of an orbital thriving scale economy. Big reusable launchers are required. Space X Falcon 9's technology uses multiple-engine propulsion. Falcon Heavy uses 27 Merlin engines. A similar tentative design was brought forward by soviet engineers in 1969 with the N1 super-heavy rocket[18], aimed to balance the US Saturn V launcher and bring people to the Moon. N1's first stage was propelled by 30 engines. That rocket has never flown, due to several test failures, and the project was canceled in 1974. The main cause of the failure was the criticality of organizing and governing 30 engines in real-time, since computer science at that time was not powerful enough to cope with capacity. Far more efficient support is offered by the 21st Century's hard real-time computer systems. And Space X is ready to take profit from this development to power Falcon Heavy and later the Super Heavy Starship's first stage, which currently mounts 33 Raptor engines.

2.3.5 In summary, the lessons by Elon Musk

In summary, is Elon Musk perhaps a genius? No doubt. Though human intelligence can be trained and increased, as with any other human property, physical muscles, and other capabilities, genius cannot be learned. Yet existing methodologies can be learned and applied.

2.4 The actuality of Gerard O'Neill, a beacon in our path to space settlement

This interview[19], made by Stewart Brand with Gerard O'Neill in July 1975, clears perfectly why, building big rotating infrastructures in space is a much better solution for space settlement, instead of establishing habitations on the surface of planets and moons. Abstracting from O'Neill's talk: "We're a little bit like an animal who lives down at the bottom of a hole, which is 4,000 miles deep. One day that animal climbs up to the top of the hole, and he gets out, and here's all the green grass and the flowers and the sunshine coming down. He goes around and it's all very lovely, and then he finds another hole, and he crawls down to the bottom of that hole! If we go off and try to get serious about colonizing other planetary surfaces, we're really doing just that. It's kind of atavistic but there really isn't any other excuse for it." In the interview, O'Neill says that his theory was rejected for several years by all scientific magazines. They started to buy only after Gerard had begun to give talks to the students, getting huge success. Maybe this fact should teach something.

O'Neill forecasted a rapid development of his project, big artificial space islands at Earth-Moon Lagrange Points, from Model One, hosting 10.000 people, up to a quarter of a million people by the year 2,000. Because "you'll be going up very fast after you get the first beachhead."

The interview goes ahead with quite interesting speculations about the possible industrial and cultural production of a Lagrange Colony. Each single concept is worth reflection and further thoughts for possible implementation.

We, at SRI, consider O'Neill's one as the best existing concept for living outside Earth, so far, from our humanist point of view. The main rationales are social and biological. Should the space pioneers live on the surface of a planet or moon, with a reduced gravity – e.g. the Moon, 1/6, or Mars, 1/3 – their physiology would dramatically change in a few years. That might bring serious health issues, considering the experience made on several orbital space stations with low gravity over the past 50 years[20]. There will be limitations to the freedom of the migrants: should they decide to return to Earth, after some years, they would be condemned to

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17 Skylon is a project of a reusable single-stage-to-orbit spaceplane, by the British company Reaction Engines Limited (Reaction), using SABRE, a combined-cycle, air-breathing rocket propulsion system. Wikipedia https://en.wikipedia.org/wiki/Skylon_(spacecraft)

18 N1 rocket, Wikipedia https://en.wikipedia.org/wiki/N1_(rocket)

19 Brand, Stewart "Is the surface of a planet really the right place for expanding technological civilization?" - https://spacerenaissance.space/wp-content/uploads/2020/05/Is-the-surface-of-a-planet-really-the-right-place-for-expanding-technological-civilization.pdf

20 Kelly, Scott "Endurance: A Year in Space, A Lifetime of Discovery" - https://www.amazon.it/Endurance-Space-Lifetime-Discovery-English-ebook/dp/B01MYFE8X9/

a wheelchair. Even simply having a holiday on Earth would be painful, when you are used to reduced gravity. Last, but not least, possible social issues would be possible, since the physical aspect of the Lunars and the Martians would be different from the Earthers', and we perfectly know how many troubles we had on Earth, with even just the different colors of the skin. The science-fiction James Corey's books and movie series "The Expanse"[21] represent how the "rock hoppers", that grow in the Asteroid Belt and on Jupiter's Moons, were discriminated against by the Earth's and Mars's people.

While any planetary surface has limits, being a finite amount of materials, there are no limits to the dimensions of artificial infrastructures, in space. Using asteroid raw materials, humanity can build and develop for millennia to come, in the Solar System. The neighbors of planets and moons, in their orbit, will be preferred locations, just for logistic reasons.

Of course, people will work on the Moon's surface, for industrial purposes. Tourism will be another reason, for traveling to the Moon, for a few weeks. Research settlements and education activities will also bring people to walk and spend time on the Moon, as well as exploration missions. All of these activities may be conducted by working shifts, while for habitation they will go back to their Lagrangian big cities. Mars will be a fantastic logistic pole, placed on the interface between the internal and external Solar System.

As a last consideration, the excellent model left to us by Gerry O'Neill in the 70's may also be updated. For instance, by capturing near-Earth asteroids, bringing them to the Cislunar area, and digging inside, we could build habitats, not only endowed by simulated gravity by rotation but also protected from hard space radiation, with some meters of rocks.

The high validity of O'Neill's model is confirmed, in the present days, if we consider the appreciation given to it by Jeff Bezos[52] and Tori Bruno (ULA)[53], who are shaping their own plans for geo-lunar industrialization over that model. From our point of view to start putting into practice O'Neill's teachings is very urgent, considering that we have been experimenting with low gravity for 60 years, and nobody is even just thinking about beginning experimenting with simulated gravity.

Also see some works, in progress by the Space Renaissance Academy on Simulated Gravity[22], Space Habitats, and an Island Zero (a demonstrator of Island One)[23].

If O'Neill can be considered the bishop of the orbital space habitats, Krafft Ehricke dedicated most of his life, as a scientist and philosopher to designing the Moon development, in deep detail, and, also, to producing excellent philosophical concepts on what he has called "The Extraterrestrial Imperative"[120], i.e. the obliged evolutionary destiny of humanity in space. Both the arguments, the Moon industrial policy and the high philosophical discussion, are of paramount relevance for us, at SRI.

2.5 The role of governments, space agencies, and industry in civilian space development

Governments played a decisive role at the beginning of spaceflight, and they still do, even if more recent developments have seen the increasing presence of non-governmental entities. In this section, we explore the role of governments and their agencies versus other actors in the development of human presence in space.

The whole detailed story may be read in Alberto Cavallo's paper on the role of Governments, Space Agencies, and Industry in kicking off Civilian Space Development.[24]

2.5.1 A bit of history

Governments played a decisive role at the beginning of spaceflight, and they still do, even if the most recent developments saw an increase in the presence of non-governmental entities. In this section, we explore the role of governments and their agencies versus the other actors in the development of human presence in space.

If we consider the very beginning of spaceflight, we find that besides the first purely ideal and theoretical steps, the role of governments was essential.

21 https://en.wikipedia.org/wiki/The_Expanse_(novel_series)
22 Grandl, Werner "Space Habitats – Topic: Simulated Gravity (SG) " - https://academy.spacerenaissance.space/wp-content/uploads/2022/05/DraftMethodology-SpaceHabitats-Committee-TopicSG.pdf
23 Stone, Jerry, "Development of Island Zero" - https://academy.spacerenaissance.space/wp-content/uploads/2023/11/Development-of-Island-Zero-ESA.pdf
24 Cavallo, Alberto – "The role of governments, space agencies, and industry in civilian space development" https://spacerenaissance.space/wp-content/uploads/2023/12/The-role-of-governments-space-agencies-and-industry-in-kicking-off-civilian-space-development.pdf

It is significant to compare the development of the first functional airplane with that of the first rocket capable of reaching space. This allows us to understand why space rocketry began the way it did.

The Wright brothers were accomplished mechanics and smart researchers, connected with fellow human flight enthusiasts in the world. They made good use of the experiences of Otto Lilienthal[25] with gliders and were actively supported by Octave Chanute. But what did they need to make a functional airplane? The Wright Flyer[26] was made of wood, covered with fabric, with some metal cables. The Wrights made their own small engine, not a brilliant one but essentially in the same category of the car engines of the time, even simpler. The propellers were made of wood and driven by bicycle chains (the Wrights were bicycle makers) . Nothing that cannot be done with a little expense and some good craftsmanship. So, they were able to build a fully functional and usable airplane with very limited technical and financial means.

The development and construction of space rockets and spaceships was more difficult and required a large number of inventions and technical innovations. The first experimenters aiming for spaceflight could only make small rockets, reaching altitudes up to a couple of thousand meters.

In the USA, Robert Goddard[27] started his experiments with liquid-fueled rockets in 1926[28] and made some significant progress when he received the help of Charles Lindbergh and Harry Guggenheim. He was aiming for space and tried to sell his projects to the government without success. He was involved only during WWII in an insignificant program for the rocket-assisted take-off of airplanes. In the USA, the interest in space flight was also testified, and further boosted, by popular science-fiction magazines, widely read in the 1920s and 1930s. Two of those magazines, Amazing Stories founded in 1926, and Astounding Stories, founded in 1930, are still being published today. They have always included both science fiction articles and science fact articles about space exploration and settlement. Wernher Von Braun was a regular subscriber to both and reportedly continued to receive them during the war through a transshipment address in Sweden. Beyond Robert Goddard, other researchers were looking at the potential of rocket mail and rockets for spaceflight. The first person to test rockets in Boca Chica wasn't Elon Musk but William Swan who died there in 1933 testing a rocket belt. Previously he had successfully tested a rocket plane in New Jersey. Members of the American Rocket Society formed in 1930 also tested rockets in New York and New Jersey. The American Rocket Society became the AIAA in 1960, after merging with the Institute of the Aerospace Sciences. Theodore von Karmen and his students at CalTech made CalTech's Guggenheim Aeronautical Laboratory the first university-based rocket research center in the world in 1936. In 1943 it changed its name to reflect its research better, becoming JPL.

In Germany, a broad movement arose, of people interested in spaceflight. Following the publication of Hermann Oberth's "Die Rakete zu den Planetenräumen"[29] in 1923 and Max Valier's[30] more popular scientific work "Der Vorstoss in den Weltenraum" in 1924[31], a peaceful "space fever" began, as Rudolf Nebel, one of the rocket pioneers, wrote and which became a terminus technicus for the early German space movement. Oberth had shown that it was possible to build a space rocket with the technical means available at the time. He had also already worked out theoretical applications such as satellites, space solar energy, and space habitats. In 1927, on the initiative of Valier and Johannes Winkler[32], the famous "Verein für Raumschiffahrt" (VfR)[33] was founded, which brought together space enthusiasts and reached a membership of up to 500 members. This enthusiasm for space was shared by artists, filmmakers, writers, and philosophers. The culture of Romanticism still had an impact. In many places, test groups emerged that carried out rocket tests with both solid-state and liquid-fueled rockets with purely peaceful aims and without the support of the military. These civilian tests were supported by large companies such as Opel, the UFA film industry, the Heylandt gas industry, Shell, the aircraft company Espenlaub/Düsseldorf Airport, and the manufacturer Hückel. The events surrounding the car manufacturer Fritz von Opel and the film director Fritz Lang caused a great public furor. At the suggestion of Valier, the owner of Opel-Werke Fritz von Opel began building his Opel RAK series in

25 Lienhard, John - "Wright and Lilienthal" https://engines.egr.uh.edu/episode/162
26 "The Wright Flyer (also known as the Kitty Hawk" - https://en.wikipedia.org/wiki/Wright_Flyer
27 "Dr. Robert H. Goddard" - https://www.nasa.gov/dr-robert-h-goddard-american-rocketry-pioneer/
28 "75 years since the first liquid-fueled rocket launch" – 2021 - https://www.esa.int/Enabling_Support/Space_Transportation/75_years_since_the_first_liquid-fueled_rocket_launch
29 Oberth, Hermann - "The Rocket into Planetary Space" (English Edition) - https://www.amazon.de/Rocket-into-Planetary-Space-English-ebook/dp/B0138MX10M
30 https://en.wikipedia.org/wiki/Max_Valier
31 https://www.amazon.de/Vorstoss-den-Weltenraum-wissenschaftlich-gemeinverst%C3%A4ndliche-Betrachtung/dp/3486748947
32 https://en.wikipedia.org/wiki/Johannes_Winkler
33 https://en.wikipedia.org/wiki/Verein_f%C3%BCr_Raumschiffahrt

1928, which later also included rocket planes with which he wanted to use for civilian crossing of the English Channel. The rockets required for the cars, including liquid-fueled rockets, were developed by Friedrich Wilhelm Sander[34]. His rocket cars were driven at high speeds on the AVUS racetrack in Berlin with sensational success that was enthusiastically reported by the media. Fritz von Opel's systematic rocket program can be seen as the German forerunner of Elon Musk, one century ago.[35] Fritz Lang's film "Woman in the Moon"[36], for which he commissioned Oberth and Nebel to jointly build a liquid-propellant rocket that was to be launched at the premiere in 1929, was also a great media success and was attended by many space enthusiasts, including Albert Einstein. The fact that the rocket could not be launched did not diminish its success, as it led to the construction of the world's first rocket training ground in Berlin. Many other highlights from this period - such as Valier's experiments with liquid propellants and Winkler's experiments with liquid rockets - show that the early rocket pioneers in Germany were moving from theory to practice on a broad civilian basis.

Due to the restrictive clauses of the Treaty of Versailles[37], Germany was not allowed to make airplanes and had limitations on artillery, but nothing was said about rockets, and this helped. Skipping many other accomplishments, within the "Verein für Raumschiffahrt", founded by Valier and Winkler, a group whose main members were Rudolf Nebel, Klaus Riedel, and Wernher von Braun brought on a serious development program.

They were well aware of the need for resources of a national state to actually reach space. Already on 23rd July 1930, they made an experiment in front of the technical committee of the Reichswehr, showing the performance of their gasoline/liquid oxygen engine[38]. This brought to the first financial help from the government. They went on with actual flight tests, over 100 within 1932, reaching a maximum altitude of 1500 m. However, the lack of financial resources forced them to approach the Army again. On 22nd July 1932, they conducted an experimental launch for the Army, reaching 600 m. of altitude and 1300 m. of distance. This was considered disappointing by Colonel Becker, commander of the research group of the Army, but he appreciated the competence and professionality of von Braun and soon hired him. When Nazism took power all civilian activity on rockets was shut down, but the Army group went on with increased funding.

So, it happened that Wernher von Braun made the first rocket that actually did it, 2 October 1942[39] (reaching 90 km, under the Karman line; higher altitudes were reached later), within a military project aimed at producing advanced weapon systems for the war. The rocket, the A4, was made with special alloys, its fuel feeding system employed turbo-pumps that were an extremely advanced industrial product, able to reach very high rotational speed and resist high temperatures. The engine itself reached very high temperatures and pressures, requiring special materials as well. Making the rocket required an advanced factory and its launch needed a complex series of operations involving a team of skilled engineers and a complex infrastructure. The circumstances of the war allowed to accelerate the accomplishment of all the conditions needed to make a rocket suitable to reach space.

In Russia as well, the writings of Konstantin Tsiolkowsky and the Cosmist philosophy spurred public interest in spaceflight: students and young professionals formed societies to study rocketry and share ideas about the future in space. Between 1923 and 1932, more than thirty nonfiction books and almost 250 articles on spaceflight were published in Russia[40]. The early 1930s saw the development of the first rockets – mainly ballistic missiles – by Sergej Korolev[41], who later became the "chief engineer" of the Russian rockets program.

However, the futuristic aim to space that ran rampant in the world between the two world wars had a turning point when it switched on the interest of the military and the government, at least in Germany. While America was focused on winning the race for the nuclear bomb, Germany, after the political changeover to the *Third Reich*, had put more effort into rocketry. The well-funded military program in Peenemünde – led by Wernher

34 https://en.wikipedia.org/wiki/Friedrich_Wilhelm_Sander
35 Winter, Frank – "A Century Before Elon Musk, There Was Fritz von Opel" https://www.smithsonianmag.com/air-space-magazine/century-elon-musk-there-was-fritz-von-opel-180977634/
36 Price, Michael, "Woman in the Moon" April 2004 https://www.sensesofcinema.com/2004/cteq/woman_in_the_moon/
37 https://en.wikipedia.org/wiki/Treaty_of_Versailles
38 Hodapp, Martin – "Germany's Rocket Development in World War II" – p. 39, 2nd par. https://hilo.hawaii.edu/campuscenter/hohonu/volumes/documents/GermanysRocketDevelopmentinWorldWarIIMartinHodapp.pdf
39 https://www.britannica.com/technology/V-2-rocket
40 Gershon, Livia - "Dreaming of Spaceflight in 1920s Russia" https://daily.jstor.org/dreaming-of-spaceflight-in-1920s-russia/
41 https://en.wikipedia.org/wiki/Sergei_Korolev

von Braun[42] – accelerated rocket development many times over, so that the first rocket was actually able to reach space in 1944[43].

After the war, starting in 1945, more than 1600 German scientists, engineers, and technicians, including Wernher von Braun's team, were mainly transported to the USA, in the frame of Operation Paperclip[44]. Von Braun and his team started working on military programs, but soon had the opportunity to continue there the technical development of the space program. The great space scientist and philosopher Krafft Ehricke[45] was reunited with the von Braun team later, in 1947. Ehricke made his decisive contribution to NASA and its main programs, including the Space Shuttle and the key concepts for the International Space Station, and produced fundamental literature about space settlement, the development of a cis-lunar economy, and evolutionary space philosophy as well. Wernher von Braun, who like the other early German rocket pioneers was a space dreamer[46], was able to partially realize his visions. However, his Mars project was rejected by the political leadership. The first artificial satellites were built in a militarized environment, using hardware derived from weaponry development. Sputnik1[47], the first satellite to reach orbit in 1957, was launched by a modified R7 intercontinental ballistic missile (ICBM).

America had undertaken two different projects for reaching orbit, one managed by the Navy and one managed by the Army. It was the Army project, led by von Braun, to succeed through the Jupiter C launcher (an advanced version of an intermediate-range ballistic missile, IRBM, a direct descendant of the German A4 rocket) to put the Explorer I satellite in orbit[48]. After von Braun's success, the US government began to separate military from civilian space projects. In October 1958 the NACA was transformed by President Eisenhower and became NASA (National Aeronautics and Space Administration), designated as a non-military civilian agency with a primarily scientific purpose. Yet in reality, it remained strictly linked to military prospects in several ways. Significantly, all the astronauts included in the Apollo program were military officers, who originated either from the Air Force or from the Navy Air Service.

The only other country that has independently sent humans to space in the Twentieth Century was the Soviet Union, which was succeeded by the Russian Federation after the dissolution of the Union in 1991. The Soviet Union reaped extraordinary successes during the early space age. They put the first satellite in orbit, the first man in space (Yuri Gagarin 1961), the first multiple crew in space, the first woman in space (Valentina Tereshkova 1963), the first extravehicular activity, the first space rendezvous with and without docking. Due to the political system of the USSR, the distinction between military and non-military activities was even less defined than in the US as in all cases space activities belonged to the state, and because independent private enterprise did not have any particular role.

After the American successes in the Moon race, interest in human spaceflight quickly dwindled. Both the governments who had sponsored the early "space race" were concerned elsewhere. Von Braun's Mars project was rejected by the US Congress, while the Soviet Union gave up the early Moon program deciding that putting a man on the lunar surface was a secondary issue – a decision that might have been due to both the failures of the N-1 moon rocket and the premature death of Sergey Korolev, the inspiring head of the Soviet space program.

It is easy to see how two completely different political systems, Russia and America, had reached the same strategic point: cut the expenses for human spaceflight, while maintaining a limited activity to keep the wholesale technical and industrial base alive. Both space-faring countries then decided to orient towards low Earth orbit (LEO) objectives. The Apollo and Soyuz vehicles, both designed to go to the Moon, were restructured as limited programs to fly low. The USSR began developing space laboratories: the Salyut stations and then the much more advanced Mir. The US developed Skylab in 1966 for 2 billion dollars, one-tenth the

42 "Wernher von Braun, Former Marshall Space Flight Center Director" https://www.nasa.gov/people/wernher-von-braun/
43 MW 18012 was a German A-4 test rocket launched on 18 June 1944, at the Peenemünde Army Research Center in Peenemünde, https://de.wikipedia.org/wiki/Liste_der_Versuchsstarts_der_A4-Rakete
44 Operation Paperclip was a secret United States intelligence program, between 1945 and 1959 - https://en.wikipedia.org/wiki/List_of_Germans_relocated_to_the_US_via_the_Operation_Paperclip
45 Ehricke, Krafft A.; Freeman, Marsha – "Krafft Ehricke's Extraterrestrial Imperative" (Apogee Books Space Series) Paperback – February 1, 2009 - https://www.amazon.com/Krafft-Ehrickes-Extraterrestrial-Imperative-Apogee/dp/1894959914
46 Neufeld, Michael J., "Von Braun: Dreamer of Space, Engineer of War", Knopf Doubleday Publishing Group, 2008 - https://www.amazon.com/Von-Braun-Dreamer-Space-Engineer/dp/0307389375
47 https://en.wikipedia.org/wiki/Sputnik_1
48 https://en.wikipedia.org/wiki/Explorer_1

amount spent on Apollo, abandoning that program seven years later, and initiating a new program to make space access cheaper, a good idea that veered off far too soon.

Space access was extremely costly, not only because it was a real and specialized investment, but even more so because it was negotiated following the logic of the military under the control of the government. Private industry in partnership did not take any risk: they were paid on a cost-plus-fee basis, which means that timelines and cost increases were borne by the government. Government agencies needed to report to the political layer, which meant that they needed to be highly efficient and have large bureaucracies: everything posed or included must be formally justified, following complex procedures. This technique was applied both to the USA and the USSR.

The Space Shuttle was then conceived as being a cheaper model to reach each earth orbit, making use of the expedient concept of reuse. The project was subject every year to justification and political approval, with the constant threat of being canceled if Congress did not agree to sustain its cost. As often happens with military projects, to justify cost a program is designed to concentrate all adjacent capabilities. This objective meant that all types of space launch potentials were then focused into one single solution and a single platform, thereby canceling all other NASA launcher projects. Requiring too many performances and too much capacity from a single device means that it becomes far more complex and costlier and it will never perform at optimal levels in many tasks. Cost about the same as the Apollo program, the space shuttle was in many ways an experimental project that successfully demonstrated essential and progressive skills, such as the (partial) reusability of vehicles and the manipulation of objects in space.

The Space Shuttle program, despite being a civilian program and not a military–asset, followed the same course as many military programs: birth to be low-cost, evolved to reach the level of several hundred billion.

The demand for cross-range capabilities, again coming from the military, together with cost considerations, brought the government to the deletion of the reusable booster program. To keep the industrial basis of the missile industry going, the Space Shuttle included two solid rocket boosters instead of its first stage, basically using the technology of ICBMs but designed as reusable artifacts. The official explanation was that they were cheaper than other alternative solutions. The space shuttle orbiter was very large, with the ability to carry many kinds of payloads, including upper stages which were designed to launch interplanetary probes as well as large military satellites. It seems that military requirements for high weightage and large size of payloads, together with the idea that this had to be the only launcher for everything, brought to the overstretched dimensions of the orbiter. Moreover, being winged and having to bring the main engines to orbit and back down – since no reusable first stage was conceived – the total mass of the orbiter became even larger. Furthermore, since only the orbiter carried the necessary engines, they had to be strapped aside the main tank and not on top of it as logic would require for an orbiter. It soon became clear that the shuttle program had not reduced the cost to orbit. In fact, its cost per kg to orbit was higher than that of Saturn V. It never replaced the necessity for cost-effective reusable launchers. Two of the orbiters were lost in tragic accidents, killing 14 crew members in total, the Challenger on January 28, 1986, and the Columbia on February 1, 2003. The skewed and hasty design of the Shuttle played a major part in both accidents. Other reasons concurred with the poor balance of the Shuttle program. The original design, by Krafft Ehricke, was a fully reusable two stages to orbit, including a winged carrier, following the experience of the X15. The pressure of the expendable-rockets lobbies, on one side, and the government's interest to keep the space frontier under governmental control, brought to review the design, in favor of a non-fully reusable vehicle concept. Another meaningful condition, that made the shuttles weaker than the direct competitor, the Russian Soyuz, was that the shuttles were produced as 5 unique pieces, and not produced by an industrial chain. The Soyuz, instead, though its design is basically the same as the 1960's, is being produced on an industrial base, so the machine and its parts are always recent, and in good shape, not overused.

All attempts to realize a Single Stage to Orbit launch system haven't succeeded, so far, including President Reagan's 1990s, the McDonnell Douglas DC-X and DC-XA, and the Lockheed Martin VentureStar, canceled in 2001.

The story of the space stations is also very significant for our purposes. The USSR put in orbit the Salyut space stations, from 1971 to 1986, and later the large and efficient Mir, which operated from 1986 to 2001 (the Russian Federation took over after the Union's dissolution). Russia and the USA found ways to deal with their financial difficulties through cooperation agreements, to operate the Mir station, and later the ISS, using the Shuttle and the Soyuz capsule. After Mir was deorbited in 2001, NASA and the new Russian space agency Roskosmos agreed, including ESA, JAXA, and the Canadian Space Agency, to build and operate the International Space Station (ISS).

The ISS – now 25 years old -- became by far the most complex space project ever constructed and a brilliant example of international cooperation. It might be considered the highest point reached by national agencies, working together in a large and unusual coalition, showing that in space the logic of international cooperation may take a formative perspective. The space race, though starting from the use of modified weapons, shows us how humanity reached a high level of common purpose and harmonic development.

In more recent years here, on Earth, international cooperation has certainly reached a very low point with a frightening level of threats and open hostility, and the war in Ukraine bringing us to the brink of direct open war between NATO and Russia. It is almost unbelievable that the same nations are still cooperating in space with the ISS. Just 400 km above the surface of the Earth nations that are almost at war here below are still working together.

2.5.2 New private dealers enter the scene

The ISS is a wonderful accomplishment, but it may also be something of a finite end. Prospects changed significantly when innovative private entities initiated an agenda to build space launchers on their behalf. They could undertake this work partially because of their own escalating financial capability, but also owing to the support of several space agencies as well as conventional private-sector space clients.

The most significant of all these companies is SpaceX, which was devised and brought to significant success by a visionary entrepreneur, Elon Musk. Musk based his wealth on the creation of Paypal, which was sold for 1,5 billion US$ after generating such a value. Musk is an example of the approach to space that is the opposite of what had come before a single entrepreneur doing what only governments could do in the past.

Musk started with a contract with DARPA, the Defense Advanced Research Projects Agency, a military program. DARPA de facto financed Falcon 1. The company achieved a contract for COTS, the NASA platform that replaced the Space Shuttle in resupplying the ISS. This project marked the switch from governmental projects, managed by the agency, to a commercial contract for a complete project. The agency acted only as a client and supervisor. Without both NASA and the military investment, there would be no SpaceX, and the space market would have remained a captive government market. The basic concept was to make a reusable launcher that could, ideally, simply be refueled and launched again without the need for significant refurbishments between flights, just like a commercial airplane. Nowadays Falcon 9 is a space unbeatable workhorse, absolute leader of the launcher market.

The Dragon capsule was the logical subsequent step: a vehicle capable of carrying cargo to the ISS and returning materials to Earth. The commercial crew program fully replaced the Space Shuttle. SpaceX and Boeing got contracts based on the fully commercial open market concept. The SpaceX Dragon 2 capsule assured then the crewed transport to ISS. Until that point, American astronauts were obliged to fly on Russian Soyuz capsules owing to the retirement of the Space shuttle.

Commercial launchers have now reached full maturity, while the role of many governmental agencies remains to deal with experimental projects that could not be sustained by private entities through open and competitive marketplace dynamics. Developing satellite constellations, the private sector begins now to run on its legs, thanks to the low-cost launch capability of SpaceX.

Though previously based on Orion and the Space Launch System, the Artemis Moon program yielded a contract to Space X. Once again, a governmental program is supporting the development of an asset that is key to downsizing the cost to orbit: Starship, finally a fully reusable Two-Stages-To-Orbit launch vehicle.

Axiom Space and other companies are starting with their own projects, leveraging the affordable cost for launch offered by SpaceX –in cooperation with NASA. Jeff Bezos, with Blue Origin, is progressing at his own pace, developing a partially reusable launcher, the New Glenn. Smaller companies like RocketLab and Relativity Space are proposing lightweight reusable launchers. It seems as if the US is simmering with commercial activities going in the right direction (up!). NASA's contribution, therefore government involvement, is still decisive for human spaceflight, even if a large commercial launch sector is now thriving and the paradigm has changed. The SLS launcher seems like a remnant of another era – a very costly one.

Russia and China are now joining forces on independent projects in space. China is fostering a private sector, but until now its space activity remains well under the control of the National Space Agency. The Tiangong space station is fully functional and a Moon program has been announced, in cooperation with Russia.

The activities of the European Space Agency (ESA) are numerous and significant, but it is still missing the independent capability to carry crew to space. Europe hasn’t embraced so far the concept of reusability. The current independent launch capacity of Europe is almost nil since Ariane 5 was retired, Ariane 6 is waiting for its first launch and Vega is a small launcher with problems of reliability. India has achieved extraordinary results with very limited investments, all based on its own hardware and technology. It plans to kick off its manned spaceflight program, developing its own spacecraft. Japan, lacking the independent capability to launch a human crew, is following a different path, through international cooperation and ventures.

We conclude that government agencies are decisive for all space activity. The US private sector sports a launch company, SpaceX, that can send a yearly weight to orbit larger than all the other entities of the world together, but even now the company depends to a large extent on NASA and military contracts, as well as the telecommunication and Earth observation satellites. The latest assignment is a contract for the launch of the X-37, the secretive military mini-shuttle.

2.5.3 Civilian space development has not kicked off yet

Civilian space development has not really meshed in yet, at least not as a global phenomenon. Government agencies will support advanced science but not necessarily industrialization in space, and they are not expected to. The alternative sector where governments are willing to spend, besides scientific development per se, is the military, a conundrum that would lend itself to further analysis.

Private investment requires the prospectus of a business venture that can bring profits, and this expectation currently involves only telecommunications, specifically constellations, for the Internet. The lack of suitable legal frames for the space industry and mining activity is a limiting factor, but plausible and technologically viable industrial developments cannot be privately financed for other reasons as well. The business cases for asteroid mining or power production in space do not close: huge investments are needed for their development, with a return time frame still unfeasible for a 100% privately funded entity.

The majority of the portfolio is still based on government contracts: essentially Earth observation and positioning systems. Motivations that can move governments to invest in space may come, realistically, from the notion of seizing certain space resources and assets that are expected to be useful soon, such as favorable locations near the poles of the Moon. The Starship project of SpaceX takes a large part of its financial support from NASA in collaboration with the Artemis program. That bodes well for future achievement unless some political decision pushes the flow in other directions.

2.5.4 Recommendations for governments, industry, and space advocacy

The political level is of course influenced by public pressure, and this is something still painfully lacking: most people subscribe to the concept that space is useless, apart from hosting telecommunications and positioning systems, the Earthbound services, and that life outside Earth is impossible. The most important job for space advocacy organizations is the creation of larger support for space among the general public, aiming to influence governments to provide funds for research that will allow a further reduction of the cost of access to space, and secure life and health protection in space.

A virtuous schematic, encompassing international collaboration among public entities and private enterprises might be the following one:

- Government agencies make contracts for space projects such as space habitats or Moon stations for research purposes
- Companies develop low-cost vehicles and systems to meet agency requirements in a competitive environment
- Private investors exploit the lower cost of space access to develop:
  - Orbital debris mitigation and recovering
  - In space manufacturing (some products may be better or exclusively produced in microgravity), including the reuse of orbital debris
  - Moon and asteroid mining
  - In space power and propellant production, from extraterrestrial resources

Currently, the USA is more or less following this scheme, while China is moving into some first steps, and most other nations still cling to older schemes of agency-driven activities.

Space agencies should pay more attention to factors that allow doing business in space: for instance, there is no reason to expect space workers to live in a microgravity environment. Production facilities for in-space technologies will be in microgravity, but crews must be allowed to spend most of their time out of it, with the use of simulated gravity.

The criteria apply to all factors of human health protection, that are mentioned in other sections of this document. These are enabling factors that are better developed by agencies since they concern a level of research and experimentation that is not intended for a specific business but to enable business activities in general. Such a method should be a goal for agencies, rather than the responsibility of private investors.

Space advocacy associations should seek out support and raise public awareness of these critical issues, this is, therefore, our role.

The role of governments, and national space agencies, is relevant at all levels:

- national level, in supporting their space industry with proper action, i.e. providing contracts and developing the essential research strains, functional to civilian space development
- in the international arena (geopolitics), favoring collaboration and fair competition, working at the U.N. as state parties, and helping the evolution of the regulatory frame of space activities
- in the space environment (astropolitics):
    - to ensure guaranteed room for collaboration and fair competition, and favoring international framework agreements – such as Artemis and ILRS – as a methodology oriented to cultivate the best practices
    - to ensure that civilian initiative not be stifled by an overwhelming military presence on the Moon and in other space environments
    - that the possibility of joint scientific research between scientists from rival powers will be guaranteed, taking an example from some best practices, e.g., the ISS
    - that some important clauses of the Outer Space Treaty, namely, not to bring weapons of mass destruction into space, are respected.

3 The Customs Clearance of Space Development, as a key factor of Sustainability, in the United Nations: the Space 18th SDG, a formidable campaign to the large public opinion

3.1 The U.N. 2030 Agenda for Sustainable Development needs a major update

Since 2015, reusable rockets have dramatically decreased the cost of transportation from Earth to orbit. Such a process is paving the path toward civilian space development and astropolitics for international alignment, as well. This trend is creating a growing and interdependent relationship between life on and beyond Earth. 2015 can now be formally identified as a “turning point” in history, signifying a change of paradigm, from “traditional” aerospace to a “new space” age. Immediately after the U.N. 2030 Sustainability Agenda [49] was published, several relevant criticalities came to the fore. A general assessment supporting the concept of sustainability as developed by the agenda remains the unquestioned limitation to the boundary of Earth’s atmosphere. The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, had actually been conceptualized during the traditional aerospace age, when outer space was not yet properly considered, as the dimension that helps to uphold, support, and increase the sustainability of human development. Space science and technologies have greatly supported comprehensive social and environmental goals on Earth, over many years. Yet even that growing dimension will not be enough, to warrant a fully sustainable global achievement by 2030. To allow immediate and durable real sustainable development, it is indispensable to start the urgent task of civilian space development, outside Earth's boundaries. Therefore, the UN 2030 Agenda of the Sustainable Development Goals needs to be updated.

3.2 The Space 18th SDG

SRI proposes an 18th SDG to be added: “Space for All, on Earth and Beyond”, a civilian-led space development, with human communities living and working in outer space to expand and multiply benefits to all the peoples of Earth.

It is widely believed that sustainability means nothing else than reducing human activities on Earth, to decrease our ecological footprint on this planet. But that would imply a rapid decay of civilization. As stated in the 1986

[49] https://sdgs.un.org/goals

U.N. resolution, development is a universal civil right[50]. Following the right to development[51], we propose a more advanced concept of sustainability: the only way, for 8 billion terrestrials, to moderate their footprint on Earth would be to commence development elsewhere. Expanding civilization into space will progressively relocate key technological industries off Earth, and consequently relieve the burden of our development on our home planet. See Jeff Bezos's plan to develop Cislunar logistics and progressively move the heavy industrial base into geo-lunar space [52]. Also consider the ULA plan for space industrialization, from early steps before 2030, including the production of propellant on the Moon towards 2050 moving into place a geo-lunar economy[53]. We see this transitional moment as an opportunity for Earth's green lungs and seas to regenerate themselves, Mother Earth will "take a breath", and human civilization will resume the positive growth outlook and become far more inclusive. We believe the only truly sustainable long-term development, for 8 billion terrestrials, actually lies in outer space, beyond Earth's atmosphere – and that we need to skillfully launch civilian space development, before 2030 as after that point it could be too late. For civilian space development to be fully implemented before 2030, specific issues should be tackled with far higher priority, especially concerning current priorities for space agencies, the trend for international alignment, the space industry in general, and the space research community at large.[54]

Civilian outer space development refers to the progressive practice of enabling humans to live and work in space for long periods and eventually to reside in space habitats within the near-term contingency) – both on planetary surfaces and in large orbital infrastructures. There are economic and biological challenges, to be addressed as soon as possible. To make human enterprise in space fully profitable, the cost of transport from Earth to orbit must decrease. Rockets reusability is already addressing this issue, as fully reusable space vehicles will bring the cost per kg under $1000, in current terms. Producing propellant in space, from both Moon and asteroid resources, will help lower the costs of establishing infrastructure further, probably to under $100/Kg[55]. Yet economic perspectives are not the only concerns. Biological issues are even more important. Safety, ergonomics, and the smooth acceleration of passenger space vehicles will be fundamental, to enable untrained civilians to travel and work in space. Protection from solar and cosmic radiation will also be critical. Commencing work on simulated gravity thereby avoiding the physiological damages experienced by astronauts on orbital space stations. is very urgent. Enabling green environments in space habitats, all the measures to support and preserve health both physical and psychological, and experimenting with self-sustaining closed ecosystems, are also of primary importance.

Adding the 18th SDG to the 2030 Agenda will give evidence to the above process of development and provide urgent and necessary information to the large public opinion about the rationales and profound humanist reasons to expand civilization beyond Earth.

3.3 The Expected Outcomes of a Space 18th SDG

Adding the 18th SDG to the UN 2030 Agenda will achieve the following outcomes, at a minimum:

- to upgrade the 2030 Agenda after major changes occurred in the global society, namely the booming new space economy
- real sustainability of the growth key pillar SDGs 7, 8, and 9[56], which will not conflict anymore with the environmental SDGs[57]
- establishing the authentic sustainability of the social SDGs[58]
- attracting more investments in space

50 Declaration on the Right to Development adopted 04 December 1986 by General Assembly resolution 41/128 https://www.ohchr.org/en/instruments-mechanisms/instruments/declaration-right-development

51 "We are committed to making the right to development a reality for everyone and to freeing the entire human race from want." Resolution adopted by the General Assembly 55/2. United Nations Millennium Declaration https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_55_2.pdf

52 "Jeff Bezos Reveal Blue Origin's Detailed Plan For Colonizing Space" - Insider Tech https://youtu.be/Ge5Q3EBQ1tc; "Blue Origin 2019: for the Benefit of Earth" https://youtu.be/GQ98hGUe6FM

53 "How to build the new Moon economy? - ULA recipe to go to the moon" https://youtu.be/pERZCQHvxY0

54 See the Final Resolution of the SRI 3rd World Congress, July 2021 https://2021.spacerenaissance.space/wp-content/uploads/2021/07/Final-Resolution-Final-approved.pdf

55 https://www.visualcapitalist.com/the-cost-of-space-flight/ https://en.m.wikipedia.org/wiki/SpaceX_Starship

56 The Growth SDGs: 7 (Affordable and Clean Energy), 8 (Decent Work and Economic Growth) and 9 (Industry Innovation and Infrastructures)

57 The Environmental SDGs (12, 13, 14, 15)

58 The Social SDGs (1, 2, 3, 4, 5, 6, 10, 11)

- unprecedented economic and scientific growth, reversing the global crisis
- a better understanding and sensitiveness, within civil society, of the great and fundamental contribution of civilian space development to sustainable development
- the inclusion of emerging space countries in meaningful discussions with major space-faring countries to formulate just policies for the extraction and utilization of space resources and avoid potential future conflicts
- elaborating and exploring the connectivity of space-based utilities, earth observation, information flows, and AI for human development
- a suitable UN clearing house collating across the wide range of space dynamics
- Promotion of a Space 18th SDG within relevant organs of the United Nations (UN), including the UN General Assembly (UNGA) and the Economic and Social Council (ECOSOC). A particular focus will be on work within a permanent subsidiary organ of the UNGA called the UN Committee for the Peaceful Uses of Outer Space (COPUOS).
- revitalization of COPUOS and UNOOSA, bringing their leading discussion to the public at large.

The urgency and opportunity of an 18th SDG may be summarized as follows.

Sustainability – Space needs to enter the equation of sustainability. The U.N. 2030 Agenda has 17 SDGs, and none of them specifically mention Outer Space. Although UNOOSA discusses space assets in relation to the 17 SDGs, no exponent of the U.N. executive branch has ever attempted, so far, to add references to outer space into the 2030 Agenda. The United Nations Office for Outer Space Affairs UNOOSA and its subsidiary Committee on the Peaceful Uses of Outer Space COPUOS are considered solely internal departments of the U.N. operating within a minimal budget while meeting for only two weeks a year and remaining almost completely unknown. Space development is publicly unmentioned by the U.N. The general public does not even know that UNOOSA exists! While many more communities are aware of the 17 SDGs, it is an engagement that does not discuss the rationale of space development. From a policy point of view, the UN seemingly is indifferent to outer space, in relation to the durable provisions for planetary sustainability.

Resolving conflicts among different SDGs – If limited to Earth's boundaries, the several SDGs relating to energy, and industrial development, together with their rationales for both social and economic growth will conflict with the environmental SDGs.

Making all 17 SDGs truly sustainable – Only an 18th SDG, fostering creative civilian space development, will make all of the other 17 SDGs truly feasible and sustainable, assuring achievement in social growth while allowing planet Earth's green lungs and seas to regenerate themselves.

Fixing the 2030 Agenda obsolescence – The U.N. 2030 Agenda was conceived during the previous space age when Earth-to-orbit transportation costs were very high. Reusable launch vehicles helped reduce such costs and will reduce them still further. The 2030 Agenda should therefore be updated accordingly.

Social urgency of civilian space development – Kicking off civilian space development before 2030 is the most urgent task. Humanity could fail the historical "launch window", should Earthlings keep on growing up, or even worse our civilization implodes, within the closed environment of Planet Earth.

Higher priority for some issues – The 18th SDG - will promote higher priorities for some essential issues, such as 100% reusable, safe, and ergonomic space transportation vehicles, for passengers and cargo; protecting life and health from the sun and cosmic radiations in space; starting experimenting with simulated gravity in space; green environments (vegetable life) in space habitats; orbital debris recovery and reuse for geo-lunar space industrialization; Moon and asteroid mining, to produce propellant in space; space-based solar power (SBSP); producing food in space.

History of Space and Science in Schools – The history of space, as well as the history of scientific research, should be added to educational programs, at all levels, from Primary to University. We need to teach the history of love, not just of empires and wars. Our children have to learn the history of the people who dedicated their life to humanity, for the progress of civilization. The 18th Sustainable Development Goal will bring on board this important educational value.

Benefits of expanding Civilization into outer space – Civilization expansion into outer space, space settlements, and industrialization – starting out in Earth Orbit, moving towards the Geo-Lunar space region, Earth and Moon Orbits, and Lagrange Libration Points – will, at the very least: relaunch the global science and technology economy to grow at an unprecedented pace, reversing an austere global crisis gripping society for many decades in the closed Earth's environment while initializing the achievement of the material base for the incremental development of many generations, trillions of people into the solar system[59], furthering the prospect of space settlement during next centuries and millennia; working to transform Planet Earth into a beautiful natural garden; creating worthwhile international and global interchange and alignment; reducing the potentials for resource wars and conflicts, and helping achieve peace on Earth[60]; giving birth to the greatest cultural revolution in human history so far, developing extensive habitats, factories and communities in outer space; progressively helping to relieve planet Earth's environment from the burden of human industrial development; dramatically enhancing scientific knowledge of our solar system, exploring planetary environments and comparing them to Earth's environment, increasing our capabilities to understand planetary ecosystems, and to discover where humans and the terrestrial biome will be the first biological entities.

Initializing the movement into space – Many of the benefits listed above were mentioned by Gerard O'Neill in his initial and visionary paper "Space Colonies: The High Frontier"[61] and his book "The High Frontier: Human Colonies In Space"[62] which covered the long-term space settlement scenarios. These extensive platforms would be mostly achieved through the development of an Island One based on a sphere. However, it would be impractical to build Island One as an initial structure or any type of earth-exported infrastructure. Such a large-scale undertaking would require the establishment of several basic utilities to extract material from the Moon, space processing to separate the various raw elements, and space manufacturing facilities to construct building blocks and station units. Even before that work is begun, a much smaller located structure would be established as a first phase, to house the personnel that will assemble these further modules. As this worker unit would rotate to provide a simulated gravity, we should first build an experimental habitat to test living and work in space at 1g - or lower. Such medical research is an essential contribution to the space settlement continuum.

The initial revolving habitat would be a project that would demonstrate many of the features of a full settlement but on a much smaller scale, both in size and expenditure. It would demonstrate the viability of some of the incremental steps underlying space habitation. Through the SPACE Project, in which a team of volunteers from the British Interplanetary Society updated the Island One design, this small unit was designated as "Island Zero".[63] The development of such a unit would be an excellent way of initializing Mankind's large-scale expansion into space. It has therefore been suggested[64] that a suitable technical organization, such as the European Space Agency, conduct a Phase-A Feasibility Study to verify the viability of an island Zero design.

The role of space advocacy – Space advocacy has a key role in addressing the above issues. We warmly encourage all space advocacy organizations in all places, to fully engage with the public, helping to explain why and how space development and further exploration can serve as the main pillar of truly sustainable development on Earth, as well as outside our home planet.

Clearing space into daily political debates – The space advocacy movement should certainly break through the thin but hitherto impermeable curtain that keeps space topics out of the general political discussions.

To save civilization and refresh Earth's environment – Civilian space development should be presented as a primary sustainable enterprise, as well as a leading economic factor, a strong global undertaking that ultimately could help save civilization and refresh planet Earth's environment.

To talk on popular generalist media – Celebrity entrepreneurs such as Elon Musk, Jeff Bezos, and Richard Branson have provided radical outreach, with their entrepreneurial initiatives. Yet, space development will greatly benefit from widely recognized social and political speakers, engaging with popular media.

To spread the essential philosophical and political concepts – The 18th SDG campaign is a powerful means to create outreach to the public at large, disseminating the unique and essential philosophical and political concepts that are well related to space enterprise. Space development is not defined as a pursuit for wealthy pioneers and superpowers. It is a vital enterprise for humanity.

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[59] Jeff Bezos foresees a trillion people living in millions of space colonies. Here's what he's doing to get the ball rolling. https://www.nbcnews.com/mach/science/jeff-bezos-foresees-trillion-people-living-millions-space-colonies-here-ncna1006036

60 Collins, Patrick, Autino, Adriano V. - "What the Growth of a Space Tourism Industry Could Contribute to Employment, Economic Growth, Environmental Protection, Education, Culture and World Peace" - https://spacerenaissance.space/wp-content/uploads/2020/04/The_Growth_of_a_Space_Tourism_Industry.pdf

61 O'Neill, Gerard K - Human Colonies in Space: The High Frontier - The Futurist, February 1976

62 O'Neill, Gerard K - The High Frontier: Human Colonies in Space - Jonathan Cape, 1976

63 "The Island Zero concept", presented by Jerry Stone https://www.youtube.com/live/V_YKlk9UFIc

64 Stone, Jerry - The Development of Island Zero: ESA - Published by the author, November 2023

3.4 Engaging the UN to Establish a Space 18th SDG Resolution

As we approach the years 2024 to 2030, SRI will also promote a Space 18th SDG resolution within various organs of the UN, including the UNGA and ECOSOC. With the help of the UN Office for Outer Space Affairs (UNOOSA) within the UN Secretariat, SRI will collaborate with the National Space Society (NSS) to promote an 18th SDG resolution within COPUOS. This promotional work will be facilitated by the fact that NSS is a Permanent NGO Observer in COPUOS and consistently participates in its meetings. It is also relevant that SRI is in the process of becoming a Permanent NGO Observer within COPUOS as well.

The possible formation of a COPUOS Working Group (WG) to establish and promote a Space 18th SDG resolution would significantly increase visibility and discussion for the resolution within and outside of COPUOS, potentially leading to increased international activities to expand human life into space.

The Space 18th SDG open source international forum may be readily identified by agencies, ventures, and enterprises as an entry-level full-time operational venue - where questions can be asked, grievances aired, and problems solved. From that level reaching the diplomatic engagement arises a functional opportunity for the collation of issues and subsequent clarification via the moderation of COPUOS and its two subcommittees, both legal and technical.

Such a WG will have, at minimum, the following tasks:

- To develop a coherent and organic literature, establishing the equitable rationales and expected outcomes of the Space 18th SDG platform
- To encourage U.N. and COPUOS state parties to formally adopt the Space 18th SDG resolution, and the legislative process for approval by the U.N. General Assembly
- To promote International Framework Agreements (IFA) for the implementation of the Space 18th SDG recommendations
- To move notable U.N. exponents such as the General Secretariat to identify Space Development as a key factor of planetary sustainability in public forums and talks.

3.5 Initializing the geo-lunar Space Industrialization: Orbital Debris' Risk and Opportunity

From the abstract of a paper[65] presented at IAC 74: "Since the beginning of the space age more than seventy years ago, humanity has launched many thousands of satellites into orbit. Most of these satellites and their upper-stage rockets are now defunct and uncontrollable debris objects, posing an increasing risk of collision with other spacecraft and their operations. A small fragment, traveling at orbital velocities, can perforate the hull of crewed spacecraft, causing quick depressurization and fatalities. There are similar concerns about pollution on Earth's surface, seas, and air. However, we have witnessed significant improvements on Earth only when terrestrial wastes are processed and transformed into useful assets, such as fertilizers, building materials, or energy. The solution in orbit is not different. If we see orbital debris remediation only as an expense, it is unlikely that real clean-up will begin. Orbital debris has value too[66]. Everything orbiting Earth is a bearer of orbital velocity, which is a big danger but also a precious property, a useful Delta-V, i.e. they just need a little more acceleration to move everywhere we might need them to go. Orbital Debris, as well as Near Earth Objects, should be considered In Situ Orbital Resources (ISOR), for all potential uses. If collected, reprocessed, and reused, instead of simply deorbited, orbital debris clean-up can mark the starting point of cis-lunar industrial development. It is therefore urgent to begin dealing with orbital debris clean-up in terms of feasibility, cost estimation, and investment return, in other words, as a business proposition."

The Orbital Debris issue may only get worse, during the next years, considering the increasing number of satellites sent to orbit. Up to closing humanity into an iron cage, that will sum its noxious effects to the philosophical cage, preventing physically navigating outside, in outer space. For a more detailed analysis of the problem, we refer to the abundant literature existing on the subject of Orbital Debris mitigation and remediation. We want to provide sound and proper political and financial arguments to encourage quickly moving to a business approach, much more effective, vs. a mere problem-solving one. Hereafter some excerpts from the quoted paper[65] mainly on Orbital Debris Reutilization.

65 Autino, A.V., et Al "Orbital Debris: a great business opportunity" https://spacerenaissance.space/wp-content/uploads/2023/10/IAC-23E62x76501.pdf

66 Autino, A. V., "Seven million and a half kg of gold in orbit" https://spacerenaissance.space/seven-million-and-a-half-kg-of-gold-in-orbit/

3.5.1 Orbital Debris Reuse: the most important market to come

An Orbital Debris Removal (ODR) market is already a reality and growing fast. A real Circular Space Economy (CSE) will require not only industrially efficient techniques and spacecraft to catch and move large and small debris, yet substantial additional items, such as orbital factories, capable of reprocessing debris, and producing raw materials for further industrial use. Such a development will mark the kick-off of the Earth's orbit industrialization. The first step on such an agenda is ODR, and it is well on its road. Yet design and investments in CSE should start immediately too, since it will be the real boom factor, for the new space economy, before and beyond 2030.

Leonard and Williams, in their paper "Viability of a circular economy for space debris"[67], prospect that a high-end estimate for reuse shows a net value of $1.2 trillion. It is worth observing that such a figure is higher than the foreseen volume of $1 trillion attributed to the space economy within 2040 or earlier by several specialists. It is reasonable to think that, if developed, the CSE-generated $1.2 trillion would add to the $1 trillion of the space economy. And likely, the combined outcome of the orbital industry and CSE will be more than the mere sum; therefore, the forecast of $3.5 trillion for the space economy in 2040[68] will not be unrealistic at all. The development of in-orbit services will be crucial to solve the orbital debris problem. A future circular economy for space may be financially viable, with potentially beneficial consequences for risk reduction; resource efficiency; additional high-value employment; and climate-change knowledge, science, monitoring, and early warning data.

We strongly recommend NASA, ESA, and the main space agencies, promote orbital debris recycling toward the space industry, and the associated research, to assist the emerging market in its development.

3.5.2 Products and Business from Orbital Debris

A rough list of products obtained by re-processing orbital debris shall take into account the possible progression of the orbital and cislunar industrialization process, that will go ahead according to the downsizing of the Earth-orbit transportation cost. Not only space industry will develop copying that curve, but space tourism and moon settlement too, at least. Orbital workshops will go through an evolutionary process:

- from mitigation to remediation
- from deorbiting to gathering
- from mere expenditure to investment and profit
- from small compact service satellites to more complex settlements, providing maintenance and more sophisticated services
- from debris elimination to recovering
- from debris destruction to reprocessing and reuse
- from merely simple automated to manned complex infrastructures

Following the above evolutionary process, we can envisage a range of progressive product classes, which will become feasible and profitable with the advance of the evolutionary steps:

1. **Risk Mitigation**. This is based on a simple question: what would be the cost, and the loss of profit, for the satellite producers and customers, of non-mitigating the risk?
2. **Rockets' Upper Stages** and fuel tanks recovery will represent a great saving, for the construction of new orbital infrastructures, such as space hotels, research stations, and simulated gravity orbital stations. Tons of aluminum can be recovered from the upper stages of Ariane 5[69].
3. **Producing Fuel from Metals**. Thousands of tons of aluminum in orbit can be very profitably recycled to produce propellant for rockets[70]. While the 1st key milestone in reducing the cost of any mission is rocket reusability, producing propellant in space will be the 2nd one. Reusability reduced the Orbit transportation cost from $54,000 / Kg to $1,000 / Kg. Producing fuel in space will bring the space transportation cost under $100 / Kg, paving the way to further progress.

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67 Ryan Leonard, Ian D. Williams, "Viability of a circular economy for space debris" https://www.sciencedirect.com/science/article/pii/S0956053X22005104

68 Autino, Adriano V., et Al, "Thesis 1 – Status of Civilization and perspective of expansion into outer space" https://2021.spacerenaissance.space/wp-content/uploads/2021/07/PAPER-SRIC3-SCT-4.1.01-007.pdf

69 "First steps to ESA's plan for recycling in space thanks to Castelgauss Observatory" https://www.gaussteam.com/esa-castelgauss-orbit-recycling/

70 "Companies Collaborate To Form Rocket Fuel From Recycled Space Debris" https://www.republicworld.com/technology-news/science/companies-collaborate-to-form-rocket-fuel-from-recycled-space-debris.html

4. **Producing Powders for 3D Printing**. In a more advanced stage of orbital industrialization, orbital manned versatile multi-products workshops will directly decompose space debris in their different components, plastic, metals, and electronic components. Duly reprocessed, each kind of material will then be available as input materials for 3D Printing.

Several business opportunities exist, related to the theme of orbital debris mitigation and reduction. They can be summarized as in-space servicing, including satellite and spacecraft maintenance, re-fueling, refurbishing, and relocating; garages to host space vehicles; scrap dealers, and demolition yards.

Some of these services in orbit are already active, though fully robotic, so far. Mission Extension Vehicles (MEV), are provided by Northrop Grumman[71], in the frame of what they called Space Logistics. "SpaceLogistics currently provides in-orbit satellite servicing to geosynchronous satellite operators using the Mission Extension Vehicle (MEV)™ which docks with customers' existing satellites providing the propulsion and attitude control needed to extend their lives." Mission Robotic Vehicle (MRV) is a similar service provided by DARPA[72]. The public-private partnership between the Pentagon's far-future research agency and Northrop Grumman's SpaceLogistics is developing a robotic vehicle to physically repair ailing satellites, to begin operation in 2026, and remaining in GEO for 10 years, visiting typical 2000 Kg satellites, and installing on them the Mission Extension Pods (MEP), elongating so of 6 years the life of the satellite. Satellite refueling is a nearly active service, as well. OrbitFab is currently offering a refueling service to satellites in orbit[73], to supply hydrazine and most common fuels to orbital clients.

Of course, the existing or near-to-exist infrastructures only make use of resources uploaded to orbit from Earth's surface and are fully automated. A true jump upwards will be done when fuel is produced in space, by reprocessing orbital debris and processing lunar and NEO's raw materials.

3.5.3 The technology of space debris rendezvous, capture, steering, and shepherding, central orbital garage repair or disposal

There are technical difficulties unique to approaching and gripping space debris. Large orbital wreckages generally consist of used rockets or non-operational satellites that have finished their missions. They have no active subsystems nor operational communication devices and have lost their attitude control capability, which could help rendezvous. For these reasons, a debris-removal spacecraft needs navigation technology, and the ability to estimate the accurate position and attitude of debris, before rendezvous. Moreover, the spacecraft will have to approach and capture rotating debris, which is far more difficult than capturing a stable target. JAXA conducted studies on this subject[74] and is developing technologies to overcome those difficulties. The most critical issue is to get the object steady to be recovered, stopping rotations, tilting, tumbling, and basculations. That can be done using thruster plumes (see Figure 1).

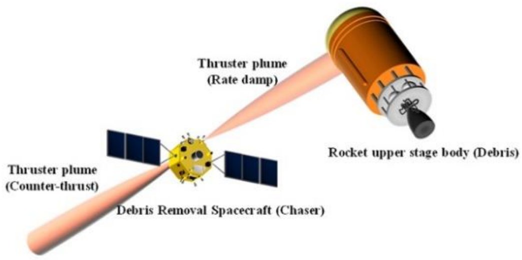

Figure 1. Large debris damp by thruster plume impingement

NASA has introduced the ADRV[75], to remove large debris from LEO, such as spent rocket bodies and dismissed satellites. The ADRV performs rendezvous, approach, and capture of non-cooperative tumbling debris objects, maneuvering of the mated vehicle, and controlled, targeted repositioning.

What can be done, once a large debris was captured and gripped by a properly designed and constructed "chaser" vehicle? At least 3 alternatives:

71 SpaceLogistics https://www.northropgrumman.com/space/space-logistics-services/
72 DARPA, SpaceLogistics step toward 2025 launch of orbital robotic 'mechanic' for satellites https://breakingdefense.com/2023/06/darpa-spacelogistics-step-toward-2025-launch-of-orbital-robotic-mechanic-for-satellites/
73 "Refuel Your Spacecraft, Gas stations in space" https://www.orbitfab.com/refueling-services/
74 "Research on technology to rendezvous with space debris" https://www.kenkai.jaxa.jp/eng/research/debris/deb-rendezvous.html
75 "Spacecraft to Remove Orbital Debris (MSC-TOPS-90)" https://technology.nasa.gov/patent/MSC-TOPS-90

a) to de-orbit the wreckage, forcing it to re-enter the atmosphere
b) to bring it to a central orbital garage, orbital yard, or workshop, where it can be disassembled, and its parts reprocessed to get new raw materials or recombined with other parts, to get a semi-worked part of an infrastructure
c) to bring it to a parking area, in Earth or Lunar orbit, or a Lagrange point, for future use.

Any of the above destinations, or other possible ones, foreshadows the need to develop interorbital transportation cargo systems, big enough to move medium and large objects among different Earth orbits and to Cislunar space.

Chinese scientists have apparently developed a new kind of magnetized coaxial gun that can generate magnetized plasma rings to move stuff at a distance without physical contact[76]. Conceived for military use, the device could prove revolutionary for many industries, if proven viable, including debris capture and remediation.

3.6 Space Law to support and facilitate a Civilian-led Space Development

Orbital Debris is considered a major issue, for space traffic safety reasons, and also because debris recovery and reuse may actually be a key element in kicking off Earth orbit industrialization. Scientific and technological challenges should be tackled with more priority, but they are not the sole obstacles: the relevant space law is also obsolete, namely on the aspects of recoverability of wreckages and utilization of space resources[77]. The updating of various treaty-based articles regarding state or private properties, territory, and the exploitation of resources on celestial bodies are often considered to be a sensitive if not controversial issue, Legislative aspects including patents, access, and reciprocal right of entry fields, need to be urgently addressed.

Other areas that can also be properly covered by space law revisions include international cyberspace assurance, nuclear monitoring and non-proliferation, and global security. The 18th SDG's role in such a critical venture is to act as a stabilizing factor, an entry point for discussion, inclusion, and the advancement of civil society assurance. The need is for a holistic and very inclusive approach to Space Law. Revisionary space law attributes that seek to accommodate an extensive global refocus will be a leading factor in shaping the future profiles of political and economic fronts amongst nation-states.

All countries should be involved in formulating space policies. Some emerging countries hold building capacities for space resources, while others may rapidly develop such capacities. The 18th SDG will motivate all of them to engage in discussions, demonstrating that expanding humanity into space is no longer reserved for a club of a few countries.

3.6.1 International Framework Agreements as a Methodology

The promotion of framework agreements for resource utilization and space governance is based on public and private best practices. The theme of property rights in the exploitation of extra-terrestrial resources cannot be finally solved by any stringent set of global rules, claiming to cover all future and hypothetical real cases. Outer space is an unknown territory, from the anthropological point of view, and trying to overrule its natural development, preemptive anticipation of a specific outcome might result in obstacles to development, such as invalidation of investments, and the discouragement of many progressive and integrated undertakings. Neither is necessarily recommended to adopt a policy that will delegate 100% of updated space law into jurisprudence assuming the various litigations that may arise from real cases, although the judicial technique will also provide an important part of the space law development. What can be done, then? Space law's evolution might formally progress through a methodological base, monitoring best practices while they are developing, and learning from existing laws ruling Earth's environments that present similitudes with the outer space's environment, e.g. the maritime law.

The Space 18th SDG can *play a key role as a clearing house* for the preparation of equitable space law, acting as a reference point for the collective and incremental experience. See the section on COPUOS and the Space 18th SDG (see 3.4). Ventures and enterprises can use the 18th SDG as an entry-level forum where questions can be asked and grievances aired. From that level diplomatic engagement arises an opportunity for collation and subsequent clarification via COPUOS.

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76 Meet China's new 'Force' gun that can move things from afar, https://interestingengineering.com/military/china-force-coaxial-gun-plasma-rings

77 "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies" https://www.unoosa.org/pdf/publications/STSPACE11E.pdf

This is the juncture where geopolitics – or, better, *astro*politics – gradually meets space law. The Outer Space Treaty is outdated, and cannot cover the process of geo-lunar industrialization, a tremendous and grand social process that will globally expand if no overwhelming crisis prevents mankind's next step forward.

While new human missions to the Moon are approaching, and the perspective of a cis-lunar economy is becoming more and more apparent, various agreements are extended on Earth, to allow Countries to work together, and to pursue the project of developing a lunar industry and economy. Inevitably, the human movement to the Moon will be initiated by two or more coalitions of Countries.

One such cluster is represented by the Artemis Accords[78], a Framework Agreement, initiated by the U.S. and signed now by 33 Countries. The mission statement of the Agreement recites: *"Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes".* It is worth noting that this mission statement mentions "Peaceful Purposes" (the cultural scope of COPUOS), and again "Civil Exploration and Use", recalling the formula of "Civilian Space Development", a concept that during the last few years gained considerable momentum, engaging the space community and encouraging governmental interests.

Similar agreements are being developed around the Chinese program to establish a permanent settlement on the Moon. The International Lunar Research Station[79] was initiated in 2021 by the China National Space Agency CNSA in collaboration with ROSCOSMOS Russia's National space agency. Eight Countries. mainly in the BRICS area, have already signed the agreement, and other nations are considering collaborations. The project will be open to all interested countries and international partners, as stated by ROSCOSMOS and CNSA. As described in a dedicated page on the UNOOSA website[80], the ILRS will be a scalable and maintainable comprehensive scientific experiment facility, that operates autonomously on the lunar surface and lunar orbit for a long time, with short-term manned participation. It will have the ability to support energy supply, central control, communication & navigation, space-earth round trips, lunar scientific research, and ground support, continue to carry out multidisciplinary, multi-target, large-scale scientific and technological activities such as scientific exploration and research, resource development and utilization, and cutting-edge technology verification.

Another similar initiative, worth mentioning, is the Global Exploration Roadmap[81], issued by the International Space Exploration Coordination Group (ISECG) in 2018. 14 space agencies signed this agreement, to expand human presence into the Solar System, with the surface of Mars as a common driving goal. Ranging from the International Space Station (ISS) to the lunar vicinity, the lunar surface, then on to Mars. The third edition of the Global Exploration Roadmap reflects consensus about the importance of the Moon on the pathway to Mars. It adds refinements in each step along this path as agencies continue to make individual and collective progress. Albeit the language still reflects the space exploration paradigm, the concept of initial space settlements on the Moon and the cislunar environment takes place among the goals, opening to commercial initiatives and civilian development. ISECG includes space agencies of Australia, Canada, China, Europe, France, India, Italy, Japan, Korea, Russia, Ukraine, UAE, the UK, and the US. Worth noting that this group includes Countries from the different alignments that characterize the geopolitics of the last years.

In the file of international efforts for treaties and agreements, we notice the positive experience of The Hague International Space Resources Governance Working Group[82]. In this document, the terms "authority" and "regime" are totally absent. The document calls for a multilateral, international, multi-stakeholder, cooperative "framework", as well as other beneficial provisions.

SRI recommends that, in any discussions, works, committees, and working groups targeted to amend and evolve the space law system, all the public and private stakeholders will be included, since any neglected interests or expectations may be cause of conflicts in the future.

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78 "The Artemis Accords" https://www.nasa.gov/wp-content/uploads/2022/11/Artemis-Accords-signed-13Oct2020.pdf

79 "International Lunar Research Station (ILRS) Guide for Partnership" https://www.cnsa.gov.cn/english/n6465652/n6465653/c6812150/content.html

80 https://www.unoosa.org/documents/pdf/copuos/2023/TPs/ILRS_presentation20230529_.pdf

81 "The Global Exploration Roadmap" https://www.nasa.gov/wp-content/uploads/2015/01/ger_2018_small_mobile.pdf

82 "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/bb-thissrwg--cover.pdf

3.6.2 A Space Salvage Entity for Orbital Debris recovery and reuse

In a position paper of NSS, October 2019[83], we read: "Given that level of expansion of space industries and activities in both the near and longer term, advanced space projects would greatly benefit from the ability to salvage and re-purpose derelict spacecraft. In addition, the safety of navigation will require that we 'dredge the harbor' of dangerous orbiting debris. More specifically, derelict pieces of orbital debris need to be either actively deorbited, or repaired, refurbished, repurposed, or recycled in orbit."

In a recent paper[84], presented at IAC 74 in Baku, A. V. Autino and A. B. Anzaldua mentioned: "Maritime tradition holds in high regard compensating private parties who rescue vessels & prevent destruction: Phoenicians, Greeks, & Romans rewarded "salvors" for rescuing ships & cargo[85]. Several studies suggest that maritime law could be added or integrated into the Space Law[86], to remediate many lacks of the Outer Space Treaty. As far as orbital debris is concerned, marine salvage laws (right of recovery of the shipwreck at sea) could be usefully applied to dismissed satellites, spacecraft, and spacecraft parts in orbit." Similarities for expansion of regulatory requisites are typically detected between maritime and orbital environments, from the point of view of debris removal, salvage, and reuse such as the creation of debris fields after catastrophic failure over land. While it is probable that space tourism will turn out to be somewhat akin to cruise ship tourism. Scientifically oriented space activities often resemble specialized maritime activities, and the commercial space launch industry in itself is more comparable to the maritime sector rather than the air transport sector. In a nutshell, any saver operating in space should have the right to recover large wreckages, within specific time frames and parameters as this right is granted in the sea and codified in existing maritime law.

The referenced NSS's position paper[85] proposes the creation of a Space Salvage Entity (SSE), the governing council of which would be composed of State Parties to the Outer Space Treaty (OST). The SSE would be endowed with several capabilities, including setting annual goals for the reduction of space debris and issuing "Kessler Credits" to commercial operators corresponding with their actuarial risk, a process that would also reflect on the inherent liabilities. Such a body would include the following attributes: to inform jurisdictions, control, and liabilities for all unclaimed and unregistered objects; to acquire registration and assumable liability risk for derelict objects; to establish bounties for the removal or salvaging of orbital debris; to license debris removal operations authorized by UN charters; to hold international auctions for debris removal or salvage.

3.6.3 Clearinghouses: A Useful Methodology

In September 2013, the U.N. placed the Biodiversity Beyond National Jurisdiction Treaty[87] (BBNJ) as a clearing house for High Seas information and data. The treaty has been signed by 84 States, and so far ratified by 60 States. It contains 75 articles whose primary purpose is "to take stewardship of the world's oceans for present and future generations, care for and protect the marine environment and ensure its responsible use, maintain the integrity of undersea ecosystems and conserve marine biological diversity's inherent value".

The adoption of the BBNJ is a consistent rationale supporting further human development outside Earth's boundaries, avoiding any expansion into the Earth's seas.

However, while some celestial bodies in the Solar System might be guests of life forms (namely where marine environments exist), the great majority of the Solar System's grounds appear to be lifeless and sterile. Therefore, the possible adoption of a setup similar to the BBNJ for outer space would be overruling and premature.

Regardless of the focus and contents of BBNJ, the methodology of clearing houses could be profitably applied to Outer Space usage. The emergent 18th SDG platform, an SRI consortium initiative discussed in this paper, could serve such an essential function along with many other specifics, providing the original UN asset in

83 National Space Society, "Position Paper on Space Debris Removal, Salvage, and Use: Maritime Lessons" https://space.nss.org/wp-content/uploads/NSS-Position-Paper-Space-Debris-Removal-2019.pdf

84 Autino, A.V., et Al "Orbital Debris: a great business opportunity" https://spacerenaissance.space/wp-content/uploads/2023/10/IAC-23E62x76501.pdf

85 Peter Garretson, Alfred B. Anzaldúa, and Hoyt Davidson "Catalyzing space debris removal, salvage, and use" https://www.thespacereview.com/archive/3847-1.html

86 McKenzie Franck, "Falling Stars and Sinking Ships: How Maritime Law Fills the Gaps of the Outer Space Treaty" https://pilr.blogs.pace.edu/2022/04/11/falling-stars-and-sinking-ships-how-maritime-law-fills-the-gaps-of-the-outer-spacetreaty/

87 Henderson, Neil - "A brief introduction to the High Seas Treaty" https://www.gard.no/web/articles?documentId=35175276 . Also see https://en.wikipedia.org/wiki/High_Seas_Treaty for links to the various parts of the BBNJ.

addressing and setting the stage for the growing complexities of globalized near-space development and global expansion into the Solar System.

The 18th SDG offers a genuine opportunity for the development of Space Law. Operating as a full-time clearing house for many interrelated issues, including high demand for 17SDGs practical applications, this accessible well-moderated entity would invite, collate and fully represent the formative shift towards a technologically enabled society, while upholding international values for collaborative space settlement platforms.

3.6.4 UNOOSA and COPUOS insufficient budgets

The current UN budget for UNOOSA and hence COPUOS forum together with their two subcommittees, is very limited, amounting to less than $10 million a year. Constraints of this type are problematic as they trend towards exclusionary and hierarchical decision-making. The Space 18th SDG, in operating as a wholesale full-time UN program actively collating input to the top-level legal body, will require additional funding, such contributions can be sourced by both public and private entities with optimal time frames for scaling up the capacity of the 17 SDGs venture.

Space Law also comprises an important feature of the 18th SDG implementation framework.

At this point, it is important to consider that global affairs have reached a watershed. Critical issues such as environment and security will predominate the global agenda while space technology will continue to enable. The UN should undertake the 18th SDG in the shortest time frame thereby steering our worldview towards an equitable future without delay. Space Law is the vehicle that can provide balance and assurance of mutual interests and expectations, the small but powerful Space Law UN forums should be rendered fully productive through extensive 18th SDG international perspectives.

3.6.5 Summary SRI Position on Space Law

The Outer Space Treaty (OST) should be considered a valid space law baseline, on several concepts. Some actualizations should be realized, using COPUOS and our proposed Space 18th SDG working group as a house for discussion and development, in a reasonable time, considering the urgency to kick off the civilian space development. We also want to point out that the necessary actualization of the space law should not act as a delay factor, for civilian space development, that should go ahead in any case at the *quickest possible pace* – according to Einstein's scientific concept, that speed should never mean superficiality.

In general terms, SRI rejects any legal setup based on coercive authoritarian concepts, aimed to dictate actions to both governments and private entities[88]. We are in favor of a legal framework that clearly defines what is prohibited, according to the democratic-liberal concept that says that everything that is not prohibited should be legally permitted. And we are in favor of an ethical concept based on freedom, whereby, at least in a minimum consensus, "freedom consists in being able to do everything that does not harm others". Space ethics still needs to be developed. Particularly in the thematic context of open and democratic competition, it should take into account that unfair practices must be prohibited. SRI blames unfair competition, cartels, monopolies, commercial barriers, suffocating bureaucracies, mafias, corruption, and any hidden agreement targeted to exclude small and new players from entering the game. Considering the great abundance of resources in the Solar System, SRI also encourages the big dealers to help the smaller competitors, generously sharing the achieved know-how, significantly reducing the competitive advantage of the game winners, respect the earthly custom. Proper clauses in the framework agreements should be added, to assure the fully inclusive character of the space enterprise. The Open Source model, used for many software developments, might also be useful for this purpose, combined with Intellectual and Industrial Property principles, establishing times and modes, for the achieved know-how to be shared, and assuring that any big or small contributions and investments will be acknowledged and rewarded. Worth observing that we warmly recommend all competitors to be fair and generous towards the less powerful. Solidarity without freedom cannot exist. Freedom without solidarity can never exist. Helping everyone increase their abilities makes everyone much freer[89].

88 We observe such authoritarian setup in the Moon Treaty (1979), and the first version of the UNCLOS https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/moon-agreement.html

89 Sen, Amartya K. "Inequalities reexamined", https://www.amazon.it/Inequality-Reexamined-Amartya-Sen/dp/0198283342

Among the provisions that should be reinforced, in the OST, we consider at first place the prohibition of bringing weapons of mass destruction into space. SRI also proposes that a specific provision should be added, forbidding *any weapon* to be brought into space.

One of the main points where the OST needs to be updated is the regulation of orbital debris mitigation, recovery, and reuse, which is completely absent in the text of the treaty. As discussed in section 3.6.2 we propose proper initiatives and authorities, to allow the recovery and reuse of orbital debris, such as a Space Salvage Entity and the right to property of debris after recovery. Such new space rules might use maritime law[90] as design inputs.

We agree on the OST principle, against the national appropriation of areas of land on celestial bodies. The OST's prohibition of national appropriation ensures that the concept of territorial sovereignty by nation-states has no place in Outer Space. SRI agrees that rights to resources for private entities may develop beyond national borders without violation of the national appropriation principle. Such a notion is reflected in recent national legislation by the USA[91], Luxemburg[92], United Arab Emirates[93], Japan[94], and the Artemis Accords[95]. We also note that the OST extends the jurisdiction and control of a country to its vehicles, stations, installations, and facilities in outer space.

Civilian Space Development could not have a course without allowing space resource property and utilization. While the OST is neutral – it doesn't forbid – the first version of UNCLOS (1982) was against it. SRI, together with the UNCLOS as delivered in 1994, and all the already mentioned space agreements, are in favor of the right to own and use the space resources extracted on the Moon, Asteroids, and other Celestial Bodies. A schema similar to the mechanism used to amend UNCLOS – where a Working Group on Deep SeaBed resources evolved into a legally binding Agreement on Implementation under the auspices of the United Nations – should be developed with the input of industry stakeholders, avoiding the pitfalls of the exclusionary supranational structure in place over the ocean floor.

The SRI internal discussion also brought us to propose to consider any celestial bodies smaller than a certain dimension (to be defined) different from big bodies, such as moons, planetoids, or even big asteroids. Such small bodies, when removed from their original orbit, should be considered extracted materials, and thus to be legally subject to property and right of utilization.

UN-COPUOS has created a Working Group on Legal Aspects of Space Resource Utilization, with a five-year mission that ends in 2027. SRI encourages the Working Group to consider the above ambiguities/deficiencies in the OST and propose an international agreement to resolve them. As several non-governmental organizations have permanent observer status with the Committee[96], SRI recommends that NGOs will be included, in the discussions related to the space law evolution.

Finally all the treaties – both concerning the sea and space – agree in considering nations responsible for private actions on celestial bodies. SRI doesn't disagree. However, we want to remark that all of the above concern Earthly nations and private entities. It is also to be considered that any space community, if and when having achieved self-sustainability, should be free to define and decide its legal and social status, even declaring independence from its mother nation(s).

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90 UNCLOS Mining Agreement: The 1994 Agreement on Implementation of the Seabed Provisions of the Convention on the Law of the Sea, G.A. Res. 48/263,U. N. Doc. A/RES/48/263 (Aug. 17, 1994), https://treaties.un.org/doc/source/docs/A_RES_48_263-E.pdf

91 "U.S. Commercial Space Launch Competitiveness Act" - https://www.govinfo.gov/content/pkg/COMPS-15975/pdf/COMPS-15975.pdf

92 "Law of July 20th 2017 on the Exploration and Use of Space Resources" - https://space-agency.public.lu/en/agency/legal-framework/law_space_resources_english_translation.html

93 United Arab Emirates: UAE Federal Law No. 12 of 2019 on the Regulation of the Space Sector (Dec. 19,2019), https://www.moj.gov.ae/assets/2020/Federal%20Law%20No%2012%20of%202019%20on%20THE%20REGULATION%20OF%20THE%20SPACE%20SECTOR.pdf.aspx

94 Japan: Japan Act no. 83 of 2021 on Promotion of Business Activities Related to the Exploration and Development of Space Resources, https://kanpou.npb.go.jp/old/20210623/20210623g00141/20210623g001410004f.html

95 "The Artemis Accords, principles for cooperation in the civil exploration and use of the moon, mars, comets, and asteroids for peaceful purposes" https://www.nasa.gov/wp-content/uploads/2022/11/Artemis-Accords-signed-13Oct2020.pdf

96 https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/space-resources/index.html

4 Evolution and Cosmology, including Earth (a planet of this Solar System)

4.1 Survival of civilization and human species at risk

We need to debunk a fake narration as soon as possible. Such a claimed moral paradigm states that, to revert the environmental crisis gripping our life-sustaining ecosystem, humans should accept being diminished and undertake actions to de-grow, on all of the meaningful Key Performance Indices (KPIs): demography, technology, and industry. The common sense is that a steady demographic size or even a demographic downsize, is acceptable or even desirable. People believe that reducing our number will not reduce the quality of our lives: but this is a blatantly false assumption.

It is supposed that science and technology are the main culprits of the environmental crisis. Which is like renouncing hydrants and axes while a fire is destroying our home.

It is supposed that space activities are incidental and a waste of time and money, a toy for rich people, while there are so many problems to solve on Earth.

The supporters of such a closed-world option also maintain that “humans were made for Earth” and cannot survive in space.

Another popular fairy tale, – often circulating inside the space community, is that humanity has time, hundreds of years, to expand beyond Earth. Therefore, there’s no rush, we should just allow our science and technology to evolve, in due time. Again, this perception is blatantly false. Humanity now has a “launch window” open, for stepping toward the stars. Such a window will close very quickly because of mounting environmental, social, and political pressures. Time is of paramount matter: the longer we take to collaboratively expand into space the more difficult it will be.

4.1.1 Global Crisis and de-growth strategy: the main threats to the survival of civilization

The combined effect of the environmental crises and the fight for remaining scarce resources will put civilization at risk of a devastating global holocaust during the current decade. Yet, any strategy based on de-growth will lead our civilization to a catastrophic and likely irreversible implosion, a remedy worse than the problem it intends to overcome.

Demographic growth is important, as are the other three vectors of development: cultural, scientific, and technological. Our big number – 8 billion – is the greatest wealth that humanity has ever possessed: we must properly consider the true richness of the number of intelligent beings, the asset of collective human know-how, and the plethora of fresh innovative ideas brought together by a growing population. Also, to be considered are the growing markets, that can ensure business and job opportunities for all. However, the other component of our evolution, material resources and space for development is now scarce, on our mother planet.

As Stephen Hawking wisely expounded in many writings and interviews, humanity cannot survive without expanding into outer space. James Lovelock, the author of the Gaia (living planet) theory, actually felt that under present circumstances this planet could not support more than 1 billion humans by 2100. There are terrible risks, in such forecasts, which are described in the Space Renaissance philosophic manifesto. We want to underline some of these concepts, while they are typically becoming more evident in the current historical age.

Firstly, any significant numeric reduction of human beings will lead to substantial cultural impoverishment, since it will reduce the nursery of young energies and good ideas. In reducing our number and numeric growth, we will lose our qualities. Our society will be a more and more static and elderly society. Technology and science will decay, and markets will sink. The closed-word civilization will be condemned to perish finally becoming extinct. The only effective countermeasure, against this terrifying risk, is to re-fuel the third component of development: resources and space. And the only dimension where we can find such fuel is outside the boundaries of planet Earth, in outer space.

Not only is civilization at risk, but humankind, as a species, is at serious risk too. Perhaps 1 billion, or less, of human beings, would survive a global holocaust or civilization implosion. They may be reduced to the level of humanoids, with reduced intellectual capacity, voted into a further devolution, since in the rationalization of the catastrophe, science and technology will be considered the guilty party. While our ancestors pursued the goal of progress, the survivors of a civilization's implosion will blame progress, which will be considered responsible for the collapse. Such a remnant society living in inimicable conditions might never raise its head again, after the profound and devastating cultural crash.

We should also consider that our species might even be terminated tout-court if a killer-sized asteroid were to impact Planet Earth. Our tenure would be rapidly terminated as was the Cretaceous age of the dinosaur after 165 million years of evolution. We might appreciate that mankind has been here for a small fragment of time in comparison, two or three hundred thousand years or so, and modern homo sapiens the dominant species for an even shorter duration. In reality, not a month goes by without an asteroid grazing our planet. Nowadays we are developing tools and techniques to locate and identify them, but not necessarily to avoid possible impacts. Only by going outside, and starting to effectively master our space region, can we hope to face this continuing threat. By establishing human settlements on lunar and other celestial bodies, or artificial infrastructures, we can effectively mitigate the risk of asteroid impact leading to the extinction of humankind.

4.1.2 The urgency of kicking off civilization expansion into space

In opposing a popular fairy tale, also circulating inside the space community, humanity does not actually have time, hundreds of years, to start expanding beyond Earth. If we were not so close to a history cusp, and should this age be a "normal" age, we would simply allow science and technology to evolve, at its own pace and in due time. Inertia and the persistence of an unconditional faith in science and progress play a role in this perception. Our faith in science and technology might be unconditional, yet we certainly see the need to assess pressing social conditions and evaluate how science and technology can play their role more efficiently. The inability of institutional dealers to update social analysis also has an impact. Yet, space science and technology are effectively mature enough to start moving collectively outside Earth: and this effort only requires a decisive boost in some specific branches, areas that represent an immediate focus of our 18th SDG proposal, namely the life and health protection issues, and the continuous downsizing of the cost of space travel. But then again why are we in a rush? This is not a normal age and it cannot be compared to any other era. The five years between 2025 and 2030 are expected to be the most critical of the whole human history, with a high risk of irreversible implosion of our civilization. The "launch window" for stepping toward the stars is well supported by the current level of development of space science and technology, but it is constrained by social, financial, and environmental circumstances. Such a window will close very quickly, as the world's social and environmental conditions keep on deteriorating and then there will be 9 or 10 billion of us, effectively "locked up" in one single planet. Time is the paramount matter: the longer we take to expand into space the more difficult it will be, up to the point when it will become impossible. The worsening thread of social and environmental crises is demonstrated by the daily chronicle.

As the Stone Age didn't terminate due to the scarcity of stones, Civilization will not necessarily implode due to environmental collapse, or the scarcity of basic raw materials. Civilization will implode due to the mass psychological reaction to such threats, *well before a physical collapse*. The social fear that results – if nothing is offered to re-infuse hope and confidence in a better future – will catalyze insularity, conflicts, and wars, positing the fragmentation of big countries into small new feudal regimes, and ultimately leading to a general conflict that may annihilate the entire civilization through immense holocausts, all against all. The fact that world leaders have not been able, so far, to understand and predict the obvious end of this escalating and malignant process, means that it is very likely they will not act until it is too late. And, when it is too late, they might make irrational decisions to quickly decimate humanity on Planet Earth, according to the insane concept of sacrificing "a few" to save many.

We are still in time, to prevent such a nightmare, if the first meaningful steps for space settlement are achieved, before 2030. A non-exhaustive list: fully reusable launch vehicles (a work that's in progress), permanent bases on the Moon, kicking-off the production of fuel in space, reprocessing big orbital wreckages, to begin experimenting with simulated gravity on original rotating space stations in orbit and Earth-Moon Lagrange Points, systematically test technologies for human life protection from cosmic radiation, the construction of commercial space stations, start mining the Moon and deploying to Near Earth Asteroids. When the peoples of Earth – and young generations namely – see such scientific and industrial initiatives commencing within geo-lunar space, fear of the future will progressively fade, and the impending crisis will be on its way out. This is essential for mind sanity. Writes Steve Taylor[97]: "Humanistic psychologists such as Maslow, Carl Rogers, and Viktor Frankl believed that human beings are naturally dynamic. They saw growth as an intrinsic part of human nature. In fact, this is true of life on Earth in general, which has always been dynamic, moving towards increasing variety, as expressed through the process of evolution. So when the individual feels a sense of

[97] Steve Taylor PhD is a senior lecturer in psychology at Leeds Beckett University and the author of several books on transpersonal psychology and positive psychology. https://www.stevenmtaylor.com/

purpose - of any type - they effectively align themselves with this dynamic impulse, which is possibly why following a sense of purpose is so beneficial, and such an important aspect of wellbeing."[98] The global economy will restart growing, under the flag of general collaboration and fair competition.

We know perfectly well, that it will not be possible to move billions of people off Earth in a few years. That's not the point. As described here, (i) expansion shall begin as soon as possible and (ii) achieving significant first steps on that roadmap will revert the mass psychological mood from fear of the future to hope and a good willingness to restart working for progress.

4.1.3 Space technologies to help mitigate the risk of decay of life-sustaining environment on Earth

Last, but not least, as our life-sustaining environment on Earth becomes more and more seriously compromised, it will be very urgent to learn how to build and maintain life-sustaining closed environments. Space technologies and the lessons learned by space communities will be essential not only for survival in space but also to be directly applied to Earth. Agricultural techniques, such as hydroponic cultures, greenhouses, and closed ecosystems are just a few examples. 100% recycling techniques, water, and oxygen management are equally important[99]. In general, all the themes of life-support systems and environments will be highly enhanced by experience in space[100].

Space resources will be the key to help sustain the Renaissance, both on Earth and in space. Dr. Thomas Matula Ph.D., of Sul Ross University, Texas addresses how experiences by communities living in space habitats may be essential to enable fundamental human sustainability – not only in space, but also on Earth's surface. Ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture, as defined by SDG 2, will require the development of new technologies and methodologies. Advanced genetic and molecular engineering techniques will also be used for the research and production of targeted medical products, as genome and DNA most effectively unravel in zero gravity conditions.

The most effective environment to experiment with such transformative attributes is in outer space – inside closed artificial ecosystems – where all operational variables are carefully predetermined, continuously monitored, and controlled. Increasing crop yield is essential, as well as improved cycles of water and oxygen, to help reduce water waste, and assure high sanitation standards (SDG 6). The new generation of recyclable elements for a circular economy can be designed and implemented through space ventures. Inside actual space habitats – both on planetary surfaces and in orbital spinning infrastructures – such platforms will be mandatory. Sustainable space habitats will require high-yield agriculture and nearly 100% water and materials recycling. The lessons learned by space farmers' communities will subsequently benefit terrestrial farmers, forest planners, sustainable use of terrestrial ecosystems, sustainably managed forests, combating desertification, halting and reversing land degradation, and halting biodiversity loss (SDG 15). It has been estimated that the combined use of Ultra High Yield Agriculture technologies and methodologies may overcome, by several orders of magnitude, the results achieved by the 1970's green revolution. Terrestrial climate-controlled agricultural buildings isolated from natural environments with optimized conditions regarding light, water, nutrients, atmosphere, temperature, humidity, and the spacing of plants will help eliminate threats from insects, weeds, and plant diseases. The outer space green revolution will help increase yields many times more than traditional agriculture systems, enhancing the potential for harvests year-round, promoting a significant reduction in needed land, and enabling a genuine reduction in the use of water. Taken together, the enterprise will be well worth the investment!

The greatest impact space settlement technology will have on Earth's multiple environmental crises will be across the sphere of agriculture. Space habitats will need to advance skillful technology for food production to achieve agricultural self-sufficiency. The development of Controlled Environment Agriculture[101] (CEA) is the next step in securing the human food supply cultivating specialized plants within enclosed environments in which lighting, water, temperature, nutrients, and even the CO2 level in the air are optimized for species being cultivated. Water used is recycled within the system, reducing the water demand by up to 95%, These types of techniques are extremely useful for resolving the freshwater crisis which is impacting many

98 Taylor, S. "A Model of Purpose: From Survival to Transpersonal Purpose", Nov 2014, https://www.academia.edu/33553161/A_Model_of_Purpose_From_Survival_to_Transpersonal_Purpose_Steve_Taylor

99 Matula, T. "The Role of Space Habitat Technology in Developing Robust Sustainable Communities on Earth" https://www.youtube.com/live/vlO8C5Vu3Vk

100 Matula, T. "Producing Food in Space" https://www.youtube.com/live/nXR_TP1cEAk

101 Hall, Loura "NASA Research Launches a New Generation of Indoor Farming" https://www.nasa.gov/technology/tech-transfer-spinoffs/nasa-research-launches-a-new-generation-of-indoor-farming/

agricultural regions. Since CEA is operated independently of seasonal cycles it is possible to produce crops continuously in a steady supply to nearby markets. The effect is accurately calculated as an increase in crop yields through CEA techniques, depending on the species, over existing agricultural yields. The most visible impact of CEA cultivation will be on climate change contingency (SDG13) as food production and transportation account for an estimated one-third of greenhouse gases (Gilbert, 2012)[102]. Because CEA is demonstrated in a controlled environment renewable energy can be used (SDG7) instead of fossil fuels for the enclosed production of food. The CEA process does not require either pesticides or herbicides because isolation from the external environment serves as an effective barrier to weeds and insects. Since CEA production is isolated from external environments it is also independent of climate zones, so facilities for producing CEA-cultivated food can be located near consumer demands in any location, reducing shipping of agricultural goods that currently account for large amounts of greenhouse gases. Finally, increased yields resulting from CEA may assist in the restoration of tens of millions of square kilometers of land to native and self-sustaining ecosystems, outlooks will not only help reverse the extinction crisis but also provide for the sequestration of large amounts of greenhouse gases from the atmosphere.

4.1.4 The Greater Earth, the First Step of Universal Expansion in the Solar System

We need to make clear the concept of civilization's space expansion, as global expansion, vs. any misleading concept of "abandoning Earth" and other mystifications constructed by supporters of the closed world thread. We see the open world, planet Earth as one planet and not "The" central planet. The Greater Earth economic paradigm[103], establishes Cosmic Universalism[104] as a universal right to development, extending the entire model of human anthropology to the Solar System. An advanced modern concept describing human expansion in geo-lunar space: the Greater Earth.

Abstracting excerpts from the Greater Earth's mission statement: "Today a communications apparatus installed beyond the atmosphere permits us to remain in constant touch with each other from any place on the planet. Many other satellites provide a huge number of functions, to help civil life on Earth's surface. Indeed, without such technological resources orbiting the Earth, modern civilization would no longer function. These activities have effectively expanded the physical territory of planet Earth from its solid dimensions of 12,756 kilometers to a diameter of approximately 84,328 kilometers which encompasses geosynchronous orbit creating a ring around our planet that may last indefinitely. As the 21st century unfolds, we find that we need more room and more resources to sustain our numbers and to maintain our drive for further development. The finite planetary resources that contributed to our present state of civilization are being irrevocably exhausted to unsustainable levels leading to geopolitical conflict and their uncontrolled use within the biosphere is resulting in severe ecological and environmental consequences. Being unequipped to occupy and transform a neighboring planet to meet its growing needs, humanity's next logical step will be to discover and inhabit the last reaches of its planet - to expand its activities to Earth's true boundaries as defined by the laws of physics and celestial mechanics." Our world will be then expanded to a dimension of 3 million km, including the cislunar space region and the Earth-Moon Lagrangian Points.

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[102] Gilbert, Natasha "One-third of our greenhouse gas emissions come from agriculture" - https://www.nature.com/articles/nature.2012.11708

[103] https://greater.earth/

[104] Frederick Jenet, Universal development in the Solar System

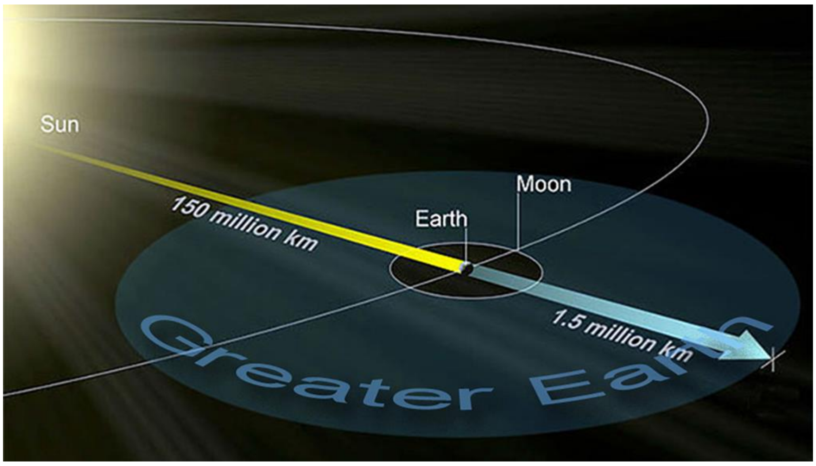

Figure 2. Greater Earth Diagram

“All celestial bodies of significant concentrated mass exert a field of gravitational attraction around their cores which extends to the point of tangential intersection with other celestial bodies. Earth's gravitational influence extends 1.5 million kilometers in all directions from its center where it meets the gravitational influence of the Sun. This sphere, with a diameter of 3 million kilometers, has 13 million times the volume of the physical Earth and through it, passes some more than 55,000 times the amount of solar energy that is available on the surface of the planet. In addition to energy, within this sphere are enormous amounts of other resources, including the Moon and occasional passing asteroids. Like the territorial waters surrounding nations, these resources naturally belong to our planet and should be used for the ultimate benefit of humanity and all life that has originated here. As it has throughout its history, humanity must understand and seek nourishment from its home planet and it must now once again refine its perception of the planet to recognize and embrace the perception of a greater, richer, and more sustainable Earth.”

4.2 A mere robotic space development?

4.2.1 Evolution thwarted by cowardice and greed

Considering here the “product” as any successful development in space, in a very broad sense, we might observe that:

Product = humans x robots

Zero humans = product is zero

Zero robots = product is zero

Needless to say, robots and Artificial Intelligence are essential to any operation in space and on any planetary surface. Many operations are safer when fully automated. And many operations will work better if automated machines are operated in telemetry by humans. While computer science – in its whole extension from simple calculation to autonomous intelligent machines – can assure systematicity and completeness to rutinarian routine or single-shot operations, there are important reasons to have humans as supervisors. Not least the simple reason that real-time telemetry cannot be used when long distances are interposed between the telemetry-operated machine and the operator, due to the delay in communications.

Yet, beyond technical considerations, we should also consider the strategic requirements of humankind: should space not properly serve our growth, development, and evolution, space would be useless. Robots and intelligent machines are a great help, an indispensable tool, for space settlement. However, should they be sent alone into space, in order to bring extensive space resources to Earth's surface, they would act as a factor of confinement for Earthlings, and therefore an anti-evolutionary agent.

4.2.2 Using Artificial Intelligence as a tool, vs. being used by it

A preliminary clarification of some terms is necessary. *“Intelligence can be defined as the ability to solve complex problems or make decisions with outcomes benefiting the actor, and has evolved in lifeforms to adapt* *to diverse environments for their survival and reproduction''*[105] An entity endowed with *intelligence* is capable of making connections and logical relations among an immense plethora of material and immaterial objects and activities, answering complex or intuitive questions, engaging in unique research, and accomplishing many original conceptual and practical tasks. According to Howard Gardner, there are many different types of human intelligence, e.g. linguistic, mathematic, musical, visual, etc.[106]

A *sentient* being[107] is capable of experiencing pain, sorrow, jealousy, and feelings, and even reacting to injustice or unequal treatment. Indeed, there is evidence that many higher animals exhibit reactions of displeasure, dismay, pain, and jealousy. In Buddhist philosophy[108], the term sentient beings is used to designate the totality of living beings. A definition that conventionally refers to the mass of living – entities subject to illusion, and suffering. It will follow that such a particular meaning is not generally applied to plants or inert matter. It is also well proven that the faculty of intelligence is not an ON-OFF property, but has many degrees, manifesting in diverse animal species, and even within the same species, including the remarkable and ascendent human continuum.

Intelligence can be trained and improved, exhibiting particular and specialized capabilities, and functioning to execute peculiar tasks, jobs, or activities. An ability that is particularly applied to AI machines, which are typically designed and developed to perform very specific tasks, within various domains, such as industrial development and marketing. AI process also enables an advanced level of unique scientific research and the development of original applications in many distinguished fields, an outlook that is posited as an exponentially expanding realm. Artificially intelligent machines are carefully designed to achieve performance capabilities that are multifold higher than human capacities, with the aim of a comprehensive systemization, in dealing with big data inputs and complex computing. The advent of Artificial General Intelligence (AGI), or general-purpose intelligent machines, capable of abstract reasoning on any subject, appears to be a fast-becoming affordable reality, using the new generations of quantum computers and the process of reiterative self-design. We might perhaps ask will such machines be capable of self-learning, and ultimately achieving a certain self-awareness and consciousness, and in some way evolve into a category of sentient being? Will they have rights, then? Such topics range between science fiction and philosophical discussion.

However, any discussion about *rights* makes sense only when related to sentient beings.

It is perhaps possible one day that machines[109] endowed by artificial intelligence could achieve self-awareness and the ability to suffer and pity. They should now and until then be considered *intelligent but non-sentient* entities.

In talking about humanity's expansion into outer space, AGI and robots can be seen as useful tools. In the literature and discussion, we often hear about a collaboration between humans and robots, but such a meme should be understood as the common habit of humanizing or anthropomorphizing things, giving them a fictitious personality. Also, although we might avoid using terms like “servants”, a servant is defined as a person, while robots are not persons, though they may be engineered into human shapes. Therefore, robots are not necessarily “servants”, or even our “partners”, and much less our “masters”.

AI and the robotic consortium are not alive. It is merely a machine programmed by humans for their needs. There should always be humans and human determinations on top of the technological hierarchy, on Earth as well as in space.

While AI may represent a comprehensive aid for space settlement, the dangers posed by giving over the identity of human agency to semi-autonomous robotic and AI entities, are being seriously considered. Many of the original creators of the AI construct have pointed out the risks involved within possible applications and transitions, which include societal impact, national and global governance, and international security.

4.2.3 A conscious superintelligence will be naturally ethical, but intelligent tools may be used for good and for bad

May the advent of AI represent another factor of crisis, in the current scenario, which is already characterized by multiple concurrent crises? As with any technological or man-made tool, since the Neolithic revolution, AI

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105 Weder, Annika - “Q&A – What Is Intelligence?” John Hopkins Medicine https://www.hopkinsmedicine.org/news/articles/2020/10/qa--what-is-intelligence

106 Gardner, Howard – “Multiple Intelligences: New Horizons in Theory and Practice” https://www.amazon.it/Multiple-Intelligences-Horizons-Theory-Practice/dp/0465047688/

107 https://en.wikipedia.org/wiki/Sentience

108 https://en.wikipedia.org/wiki/Sentient_beings_(Buddhism)

109 The term “machines” should be understood here in a very general sense, including both hardware and software devices

itself has been an indifferent entity and may be used for good results and bad effects. AI will be available for good and bad eventualities, to protect life or to endanger it. At least until the point when AI reaches self-consciousness, and the capacity of rational moral reasoning. If and when that refinement is achieved, we might expect that AI would become a super-intelligence, the IQ of which cannot be predicted. As humanists, we assume that any superintelligence – natural or artificial – naturally tends to the good. Passing over a certain IQ threshold, virtually any being understands that compassion is more convenient than hate and that engaging in benign competition is far easier than overt antagonism and suppression. Yet until reaching self-consciousness, AI will be just a tool, though a very sophisticated one. AI development will provide another gracious and effective support for worthwhile and beneficial projects. At the same time, it presents the possibility of being utilized as a smart weapon, which might unfortunately become accessible to ruthless exploiters, psychopathic elements, and terrorists.

In the context where our growing humanity of 8 billion, experiences a rising wave of competition in the struggle for life and death, we will have artificial competitors too! A general recommendation is that a license should be required, to "drive" AI tools, as well as having licenses to drive cars. Ethical and moral rules for usage should be established, taking a cue from Isaac Asimov's three laws of robotics[110]:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given to it by human beings except where such orders would conflict with the First Law
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Various sources and initiatives are discussing and expressing serious concerns on the theme of the Ethics of Artificial Intelligence and its governance: the UNESCO Global Forum[111]; an open letter from the Future of Life Institute[112] in Oxford UK also signed by Elon Musk; the statement of the Center for AI Safety[113] also signed by Bill Gates and Ya-Qin Zhang Dean of Tsinghua University. Many normative societal values are also likely to be greatly impacted by AI development. Civil society will best operate based on fairness and equality, yet AI being nothing more than a machine obviously has no such sensibility. Discrimination, exclusion, or favoritism may be exercised by programmed algorithms. It is obvious that this Earthly world may quickly become an even smaller and more claustrophobic environment, where opportunities for jobs are narrowing, commercial undertakings become even more difficult, and the prospect of survival and growth is more and more critical for all.

In such an anxious scenario, the possibility of expanding into a greater world will become even more relevant, as we view space as the catalytic dimension where resources are available, and opportunities become abundant. Evolution and innovative thought need space. Love and compassion require space. Human societies look to space development, for self-determination and progress in moving away from fratricide confrontations. The theme of AGI is pushing humanity to aim high and move into outer space.

The 18th SDG offers an expedient technique and poses short path proficiency moving ahead of the negative influx. As an extensive and well-qualified 18th SDG consortium creatively endows the catalytic 17SDGs' dissemination, global attention will turn outwards toward the stars, ending the cycle of hopelessness, focused on collaborative space settlement. Such perspectives must clearly embrace and recognize the urgent priority of scientific and technological enhancements necessary to protect life and health in outer space. The contribution made by AI in the development of this leading science and technology will be key: if properly used we could even state that AI came up exactly when it was needed most: to support the kick-off of humanity's expansion into space.

4.3 A cosmic universal ecology science vs. an Earth-bound blind Ecologism.

When discussing ecology, the popular conceptualization always refers to the planet Earth's natural environment. Planet Earth is referred to as "The Planet". No doubt that, for us Terrestrials, Earth is THE Planet,

110 "Three Laws of Robotics" https://en.wikipedia.org/wiki/Three_Laws_of_Robotics
111 UNESCO - "Global Forum on the Ethics of Artificial Intelligence 2024" https://www.unesco.org/en/articles/global-forum-ethics-artificial-intelligence-2024
112 Future of Life Institute - "Pause Giant AI Experiments: An Open Letter" https://futureoflife.org/wp-content/uploads/2023/05/FLI_Pause-Giant-AI-Experiments_An-Open-Letter.pdf
113 Center for AI Safety - "Statement on AI Risk" https://www.safe.ai/statement-on-ai-risk

the only one providing a life-sustaining environment *for free*. And here we find a first unsettling question: is that support really for free? Or, will it always be free, for any number of us? Of course, it is not.

But there are other objections expressed against the abuse of the term ecology as only referring to planet Earth. Earth is in space, and not in any special different dimension. As the space philosophers of the past have already recognized, the Earth is not fundamentally different from other celestial bodies. It consists of the same basic material elements and is subject to the same physical principles as all other celestial bodies.[114]

We should therefore understand that we are immersed in a cosmic ecology, not only in a planetary one.

4.3.1 Earth is in space

A philosophical inquiry will perhaps ask itself, what is the actual nature of outer space, and what is the role of humans within the immense universal background?

This question was asked already at the beginning of modern times, during the historical Renaissance, by the great and famous philosopher Giordano Bruno. He cognitively opened space to humans by postulating the uniformity of universal space, which could enable humans to leave Earth.[115]

He had dismantled the Aristotelian, scholastic cosmology of the Middle Ages, which described the Earth as a unique and special body at the center of the universe, from which it was separated by the so-called celestial spheres. Instead, he postulated a unified, unbounded space in which countless worlds are organized, each with their own centers, some of which may have given rise to life. All stars are suns. Bruno's hypothesis went far beyond the theories of the cosmologists of the time, from Copernicus to Kepler, who continued to assume a fixed star sphere, according to which the stars were attached to an outermost shell of the sky. Bruno's universe offers inexhaustible possibilities, also for humans. He developed the futuristic vision that universal space is accessible to humans and enables them to transcend the earth and fly to other celestial bodies. [116] We are therefore no longer just earthlings, but integrated into a cosmic, universal space; we are cosmic beings. Bruno had a humanistic vision of a life-friendly and human-friendly universe. He could not have known that the vacuum, which he postulated, and cosmic radiation are hostile to life for us humans and all other living beings and that it is not so easy to leave the Earth.

Apart from the notable and salient responses of religions and the insights of historical and cultural expositions, space itself poses many dilemmas. Outer space is certainly not a conducive environment, a sterile and radioactive desert after all, but the exploration of space remains entirely pertinent for the themes of a durable, guided, and humanistic global evolution. Of course, the Earth is unique, in our Solar System at least, since it holds a combination of cosmic characteristics that allowed the growth of life, in a version favorable to sustain a species of oxygen breathers, us humans. Yet the substance and the materials composing planet Earth are not different from the substance and materials composing the other planets, moons, and smaller bodies of the solar system and, presumably, the rest of the universe.

As it was demonstrated that such materials and substances may be recombined and engineered to obtain environments and infrastructures suitable to support life, no physical obstacles are preventing the expansion of our species into the Solar System, and beyond, in a distant future.

Earth is in space. In a broad concept, we don’t need to “go to space”, because we already are in space. Or, better, we need to expand outside Earth, but that doesn’t mean moving to an environment different and separated from our native planet.

The task of Space Renaissance, and the space advocacy community, is to make such concepts evident to society and dismantle the still ruling pre-Kopernican view of the world, that still keeps our species chained to the bottom of the Earth’s gravity well.

4.3.2 Towards a Cosmic Science

In looking at the features of exploration and settlement, we see many exciting points of scientific convergence and lines of demarcation. For example, radio astronomy has been proposed for the far side of the Moon, a

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114 See in particular Giordano Bruno, “De l'infinito, universo e mondi”, London 1584

115 First recognized and described by Marie-Luise Heuser: „Transterrestrik in der Renaissance: Nikolaus von Kues, Giordano Bruno und Johannes Kepler“. In: Michael Schetsche, Martin Engelbrecht (Hg.): Von Menschen und Ausserirdischen. Transterrestrische Begegnungen im Spiegel der Kulturwissenschaft. Bielefeld (transcript Verlag) 2008, 55–79. ISBN 978-3-8394-0855-1.

116 Heuser, Marie-Luise, „Raumontologie und Raumfahrt um 1600 und um 1900“. Tübingen 2016, https://publikationen.uni-tuebingen.de/xmlui/handle/10900/69443.

facility facing away from Earth, on the remote lunar terrains, eliminating all terrestrial frequencies. That will also achieve a far better capacity to understand cosmic weather, solar winds, and storms. The eventual placement of capable cis-lunar infrastructure, including habitats and stations will enable many such ambitious enterprises, including the development of extensive techniques for asteroid mitigation and use, and planetary defense. Other features may include a biological or DNA bank, which would act as a repository for the Earth's diversity, an encapsulated library of species and phenotypes.

Among rationales for expanding outside Earth, the concept of *"not keeping all eggs in one basket"*[117] has a primary place. Once established on or around other celestial bodies in the Solar System, we will have halved the possibility of premature extinction due to a cosmic accident. Settling outside Earth, and manning the orbit (LEO, MEO, GEO) we will also achieve a better capacity to study and understand the huge number and variety of objects that pass through the Earth-Cosmo interface, including the small objects, destined to burn when they impact the atmosphere, and the always changing particles coming from the Sun and the novae explosions.

By building special proper infrastructures in orbit, we could achieve the capability to act on Earth's climate, balancing, if needed, the too-quick disruptive changes, both due to cosmic influence and anthropic activities. For instance, large mirrors (see the "Lunetta" concept by Krafft Ehricke) could warm selected regions on Earth's surface, in case of incoming icing periods. While large shields could be used to obscure the Sun rays, getting a cooling effect, when the temperature is climbing too much.

The philosophical and scientific scope is wide, sustainability implies expansion outside Earth, to limit unsustainable developments on Earth's surface. During this phase of disruption, planetary transition, and readjustment, humanity is motivated to seek out a focal point, an answer perhaps to the eternal question, what is mankind's purpose, what is the future objective? For the individual the response remains personal, our beliefs and religions are also subjective, but for the open and forward-looking awareness of our modern-day collective mind, the answers will certainly follow a universal theme. Saving the planet clearly requires a "stepping outside" of our confines.

In the context of a broad philosophical discourse, we might consider that the scope of our existence, as an intelligent and self-conscious species, is to help Mother Gaia to give birth, spreading life – the terrestrial biome – into the solar system and beyond. Why the universe should be infinite, if we had to be concerned about expansion, even if there were billions of intelligent species working toward the expansion of their civilizations? If the universe is infinite, there will be room for everybody! This is our concept of universal civilian development, on behalf of our sentient, intellectual, sense-able, and reason-able species[118]. Several authors have tried their hand at space philosophy and the ultimate scope of human life. One is Stephen Ashworth, an astronautical humanist, or *astronist*: *"Homo sapiens represents an intermediate stage between a terrestrial and an astronomical order of life."*[119] Our references in the realm of the modern space philosophy include Krafft Ehricke, and his theory of life industrialization, from the first organisms expanding from the sea to the Earth, the current age of information metabolism, and the next incoming evolutionary step towards outer space and subsequent rescission of the umbilical link[120]. And, of course, Nikolai Kardashev, and his theory of civilization evolution[121] from type I (using planetary energy) to type II, using sun energy at the solar system level, and so on, to type III (galactic civilization).

We need to take the view from space very seriously. Frank White synthesized the "Overview Effect"[122] concept, to represent the feeling of many astronauts, when they have seen the transient beauty, fragility, and vulnerability of our earthly home. William Shatner, when flying to suborbital altitude on a Blue Origin Space

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117 Globus, Al "Countering Objections to Space Settlement" - https://2021.spacerenaissance.space/wp-content/uploads/2021/07/PAPER-SRIC3-SCT-4.1-06.065.pdf

118 See the lecture held by Dr. Lucas Mix "How is Heaven Related to Space? Physical and Spiritual Ascent Narratives" https://www.youtube.com/live/sGPqf6uIegc

119 Ashworth, Stephen "Humanity does not steer, but should enjoy the ride" - https://s3.amazonaws.com/fqxi.data/data/essay-contest-files/Ashworth_FQXi_essay_Ashwort.pdf

120 Freeman, Marsha "Krafft Ehricke's Extraterrestrial Imperative" - https://www.amazon.com/Krafft-Ehrickes-Extraterrestrial-Imperative-Apogee/dp/1894959914

121 Planetary civilization, according to Nikolai Kardashev - https://en.wikipedia.org/wiki/Planetary_civilization

122 White, Frank "The Overview Effect: Space Exploration and Human Evolution" - https://www.amazon.com/Overview-Effect-Exploration-Evolution-Library/dp/1563472600

Tourism flight, felt a sense of profound sadness and dismay, when viewing the profound vastity of the black sky, looking outside[123].

It is time to set out on the longest journey, the road to space, the intelligent purpose that will ensure human evolution and survival.

4.4 We need Space today, not in a distant future

4.4.1 Avoiding confusion between science fiction and today's feasible projects

Such confusion has historically been a means of mass distraction. We need to be extremely accurate, in distinguishing dreams though perhaps legitimate insights from things feasible in the short term. If the latter will not be realized, the other will remain dreams forever.

We are often uncertain about the boundaries between proven scientific fact, conjecture, research and development, and science fiction. In 1931 Albert Einstein claimed that "imagination is everything, it is the preview of life's coming attractions", yet almost a century later, our projection of a dismal dystopian future fully dominates the picture. We feel that the structures of human civilization are quickly shifting but are constrained in attempts to create a political dynamic large enough to encompass the changes foreseen. We have rapidly become the residents of a pervasive electronic dimension where each and every individual might be connected to vast networks of others, allowing a readily translated ability for communication and opportunity for all manner of engagements, cultural, educational, and economic. We are in the middle of what Krafft Ehricke called "the metabolism of information"[124]. Such an immediate ability is constructed and implemented in many ways, yet it is entirely the man-made creation of recent decades. The space age and the silicon age, the age of mass communications, working together in tangent, have provided mankind with a glimpse of an interrelated horizon that in many ways resembles the horizon of a dream. What that human dream resembles and what it describes is in many ways up to us, although we do not have certainty, we can have expectations. Within those expectations, the advancement of a world in transition will continue to propose the definitive stages of our future evolution.

The imagination of science is highly productive, its origination is profound, diversified, indeterminate, and subjective, yet it closely follows the collective insight of mankind. Humanity at large clearly sees the imminent watershed, the criteria of severe environmental denigration, and the vulnerability of future generations. Certainly, the responsiveness of our society to such serious threats also depends upon the problem-solving effect of modern scientific acumen. Scientific advancement is not a static condition, it is consecutive and incremental, the proven usage will lead to further discovery. Knowledge builds upon itself, yet to grow and expand and ensure the benefits of a future world it requires the establishment of a cohesive underlying perspective. These boundaries are not limited, science has already envisioned the journey into a human cell, the fragmentation of an atom, and the settlement of the reaches of outer space.

Our present circumstance indicates the pressing need to find pathways and methods of interchange, because national identity does not preclude international engagement and because the encroaching scenario of a technological "closed world" system, is perhaps the most dangerous threat faced by modern society. Although the tools and techniques of the information-based society are very different from the political frameworks of a past era, the demonstration of a trans-political and mutually compatible international model will be formally dependent upon dialog and suitable modes of reference. The formative and guiding themes of space development do not only address near-term contingencies. They lend themselves to thoughtful long-term international planning. Indeed space-faring communities across the world have long envisioned, upheld, and encouraged the exposition of ambitious settlement plans, detailing the development of extensive space-based infrastructures and comprehensive systems of transport. The merit of such demonstrative exercises has proved itself time and time again. While the eventual realization of many space-faring dreams will spin out across centuries or even millennia, each engagement, each small achievement in the gradual progression towards the goal also represents an education, a building block, a scientific application that is of value to society.

Space science represents the leading edge of insight and knowledge, describing the emergent properties of remarkable materials and techniques. The fields of inquiry are situated across the board, ranging from low

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123 Rivera, Enrique, "William Shatner experienced profound grief in space. It was the 'overview effect'" - https://www.npr.org/2022/10/23/1130482740/william-shatner-jeff-bezos-space-travel-overview-effect

124 Ehricke, K., "Lunar Industrialization and Settlement - Birth Of Polyglobal Civilization" https://www.lpi.usra.edu/publications/books/lunar_bases/LSBchapter12.pdf

gravity superconductor development to super strength building materials to bio-engineered medicines and natural organisms. Energy in space will take on many additional dimensions, including advanced fusion, and solar power beaming while photonic light transmission and the development of quantum engineering engage a further phase of space-based communications assets. Space industrialization will assume many significant fields of economic activity, most apparent is the imminent prospect of mass communications satellite deployment, with a singular global usage that is expected to increase exponentially over the coming decades. As such techniques continually advance, earth observation will permit a radical assessment of environmental attributes. Features such as industrial emissions, water flows, and agricultural utilities, will be compiled within essential data banks, for reference by national and international bodies seeking to optimize resources. Many complex activities of this type will be further enabled by the usage of data-based artificial intelligence in planning and designing national economic agendas.

The implications are apparent, near-earth orbital activities will rapidly become the driver of economic development for the future world. It is essential that these pathways remain open to all nations in all places, and that they are not compromised by political venture or lack of access. Global consensus for development may be generated through the implementation of the U.N. SDGs working with associated technological agencies. Even so, the expectation of adequate terrestrial development may become fully compromised by any failure of the sustainable development goals to address the long-term perspective for outer space. The prospect of the ensuing vulnerability of the space development continuum calls for careful analysis and forward-looking engagement. Funding is limited, and time frames are constrained. The manifest risks we face include: compromised human rights domains, political and cultural segregation, cyberspace devolution, and defensive commitments. Economic criteria will clearly dominate, yet the global focus has to be directed towards low-cost problem-solving effects. With environmental stress comes political stress, and growing tensions will trend toward militarization, leading national economies into unproductive defensive commitments.

The rise of space-based global information technology is ubiquitous, providing an impartial medium that offers radical solutions but also creates radical dangers. Certainly, the introduction of wholesale technology does not in itself represent a solution to problems apart from the features of worthwhile and compatible usage. Concerns multiply accordingly, while calls for guidelines and frameworks to ensure an ethical application basis continue to disrupt the international dialog. Dystopian perceptions will imply the growth of authoritarian digital societies and the incremental disenfranchisement of civil society together with the fragmentation of cyberspace and the dismal propositions of robotic militarization. Despite encroaching and apparent limitations, the preparation of an original UN-mandated international venue for outer space provides an organism that continually addresses both immediate insights and long-term perspectives. This resource should be obtained as the durable 18th SDG “space4all” asset, bringing public awareness to the committed nature of the original 17SDG’s application basis. While space-based communications and near-earth observation are providing support to the application of the 17 SDGs, several interrelated UN bodies and committees hold current legislative oversight for outer space development. Yet none of these have actually construed space development in terms of the short-term and long-term projection, a mutable vision of intergenerational expansion into the solar system. This significant and worthwhile perspective should get primary priority. The objective of such a goal is far more than an ideal, an incidental delineation, or a scientific fiction, it provides the actual basis for the continuing technological endowment of modern society. It represents an incremental and inclusive process that must be investigated and assured in many ways, working towards an equitable, compatible, and peaceful worldview. The 1967 Treaty on the Peaceful Uses of Outer Space now requires something more than a simple statement or commitment Over the past fifty years it has become the template and the basis for a far greater vision. It has actually become the means for fully establishing a cohesive and equitable human society and ensuring a stable and prosperous future world. The pathways and parameters of the formative 18th SDG “space4all” organism will obtain an elaboration, a framework, and a map, not only for the immediate term but for the future progression of mankind. They are a verification of the immense value of the scientific dream, the imagination of great minds, and the latent potential of human exploration and discovery.

4.4.2 The SRI summary position on the border between feasible dreams and science fiction today

Nowadays, thanks to a few brave entrepreneurs, we are very much more advanced, on the path to space settlement, compared to, let’s say, 20 years ago. The main factor is rockets’ reusability, well rooted in the launchers market today. So, where is, today, the border between feasible dreams and science fiction? Kicking off geo-lunar space manned industrialization is at range, before 2030. Yet, there are some neglected relevant priorities: life protection in space, a business approach to orbital debris, and sustaining the effort of the new space industry. These are the feasible dreams before 2030. The transition toward low-cost and safe human spaceflight has already begun: but many obstacles and traps are around the corner. The transition to rockets' full reusability is far from being completed. Protection of life and health in space still doesn't have the due priority, while it needs proper scientific research and subsequent quick technology development. A coherent business approach to the orbital debris issue is still in the early concept discussion stage, while we run the risk of remaining closed into an orbital cage made of debris. An updated space law system is bogged between overruling and excessive lasses-fair opposite currents: it should move towards a methodology based on learning from experience, detecting best practices, and building rules upon the above. Our duty is to help go over, accelerating real progress!

4.4.3 Looking at the future and the present

Making the first meaningful steps of civilian expansion into outer space during the next years is very urgent: low-cost access to orbit, protection of life and human health for civilian passengers and settlers, and a coherent space law system, to rule the commercial civilian activities in outer space.

The change of paradigm is now feasible, moving from the military tone of space-based association into a guiding process of open civilizational expansion into outer space. The shift is due to the successful development of reusable launch systems: *the machine* to move us onto the new futurist movement. This is also our *presentist* vision: the future shall be NOW! Traditional futurism, which was used to promise a brilliant and distant future, is now obsolete. Humanity needs that brilliant future, now.

Over the next years, working towards 2030, we shall promote the *presentist* vision and narrative for our immediate future life in space. We shall bring to the broad general public an awareness of the urgency to open the space frontier to civilian and industrial activities. The futurist narrative of anticipation promised a future in space for several centuries so far. The time to actualize and realize that the future is NOW, - lest we miss the favorable historical window.

4.4.4 SRI is 100% for peace, on Earth and Beyond

There's an eternal common misconception, that humans are bad in their nature and that thousands of years of evolution haven't changed and will never change that very basic animal behavior. We space expansionists are humanists. We believe that human nature is good: when humans have enough resources and space to develop in peace, only psychopathic characters will stick to using violence. Why the heck should I prefer to fight and kill to get what I can have in peace? Very much better to have fun, well-being, and love, than to have corps, destruction, desperation, and hate!

Peace is of paramount relevance, for human society's evolution into a solar system civilization. While we firmly believe that achieving the immense resources of the Solar System will decree the obsolescence of the reasons for resource wars on Earth, we are also concerned that a global conflict may suffocate the ignition of civilian space development and abort the renaissance of civilization in space. Technological advances have often progressed in history thanks to war efforts. This is not the case, in the 21st Century. The world is appalled and dismayed by the rise of conflicts at the boundary of Europe – Ukraine and Palestine. The global economy is depressed. Even worse, the creativity of the good willing people of Earth is frozen by the backward violent strategies pursued by ramping immature political leaders. That's why we at SRI will fight against war and will do our best – in all the international and national contexts where we are active – to call our audience and our allies to engage behind the flags of the Space 18th SDG, Space for All on Earth and Beyond, and Space for Peace.

Wrote Patrick Collins and Adriano Autino, in their paper[60] presented at the Plenary Session of the International Academy of Astronautics' 1st Symposium on Private Human Access to Space, at Arcachon in France, in May 2008: "The major source of social friction, including international friction, has surely always been unequal access to resources. People fight to control the valuable resources on and under the land, and in and under the sea. The natural resources of Earth are limited in quantity, and economically accessible resources are even more so. As the population grows, and demand grows for a higher material standard of living, industrial activity grows exponentially. The threat of resources becoming scarce has led to the concept of "Resource Wars". Having begun long ago with wars to control the gold and diamonds of Africa and South America, and oil in the Middle East, the current phase is at the center stage of world events today."

Other resources are nowadays gradually replacing oil, while electric mobility tries to trash fossil fuels. However, the needed materials – rare earth metals, used in smartphones, computers, and advanced technologies

– are even scarcer than oil on Earth and are already a cause of resource wars. Btw, rare earths are present on the Moon, including scandium, yttrium, and the 15 lanthanides, according to research by Boeing[125]. Metallic asteroids[126] are primarily iron and nickel, but can contain rare metals like platinum, gold, iridium, palladium, osmium, ruthenium, and rhodium at concentrations several times higher than what is found on Earth.

In a newsletter of April 18, 2022[127], we discussed the theme of peace and space development, and how the two are mutually supporting each other. Hereafter are some excerpts, relevant to our discussion in this paper.

Pope Francis re-proposed recently what He already had proposed in His Encyclical Letter "All Brothers"[128] of 2020: *"With the money spent on weapons and other military expenditures, let us establish a global fund that can finally put an end to hunger and favor development in the most impoverished countries so that their citizens will not resort to violent or illusory solutions, or have to leave their countries in order to seek a more dignified life."* How could we disagree on such a proposal?

Big money – almost 2 trillion / year – is invested in death means, and so little or nothing for the development and the elimination of hunger and underdevelopment. There are currently many conflicts (70 ongoing wars): a World War III in pieces, that are tragically enlarging and joining each other, towards a giant global conflict, that seems to be ineluctable.

SRI stands for general and global disarmament. Also see, in this paper, the Summary SRI Position on Space Law (section 3.6.5). The whole weapons industry may be reconverted into civilian astronautic industry, without losing any jobs, but incrementing employment, both on Earth and in space.

Our world also dramatically lacks big projects, widely shared worldwide, to inspire and motivate people to work for the development of the whole of humankind. This is one of the main SRI recommendations.

Many anti-human tendencies, in the nowadays world, share an unspoken sentiment, that there are "too many humans on planet Earth". In such an evil view, all of the crises appear like good events, since they will reduce the number of humans, and war is just an *extreme tool*, to help nature to reduce our number on Earth's surface. We at SRI will fight against such a suicide concept! We, space humanists, are bearers of an opposite alternative, to help the nature of planet Earth: to start developing outside, avoiding any giant holocaust or Armageddon!

The real question should be: how to assure proper sustainability to human growth, in the 21st Century? How to develop concrete programs and strategies oriented to peaceful development? Our response is clear: by expanding into a greater ecological niche!

As humanists, we think that real wealth is not money, but natural resources and human know-how (i.e. human culture, in its broadest meaning). With 8 billion intelligent beings, humanity was never so rich, provided that there's enough space and resources to allow everybody to be educated, grow, and develop. As humanists, we do not want humankind to lose any part of this huge promise and patrimony: every single life is precious since it could come up with solutions to the big global issues for Earth.

Wars find fertile ground in a world where there are so many people in hunger, and these people are forced to fight, due to their poor conditions, trying to get the necessary to satisfy the very basic needs, in Maslow's pyramids of needs[129]. In general terms, we would say, that social fear is moving people – not only in underdeveloped countries — to regressive behaviors: when people do not see a future and fear not being able to provide the necessary food and shelter for their family, they become easy prey for dictators and violent leaders, who speculate on such fear. Said Gino Strada[130], the founder of Emergency: "As a doctor, I could compare war with cancer. Cancer vexes humanity and claims many victims", "The biggest challenge for the coming decades is to imagine, design, and implement the conditions that will allow us to reduce the recourse to force and to mass violence until they fully disappear. War, just like deadly diseases, has to be prevented and

125 https://www.boeing.com/resources/boeingdotcom/features/innovation-quarterly/2021/06/moon-mine_960.jpg

126 Asteroids can be grouped broadly into those that are primarily carbonaceous, silicates, or metallic.

127 Autino, Adriano V., Foing, Bernard – "Dialogue with Pope Francis on Peace and Sustainable Development" SRI newsletter April 18 2022 - https://spacerenaissance.space/a-dialogue-with-pope-francis-on-peace-and-sustainable-development/

128 Bergoglio, Francesco – "Encyclical Letter Fratelli Tutti of the Holy Father Francis on Fraternity and Social Friendship" https://www.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20201003_enciclica-fratelli-tutti.html

129 Autino, Adriano V. – "A lecture on Space Philosophy at International Space University, Strasburgh" - https://youtu.be/TIXTls49WuA

130 Strada, Gino – "Abolishing war is urgently needed, and this is achievable - Gino Strada's acceptance speech at the Right Livelihood Award 2015 (the "Alternative Nobel Prize") ceremony" - https://en.emergency.it/culture-of-peace/abolishing-war-is-urgently-needed/

cured. Violence is not the right medicine: it does not cure the disease, it kills the patient". Like cancer, war is self-feeding, destroying economies, producing more social fear, and so producing more wars.

As humanists, we believe that humans – the vast majority of us – do not like to fight, if not play innocuous games. People like to work, to have fun, to socialize, to spend beautiful holidays in beautiful places, to love, to have children, and to grow them up. Later, when elderly, they like to see their children well-rooted in a higher social position. Please show us just one crazy guy who likes to raise children, take care of them, send them to the best affordable schools and universities, cure their teeth, pay for their lessons of music, sustain them playing basket, and everything, and then is happy to send his/her children to dye in a muddy trench, and to murder, torture, and massacre "enemies" before dying. So why, now, perfectly reasonable and good people are going to think that the above is ineluctable, some kind of our destiny, at this point in human history? It is because they feel in their bones, even if they are not rationally aware of that, that there is no more future because 8 billion humans in a closed world are too many, and only a few of them will maybe have an opportunity to have a future.

We want to give bad news also to that fortunate minority: nobody will have a future. Super-wealthy people will share the same destiny as the poorest ones, if science and technology will die, in a collapse of civilization. Money is just one of the accountant's indicators of true richness, and there are other indicators when we progress on all steps of Maslow pyramid: when people do not have any more faith in honest work, progress, and social growth, then everybody will be extremely poor.

Like freedom, peace is not a natural plant, growing up in nature. War is the genetic inheritance of our animal nature, an instinct that is triggered when we feel in danger, and fear overrides all reasoning. Peace is a cultural product, and is only attainable by actuating proper strategies, targeted to deprive war of its food, its air, its water, and its fuel. The pretexts for wars are ethnic, religious, and linguistic differences. The fuel of wars is the disputes in certain regions, where different ethnic groups historically tried to cohabit. The ultimate food of wars – and the triggers – are the speculative strategies of a few powerful people (whatever their ideology, if any), which see the opportunity to use the conflicts to enlarge their territory, their dominions, their markets, their power, and to stole resources to their competitors.

What could be a good strategy, then, to deprive war of its main food?

Is it useful to call for a moral conversion to pacifism? Of course, yes, calling for peace is always useful. Yet, what always undermines the success of any strategy is to add concepts that come from some ideological agenda, and that are not strictly necessary to the goal. Some samples: extreme left wings think about big crises as excellent opportunities to pursue their goals, i.e. destroying capitalism. Environmentalists will see the energy crisis as an opportunity to enhance renewable energy sources, etc.… The goal of getting peace is then weakened, if not forgotten.

We should not try to "educate" people to any particular agenda, we should just focus on the main goal, shared by many good willing people**:** to relaunch the growth, in peace and freedom. What will be the prize to keep on fighting for some precious regions on Earth's surface when new territories, new resources, new energy sources, and new markets, are available in the geo-lunar space, on the Moon, the Near Earth Objects, on Mars, and beyond? Such a perspective, when properly marketed, can defuse wars on Earth, in a surprisingly short time.

Each year Earthers spend about 2 trillion USD or Euros for weapons and military expenditure, fighting for those small disputed regions. The Western Countries spent in the war in Afghanistan, during 20 years, 2.3 trillion. Yet we were not able to implant in that region a solid industrial civilization. That means we did not yet understand that the industrial society, bringing social growth, is the sole necessary condition for the development of democracy and that a market of consumers cannot live if those people will not be industrial producers too. People cannot be forced into democracy, or to be consumers, or any other thing, by the power of arms. The development of the civilian astronautic industry and all the sectors connected to space travel and space tourism will largely help underdeveloped countries to raise an industrial society.

Here is where the message of Pope Francis, to redirect the money spent on weapons and other military expenditures to a global fund that can finally put an end to hunger and favor development in the most impoverished countries, cannot work, if confined to planet Earth boundaries. It is an excellent proposal, yet, to succeed, it needs to be sided by a space development strategy, based on the immense resources of the Solar System, and how their exploration and exploitation can unleash benefits worldwide: scientific knowledge, technologies, innovation, peaceful international cooperation, private/public partnerships, industrial development and new jobs on Earth and in space, inspiration and education for public and youth, creating a

New Space Renaissance for this century. The proposed fund should then also be used to support the new space industry and stakeholders, accelerating civilian space development.

By the way, such a strategy will also respond to the other great requirement: to kick off giant projects, suitable to attract and inspire all of the young and less young people of goodwill on Planet Earth, giving them back hope in the future.

His Holiness the Dalai Lama[131]: *"Disarmament can occur only within the context of new political and economic relationships. Before we consider this issue in detail, it is worth imagining the kind of peace process from which we would benefit most. This is fairly self-evident. First, we should work on eliminating nuclear weapons, next, biological and chemical ones, then offensive arms, and finally, defensive ones. At the same time, to safeguard the peace, we should start developing in one or more global regions an international police force made up of an equal number of members from each nation under a collective command. Eventually, this force would cover the whole world".*

SRI will work at the U.N. Committee for the Peaceful Use of Outer Space (COPUOS), together with our allies, to develop a coherent Space for Peace plan. As proposed by Marie-Luise Heuser, a key demand should be to expand the Outer Space Treaty (OST) so that not only weapons of mass destruction should be banned in space, but also any other weapons, leaving the moon as a weapon-free zone. Also, a coherent strategy for peaceful civilian space development should recommend the governments of planet Earth to operate a general disarmament, converting the weapon industries into civilian astronautics, and the related industrial and commercial sectors. Such a policy will not compromise existing jobs in the weapons industry, and will decidedly support humankind in its epochal evolution process.

4.4.5 The 21st-Century Vanguard Movement (for a Manifesto of the Space Expansionist Movement)

The space expansionist movement of today may recall – in some but not in all concepts – the Futurist movement one century ago. The futurism of that time was elaborated as a formidable forge of art, science, and philosophy. Transcending ideological and political boundaries, futurism planted its roots in revolutionary movements, grouping together and inspiring generations of progressive visionaries, poets, and philosophers. It gave birth to original artistic currents, such as surrealism and the transformative modern art of the 20th Century. Futurism was a fantastical engine boosting progress and insight across scientific, philosophical, technical, and cultural layers.

The greatest strength of Futurists – and the part of their ideology that we want to recall – is that they were quite determined to support and promote all the technological advances of their time, from trains to airplanes, and the upheaval of the Industrial Revolution. They were certainly not dreamers for a distant future.

But the Futurist Manifesto declared *"We will glorify war — the world's only hygiene — militarism, patriotism, the destructive gesture of freedom-bringers, beautiful ideas worth dying for, and scorn for woman."*[132], and this is a profound key difference between us and them.

Traditional futurists were certainly activists, engaging the realms of culture and education not simply hoping for the future world, but dancing in fields of art, philosophy, and technology. Their contribution to the development of our modern culture, which is based on progressive industrial development added a tremendous boost to social growth, implicating confidence in progress, and prospects for the future. This momentum was essential, at the time of the 20th Century. Yet, as we know, key movements and momentums cannot be simply recalled and reproduced out of their historical time, just because they would be useful. It is worth describing in brief the historical dimensions. The futurist movement is considered to have been formally initiated in Italy, in 1909, by Filippo Marinetti, Umberto Boccioni, and Antonio Sant'Elia. Shortly after, in 1913, the Russian futurist movement published a Manifesto, composed by Vladimir Majakowskij and others. Kazimir Malevich developed his extraterrestrial Suprematism, also in 1913, against the backdrop of Russian Cosmism.[133] The futurist vanguard also developed in France, with Guillaume Apollinaire and Valentine Saint-Point, and in Germany with the Bauhaus group and the rocket enthusiasm of the early space movement in the 1920s. The Italian side of the movement, initially focused on art, but being animated by anarchist-libertarian concepts,

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131 "Disarmament for World Peace" - His Holiness the Dalai Lama speaking in Bern, Switzerland on October 13, 2016 - https://www.dalailama.com/messages/world-peace/disarmament

132 Marinetti, Filippo Tommaso – "War, the World's Only Hygiene", 1915 - https://www.arthistoryproject.com/artists/filippo-tommaso-marinetti/war-the-worlds-only-hygiene/

133 Heuser, Marie-Luise., "Russischer Kosmismus und extraterrestrischer Suprematismus." In: Planetarische Perspektiven. Bilder der Raumfahrt. (Kritische Berichte Jg. 37, H. 3, 2009), Marburg 2009, 62–75 - https://journals.ub.uni-heidelberg.de/index.php/kb/article/view/18240/12041

was later compromised by the fascist regime and, for that reason, the Russian futurists sharply criticized Marinetti and his associates and refused to unify into a unique movement.

None of their warmongering concepts, and contempt for women, belong to us in the 21st Century, where dangerous back-ward wars are arising on the whole planet, and equal rights for women are still seen through the lens of political struggle. Rather than promoting disruptive hubris, our movement should act to generate a powerful wave of inclusive compassion for all humans and sentient species, aiming to intelligently assure a future for all. The historic Futurism movement also had intricate connections with the other vanguard and artistic movements of that time, such as Surrealism, Cubism, Abstractionism, and Dadaism. Each of such movements might be considered an airfield of the Twentieth Century in representing the culture of progress, often elaborating on the capable perception of accrued benefit and the insightful criticism of detrimental effects.

Last, but not least, the historic futurists – and this was their weakness – were not aware of the significant limits of planet Earth, and the dreadful existential risk posed by humankind's growth in a closed system. That is the second key difference between us and them. We know the risk. We know that little time is remaining. We know that we cannot be just "futurists" because the long-time promised future in space shall be achieved NOW. Ours is the awareness. Ours is the duty.