



Space Renaissance International

A Position Paper on Civilian Space Development and Space Technology

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Abstract

Two months ago, the SRI 2nd World Congress updated our analysis of the status of civilization, and defined our program for the next four years, toward 2020. This paper aims to focus our priorities within the current global perspective, as the space renaissance continues to unfold. We may face unavoidable turmoil and dramatic events, challenging established routines and customs, and extending public opinion as perceptions move forward. Looking towards our immediate future, even events perceived as far distant, will become immanent, as a fast paced process of global engagement for space begins to emerge. We have identified, three essential developments, which SRI will support with immediate outreach actions:

Establishing Low Cost Access to Earth Orbit, addressing the issues of the protection of civilian life and health in space, and advocating for a suitable set of laws for the global governance of activities in Outer Space, i.e. to collate, and extend international civilian rights in space.

Some key technological advances, including fully reusable rockets and additive manufacturing, will allow the inception of comprehensive manned activities in Earth

orbit, and the first steps for industrialization of the space surrounding the Earth and Moon space region.

SRI will promote and support such an on going process: establishing the paradigm shift from *military* space exploration to *civilian* expansion in Outer Space. In the “Military and civilian space” section of this document, we include a brief note about our anthropologic analysis of the paradigm shift.

Acronyms used in this document

Acronym	Definition
ACES	Advanced Cryogenic Evolved Stage
ARM	Asteroid Redirect Mission
GDP	Gross Domestic Product
IT	Information Technology
LEO	Low Earth Orbit
NASA	National Aeronautic and Space Administration
NEA	Near Earth Asteroids
NEO	Near Earth Objects
OSL	Outer Space Law
OST	Outer Space Treaty
SBSP	Space Based Solar Power
SRI	Space Renaissance International



Acronym	Definition
ULA	United Launch Alliance
UN	United Nations

The renaissance is developing, upheavals and events, the future is now

Two dramatic events took place in 2016: the successful development of fully reusable rockets¹, by Space X, and the unexpected election of Donald Trump as President of the United States. Both events might represent the affirmation of single persons' strong will and determination. Both events also represent, although in different modes, an inherent criticism of the stagnant policies pursued by political and technological leaderships during the last decades. We see that many communities around the world have grown tired of promises of more or less brilliant futures: they want the future now, and with a growing urgency. Such a "presentist"² philosophy is easily observed through an individualist style for leadership.

To examine Elon Musk's approach: let's do what we can with the technologies we have, a style which has clearly demonstrated that we can achieve immediate results through such a strategy. A Columbus egg, a brilliant yet logical idea after all, if we cannot yet build a single stage transportation directly to orbit³, let's take both stages back down to Earth surface for reuse. Such a simple concept is already decreasing the cost to orbit, while making the older monopoly of expendable rockets obsolete⁴. This exciting innovation was perhaps the first big stone, whose ripples spread across the innovative lake of the world-wide space community. The election of Donald Trump will perhaps represent a second huge stone, thrown into the lake of the world-wide civilization. Nothing will be as before. We do not yet know how the new US administration will take up for global space venture, to build settlements on the moon and Mars, perhaps. Even so change is in the air along with the discussion for reform, the next phase of the space age has already been described and the movement is well underway.

Expanding civilization into outer space is the solution of humanity's bigger problems

SRI is not a political party. As individuals and as humanists, we might criticize or appreciate single policies, according to their social and cultural impact, and while considering how they will push in the direction of an equitable economic growth or not. SRI has only one clear priority that is our polar star: that expanding civilization into outer space can provide the solution of the bigger problems of humanity⁵. Downsizing the cost of transportation to Earth orbit, and establishing an extensive civilian space development will help to re-launch global economic growth at an unprecedented pace⁶. This advanced technological impetus will decrease the underlying cause of conflicts on Earth: the insular and

regressive tendency, the social and cultural fear, that has been building up during the last decades, due to the inability of world leaders to conceive and run innovative industrial development programs⁷. Civilian space development is nowadays the only genuine strategy that can assure exponential and well related economic and cultural growth⁸. Establishing what we call a true renaissance, and in modern terms, a space renaissance⁹. As we discussed during our recent congress, the classical renaissance, from the 16th century onwards, created a continuous scientific advancement, culminating in the industrial revolution, and this ongoing process is now directly aiming towards outer space, as the natural evolutionary step. Should this step be misunderstood, misinterpreted or set-aside, the renaissance will be defeated and mankind may enter into yet another dark age. We know perfectly well that, if almost eight billion people remain limited within the boundaries of a philosophically closed world, that many attempts to oppose wars and conflicts will represent wasted time and ineffectual energies: we have seen more than 50 years of pacifist movements, yet wars still exist. We might even consider that pacifism in itself, has not been enough to eliminate wars, while respecting the many who engaged in such serious commitments. We also know that, while almost eight billion people will be forced to develop their industry within the boundaries of a closed world system, such development may remain stunted, in dealing with our scarce (planetary) resources and the growing problems of toxic and atmospheric pollution. We have seen 50 years of inquiry, ecological investigation and environmentalist movements: yet pollution and waste of resources continue to dominate, notwithstanding the considerable progress of "green" technologies, and the committed motivation for sustainability. Given such limited results, we might consider that the solution, for achieving both industrial growth and a clean and sustainable environment, is located elsewhere. Following the same thread of reasoning, it is apparent that no purely moral or ethical recommendation will solve serious crisis such as starvation and underdevelopment, nor necessarily provide job opportunities and social resources to the younger generations. Nor can we necessarily even convince our children that they have a future, since the future within a closed world system is so limited in scope¹⁰. It is apparent that the solution, in providing a positive future for the next generations, is to invite the world to the historic and evolutionary ventures, building together the space based infrastructures of the eras which will lie ahead. The space renaissance has begun, and it will demand all of our careful insight, our commitment and our dedication for the way forward.

Our duty is to discuss the effectiveness of the established space policies, and to take part in the determination of the newer space policies, in all the countries where we have the possibility for dialog and the interface with governmental representatives. As a motivated vanguard



movement we should be prepared to take up any opportunities to bring forward our positions on space development, seeking to inspire a global community, to be listened to and carefully considered by decision makers, helping to determine the acceleration of positive civilian space development around the world. The forthcoming space renaissance will rapidly expand into many areas, establishing many leading and significant technological advancements and creating notable engagements within the primary focus of national and international affairs. Space development outlooks within civil society communities, will include the furtherance of commercial fields, including space tourism ventures, while the parallel growth of pervasive space based informational services within both public and private sectors will continue to extend the platforms for sustainability and global economic development through the adaptation of many unique data bases and planning contingencies.

Five main areas: Low Cost Orbital Access, Geo-Lunar Civilian Development, Space Law, Life and Health in Space, International Cooperation.

Deeply involved in the development of a coherent and consolidated civilian space program, to be developed during next fifteen years, moving towards 2030, SRI indicates five main areas of investigation, where all possible energies should be concentrated, both from private industry sources from public and national agencies sectors:

- 1) accelerating the development of Low Cost Access to Earth Orbit,
- 2) to develop Civilian Space Infrastructures in the Geo-Lunar Space,
- 3) to provide an extended Outer Space Law System, in order to regulate and optimize the further expansion into Outer Space,
- 4) the furtherance of scientific research for life and health protection and safety in space,
- 5) the promotion of International and Inter-Agency collaborative space venture, manned settlement and further exploration.

In this work we are highly encouraged by positive events, or even "renaissance events", taking place during these last few months, and we are confident that many more will occur during the coming months and years. The duty of all our political and economic parties, holding through their mission the benefit of society, or even just the sincere interest of concerned communities – and with full respect for all points of view -- is to support the global space renaissance worldwide, giving their full support to the development of the above initiatives, and the advancement of an equitable and capable world view.

The technologies booster of the space renaissance

As we have mentioned, several very promising events took place in 2016, including the already mentioned development of fully reusable rockets¹¹. After the leading experimentation and successful examples by SpaceX, several other rocket industries are following up. Jeff Bezos's Blue Origin¹², and ULA (Boeing+Lockheed)¹³ are now developing reusable rockets. While the Space X strategy is based on an reusable first stage, ULA's ACES (Advanced Cryogenic Evolved Stage)¹⁴ will comprise a second stage remaining in orbit, for reusable purposes. The other significant renaissance technology currently emerging is 3d additive manufacturing¹⁵. This technique has tremendous range of application, which may eventually fully replace the traditional mechanical technologies, allowing a significant downsizing of the costs in all aspects of design, prototyping and production, not to mention the possibility to 3d print engines and component parts within space station and habitat configurations in orbital space. We could say that the boosters of the space renaissance provide two facets: technologies and a guiding philosophy, representing the features that will originate a clear and political vision. If either one of these two aspects is missing, the renaissance will not complete: and a social and evolutionary process, lasting more than the previous five centuries will miserably lapse into obscurity. Reusable rockets, additive manufacturing and the unfolding of a genuine political vision, will provide the impulse to the development and placement of a serious and coherent civilian infrastructure in the Geo-Lunar space.

A progressive settlement of services and industries in the Geo-Lunar system

Given the plan of Blue Origin¹⁶, leading out the new space segment, and the participation of ULA community¹⁷, a traditional dealer that seems to be capable of a quick transformation, we can see the guidelines of a strategy for the fast industrialization of our space region. The development of a fleet of shuttle type "space trucks" in Earth orbit will support the use of heavy lift vehicles, creating what ULA describes as throughput "*freight trains*" and continuous traffic loops for deep space deployment. The exponential usage of additive manufacturing (both on Earth and space based), with far lower costs will also provide a massive capacity. Such a system will make it highly practical to construct many large-scale infrastructures and to generate industrialization and productive economic activity in space, including Earth-Moon transportation systems, microgravity manufacturing facilities of many types, commercial habitats, and lunar and asteroids mining. Both Low-Earth orbit and higher Geo-stationary orbit will provide the logistic interfaces and way stations between Earth and elsewhere in the Solar System. Many innovative



companies, such as Planetary Resources, Bigelow Aerospace, Deep Space Industries, Moon Express, and so on have already secured early seed capital from Silicon Valley investors and private sources around the world to develop these notable technologies and to realize such business plans, which are just waiting on a reliable, cheap space transport system. Examples of this type may soon be generated in other many locations as nations around the world join the renaissance vision, we may see remarkable enterprise from Russia, India, China and in many locations, for many types of space industrial usage and to develop many types of infrastructure resource. The undertaking of a collaborative and internationalized space development will represent the key to our future world, generating a growing sense of optimism and a genuine respect for our diversity and the profound depth of human culture, inspiration and awareness.

The development of outer space represents an unfolding process that will describe a progressive settlement of services and industries in the Geo-Lunar area. Many construction and maintenance services will be located in suitable orbits. In this way greatly reducing the cost of large scale satellite placements, and permitting complex communications structures that can be assembled, refueled and maintained in orbit. In this way reducing the need for automated systems to be inclusively provided and allowing for upgrades and specialized parts replacement. Inter-orbital maneuverability will be fully developed, providing safer technologies for re-entering the atmosphere, as well. The recovery of space debris will be properly facilitated and enabled, through a number of innovative techniques, both for recycling purpose and within clean up operations, thereby preserving the integrity and long term duration of the orbital pathways.

A serious program of civilian expansion into space will include the development of capable resource technologies to assure durable power supplies to space infrastructures, vehicles, habitats and industrial settlements. Space Based Solar Power plants will represent an essential, for the provisions of space based infrastructures as well as for terrestrial uses. As solar energy is fully abundant and fully constant in the geo-lunar space region, SBSP will provide the power backbone of the civilian space development. Solar energy technologies have already been routinely utilized on many spacecraft over half a century. Within a longer perspective, as the SBSP infrastructure is productively developed for space enterprise usage, it will eventually become competitive as an alternative energy supply for Earth too.

Space Settlement and Space Tourism

The design for space settlement and colonization doesn't always focus on the surface of planets. From a humanist point of view, the residence of civilians outside of our planet, for long periods, or undetermined time, involves a

unique approach, bearing in mind the many essential life support requirements. These will include at least, the ability to travel and reside while protected from cosmic radiation, and in conditions of gravity equivalent to Earth. A solution proposed by Krafft Ehrlicke – Selenopolis, the lunar city¹⁸ -- would address the problem of protection against cosmic radiation, building Selenopolis into the lunar subsurface, but there would still remain the problem of the Moon's gravity, which is about one sixth that of Earth. The lunar environment would provide excellent prospects for microgravity utilities, also taking into account the low cost of transportation from the lunar surface to LEO access points, but inhabitants that acclimatized to such low gravity conditions, would inevitably suffer physiological effects over the long term. Gerard O'Neill's solution¹⁹, on the other hand, would solve the problem of a necessary gravity, through the balanced revolution of a orbital space habitat cylinder, but not an equally important issue: how to shield a large structure, the size of the magnitude of kilometers, from cosmic radiations? A solution for both problems could be found through the utilization of near-Earth asteroids. Many of these have a manageable mass and acceleration, and estimates are that they could be captured and towed to locations in Cis-Lunar space including the stable Lagrange points for further resource development. NASA has already identified multiple candidate asteroids and continues the search for one that could be redirected towards a lunar placement in the 2020s. Since the announcement of the Asteroid re-direct Initiative in 2013, NASA's Near-Earth Object Observation Program has catalogued more than 1,000 new near-Earth asteroids, discovered by various search teams. Of those identified so far, several could be good candidates for capture and relocation. Scientists anticipate many more will be discovered over the next few years, and NASA will study their velocity, orbit, size and spin before deciding on the target asteroid for the upcoming ARM research and development mission²⁰. A larger dimension metallic group asteroid, once captured and relocated, could be also mined out, obtaining an enormous internal spheroidal space. The resulting raw materials, ores and minerals, can be used for internal construction of an entire urban, industrial and agricultural infrastructure necessary to the eventual settlement of large populations of people. As such a complex was developed, the whole asteroid-city could obtain an imprinted rotation, in order to generate a continuous artificial gravity. The asteroid walls would interpose between the layers of the internal habitat and the outer space environment, providing protection against radiation and micrometeorites. As we move towards such a remarkable evolutionary vision, generations of private enterprises, and public research and development settlements will be constructed on the Moon, on Mars and the moons of Mars as well. Eventually people might travel to a planetary settlement for let's say



six months at a time, and then return to their Lagrange home town.

Within the immediate time frames, once effective low cost access to orbit is achieved, and a growing fleet of passenger and freight transportation vehicles are in place, Space Tourism will become one of the leading industrial development lines. As assessed by the "General Public Space Travel and Tourism" study, developed in 1998 by NASA²¹, the travel and tourism business is among the largest in the world. In 2015, travel & tourism revenues in total contributed US\$7.2 trillion to world GDP, representing 9.8% of global GDP²². The NASA study concludes that serious attention should be given to activities that would enable the expansion of forthcoming terrestrial space tourism businesses, and the creation of in-space public travel and tourism venture. Indeed, this study concludes that over time, space tourism should become a very significant part of US overall commercial and *civil space business*-program structure. Such an industry would offer innovative business opportunities that could capitalize upon previous US human spaceflight public expenditures and provide additional employment to the growing reservoir of space professionals, facilities and institutions. The study also makes specific suggestions as to how the Federal government, particularly the Departments of Commerce and Transportation, and the National Aeronautics and Space Administration, should cooperate with each other, with private sector aerospace entities and with space tourism business interests in order to hasten the creation of a sound and potentially very large space related business.

The Outer Space Law system

Now, we can't imagine all of the above – which represents huge civilian activities and a comprehensive undertaking - - to take place without a suitable system of guidelines, regulations and laws, to steer our human civilization, as it expands into Outer Space. For such a purpose, the furtherance and extension of the Outer Space Treaty (OST), provides a wonderful opportunity, in 2017: comprising for the 50th anniversary of the Outer Space Treaty, and the upcoming UNISPACE+50 conference in 2018, which will represent the fourth International referendum on the International space law regime. The Outer Space Treaty was instigated and established in 1967²³, between the space-faring countries of that time and has since been universally ratified. This unique treaty based platform continues to enable ongoing and productive international discussions and shareable considerations, regarding the pacific use of space. Even so, many attributes are still missing (considering the comprehensive developments of the past 50 years). We might evaluate these as representing the further essential guidelines for activities conducted by civilian corporates in space: industry, tourism, services and navigation. Additionally we should take into account the

development of mass space communications, which also pose as a unique and distributed global asset. Another consideration would represent the mutual international development of sensitive and advanced space technologies, such as within beamed energy and nuclear and fusion resources. SRI recommends that the Outer Space Treaty should be taken as a design and input point for the future phases and that the requirements and purposes of a newer Outer Space regime should be fully investigated, described and compiled. For this purpose we might take international Maritime law as providing a necessary background, original template and a source of equitable regulation, as consolidated for a long duration in Earth's international waters. We will find that many important institutions are already working on these various topics and developing a relevant literature: International Institute of Space Law²⁴, International Academy of Astronautics, United Nations Committee on the Peaceful Uses of Outer Space²⁵, European Center for Space Law, just to mention a few. Although of course we deeply appreciate the collaboration and commitment represented by such a huge work, we would like here to clearly recall our original and "presentist" doctrine: space law was so far established as providing in some sense "*a law of the future*" without much concern for the more immediate and directly impacting expectations. But we need a comprehensive international space development now, as an immediate and global venture. So let's come to a very pragmatic point: let's use what we have. For sure it is actually very much more than what we need! And, also, let's call for a considered contribution towards the OST development from civil society and the space community at large. The SRI inquiry indicates a straightforward and direct line of approach, representing a formative discussion and a productive result that can readily be achieved, just as somebody had to finally describe and experiment for the successful development of reusable rockets. We offer our support and availability in collaboration to bring together all of the mutual threads and considerations of SRI international community, since an international law will provide a unique standard, shared by all, and this is a now very urgent task.

We would like to extend our space humanist point of view, proposing several essential requirements for the new rules to be designated and the topics that must be addressed:

- 1) The Outer Space Law (OSL) should extend human rights, as recognized and codified by the United Nations, into Outer Space.
- 2) The OSL should extend the human rights to development, as recognized and codified by the United Nations, into Outer Space.
- 3) The OSL should address the safeguard and protection of human life and health and, in general terms, the



warranty and assurance of civilian life conditions, in the Outer Space environment.

- 4) The OSL should adopt and describe a "Freedom of Space" concept, imported from the Earthling maritime law "Freedom of the Seas", and from the commercial aviation rights, called "Freedom of the Air".
- 5) The OSL should provide regulations for the development of a free market in Outer Space, in the full respect of human rights and the related laws.
- 6) The OSL should support the exploitation of extraterrestrial resources, such as asteroid and planetary raw materials, by private industries.
- 7) The OSL should define the establishment of extraterrestrial ground claims and portions, by private entities.
- 8) The OSL should define the threshold altitude (LEO? Suborbital?), where the national skies end, and the Outer Space international regime begins.
- 9) The OSL should describe and promote an international platform for the removal, mitigation and reuse of space based debris, which currently threatens the future integrity of the low earth orbital asset.
- 10) The OSL should recommend, uphold and support International, and inter-agency venture and collaboration, in particular unifying efforts for the rapid development of manned settlement and industrial infrastructure in the Geo-Lunar space, and for further exploration, towards Mars and the external planets.
- 11) The OSL should acknowledge the importance of space based communications and a related global informational development, recognizing the exponential value of space based IT to humanity, in enabling fast global development.
- 12) The OSL should support and facilitate international consensus on informational space based global security and non-proliferation attributes and for mitigation against crisis.
- 13) The OSL should establish a secure international cyberspace under the UN auspices, supporting the subscription and participation of countries around the world and thereby facilitating both global security and global development prospects.
- 14) The OSL should acknowledge the role of near earth observation and the earth sciences in ensuring, remediation against natural disasters and crisis, sustainability, environmental conservation, and resource development.
- 15) The OSL should describe and enable an inclusive international consensus for the usage of advanced and sensitive technologies in space, such as nuclear fusion, space based solar energies and laser beaming.

Hereafter the Article 87 of the United Nations Convention on the Law of the Sea²⁶:

Freedom of the high seas

1. *The high seas are open to all States, whether coastal or land-locked. Freedom of the high seas is exercised under the conditions laid down by this Convention and by other rules of international law. It comprises, inter alia, both for coastal and land-locked States:*
 - (a) *freedom of navigation;*
 - (b) *freedom of overflight;*
 - (c) *freedom to lay submarine cables and pipelines, subject to Part VI;*
 - (d) *freedom to construct artificial islands and other installations permitted under international law, subject to Part VI;*
 - (e) *freedom of fishing, subject to the conditions laid down in section 2;*
 - (f) *freedom of scientific research, subject to Parts VI and XIII.*
2. *These freedoms shall be exercised by all States with due regard for the interests of other States in their exercise of the freedom of the high seas, and also with due regard for the rights under this Convention with respect to activities in the Area.*

With reference to the construction of space habitats in the Cis-lunar space (as described in previous section), we note that clause 1.(d), allowing the construction of artificial islands, seems particularly appropriate. The "Position Paper On Space Resource Mining"²⁷, adopted by the International Institute for Space Law, December 20th 2015, states: "In view of the absence of a clear prohibition of the taking of resources in the Outer Space Treaty one can conclude that the use of space resources is permitted." As asteroids in general terms are nothing more than agglomerated materials, characterized by unstable solar orbits, they can be considered space resources, available for exploitation, as well as the Moon's regolith and other self existing space based attributes.

We can conclude that, so far, the existing legal concepts would be sufficient, to regulate the construction of a comprehensive space infrastructure in the geo-lunar space, and that building space habitats in Cis-lunar space would not require any affirmation of property rights or legal reform such as for the related lunar territories, which could be controversial and cause delays.

Even so the extension of space law in order to formally recognize the many aspects of a forthcoming phase of collaborative, integrated and internationalized space development, will help ensure global stability, facilitate space related international trade and interchange and in general terms greatly speed up the developments of the next 50 years, while averting unproductive measures and ensuring on-going, equitable and continuing benefits to our international communities and to the many diverse societies and cultures in all places. Formally defining the



comprehensive value of space based communications, and information flows from space within OST will ensure that space based IT continues to provide optimal benefits to humanity within an optimal framework of utilization and potential.

Military and civilian space, and international security

The topic of Outer Space Law will lead us into the topics of weaponization, proliferation and international security. The overwhelming majority of UN member states are significantly concerned that any "weaponization" of outer space²⁸ will lead to a global arms race and insist that the purpose of the OSL multilateral treaty is the only way to prevent such an outlook, emphasizing that additional safeguards within the treaty would not limit space access, but would actually prevent such limitations and avert any threat of antagonism at this level. Within such eventualities the role of a secure international cyberspace will represent a paramount consideration. Although national security informational structures, will necessarily be formulated and maintained within isolate and unique identities, the additional features of a non aligned, well related global information and security resource under the OSL auspices will offer many significant potentials. In particular such engagements between the superpowers will have a profound and long lasting value. Internationalized space-based security assets will find many applications, not only to ensure the effectiveness of the global nuclear monitoring, and to provide verification and avert nuclear proliferation but also to uphold an effective and expedient response to terrestrial crisis and support the growth of global informational resources around the pressing sustainability issues. Space represents a sensitive and highly advanced international arena within which technological advancements will also formally represent the next generation of a global security prospectus, while International agreement and treaty level consensus will play a leading role in establishing the stable guidelines and frameworks of such essential resources. As the unfolding of the global space development paradigm, will describe and enable the preparation of many newer abilities, within advanced technological fields such as laser beamed point to point transmission, and nuclear and fusion power for space transportation, the related security dimensions must quickly obtain the optimal guidelines and the equitable perspectives.

The impetus for security modernization, including for nuclear assets, between the superpowers will no doubt move forward, although international pressures for global disarmament may result in further complexities, and the formula of a next generation nuclear deterrence might eventually be achieved in other ways. Certainly the money spent on nuclear weapons modernization, would be better spent on collaborative space venture²⁹. The

development of space provides an inclusive condition, with significant and extensive global implications, as the new space paradigm itself, may definitively provide the underlying medium and basis within which nuclear deterrence, and a complete global nuclear disarmament will eventually be fully reconciled.

Military segments may also benefit from low cost launch development, without cutting into the substance of a perceived need for military proficiency and technological advancement. Therefore we might appreciate that some virtuous ways could be found, to redirect part of the military expenditure -- at least the part saved by the reduced cost to orbit -- for supporting civilian space development, and, maybe even to support the further development of non-lethal weapons systems³⁰, which represents a high profile humanist goal.

From a philosophical humanist point of view, genuine policies should look more to people's interest, requiring public investments into the technologies for life and development, i.e. civilian enterprise. However, in general terms, SRI doesn't assume that there should exist any specific competition between the military segment (both space and non space) and the civilian space economy. It has been determined that, each Dollar or Euro invested in space gives back 5 to 10 folds in terms of economic development. This is true since the very start of the space age 50 years ago, and throughout the entire span of the original scientific & initial exploration enterprise. It is logical to expect that, with the onset of the newer phases -- civilian industrialization and settlement --, the return of such Investments will become even bigger, representing millions of new jobs, both in space and on Earth.

When evaluating about the essential very needed paradigm shift, we insist on the needed civil evolution of space development: from *military* space exploration to *civilian* space development. The point, for us, is not the military or non-military setup of the many different space agencies, which will construe as various systems and configurations. We look at these paradigms from a humanist anthropologic point of view, i.e. defining the different legal and life-protection approaches, between the military exploration and the civilian settlement. The military space exploration paradigm saw short missions and round trips, hard traveling conditions, long military training needed; none legal warranties for astronauts who fly at their own risk, under military conditions (life is by definition "spendable"), low protection against cosmic radiations, and none structural protection against zero or low gravity. A coherent civilian space development and settlement approach considers long durations and permanence in space, establishing transportation and residency conditions appropriate for civilian passengers, the placement of civilian legal warranties for travellers and residents, and the on going development of full protection against cosmic radiations, and artificial gravity living conditions.



Increasing the international inter-agencies collaboration

The formulations of the global road map, internationalized space settlement and the further phases of a deep space exploration program will certainly move quickly ahead, bringing alternative venues to the peoples of our world and providing a worthwhile and comprehensive basis for the endowment of an equitable, inclusive, informed and well related global society. Space development will bring genuine opportunity to nations and peoples around the world, the transformation achieved by an immanent space renaissance will affect human society in many ways, enhancing education, security and prosperity, and mitigating the risks posed by untoward circumstances in the 21st century, while rapidly extending the growing potentials of a future world.

We re-summarized in this paper the conditions that will make the shift to civilian paradigm possible. An accelerated development of technologies for low cost access to Earth Orbit is the primary requisite. This engagement represents an on going process, but the new space industry shouldn't be left alone, within such an evolutionary purpose. Our space agencies hold a huge expertise and we should assume that such proficiency also belongs to the public at large, the citizen, and taxpayers, who have sustained the cost of these developments. Therefore it would be realistic to expect that agency assets of many specialized types, should be generously shared with startups, small and big companies, working towards the opening of the high frontier. While the cost of the launch to orbit is being quickly reduced, a wider horizon is coming into view: the building of the industrial, touristic and settlement infrastructures in the geo-lunar system. We are not talking only about or mainly of the Moon. The Moon in itself is just one of the targets, in this area, we include the Lagrange Points, the Near Earth Asteroids, and the development of hundreds of different manned systems, in Earth and Moon Orbit, a giant plan, describing a region sometimes referred to as "Greater Earth". In this venture, our private industries will play a primary role, developing and building an essential space based infrastructure as orbital access quickly becomes more generally available and far more affordable.

We also advocate a broad international cooperation, between governments and amongst the space agencies, to promote public engagements with private consortia, sharing know-how and establishing financial resources and investments. Such collaborations will be of much value, especially to start to solve two serious problems, requiring a focused and restless scientific research: protection of life against cosmic radiations and generation of artificial gravity.

It is evident that the issues of life and health protection in outer space will assume a continuing relevance, for the

perspectives of civilians living and working in space for indeterminate time frames or long durations. This regulatory issue had not been seen as being so relevant within the frame of early manned space exploration, in which short missions are considered, or for government enterprise frameworks where astronauts are primarily engaged through military context. The current perspectives will require continuing assessment, as pioneer space tourists, or civilian astronauts engaged in free enterprise or commercial ventures may remain totally uncovered by even the types of legal warranties, typically proffered to aeronautic civilian passengers, for example by an airline company. Developing the essential life protection clauses within the OST attributes may represent one of the most significant aspects of the change of paradigm we advocate: from *military* space exploration to *civilian* space development.

The scientific community was able to successfully collaborate across national borders, even during many dark ages of war and hard confrontation. We are convinced that the enlightening forces of the space renaissance will win over the complexities of the planetary crisis and prevent the fall into regression. SRI is offering their entire support to the United Nations and all the international institutions that are working for the renaissance of our civilization!

References

- ¹ https://en.wikipedia.org/wiki/Reusable_launch_system
- ² The term "presentism" is used in opposition to the word "futurism". The futurist movement, born between the two world wars in Italy and Russia, on the wave of the industrial revolution, was projected to the future. More recently, the term was used to indicate a broad aim to the future. The astronautic humanists of the 21st century are presentist, because they are the best representatives of the desperate need of humanity, to have the promised future now, to relaunch the global development and avoid a civilization implosion.
- ³ <https://en.wikipedia.org/wiki/Single-stage-to-orbit>
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