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Future multiplanetary economy utilizing the space elevator

Abstract

In the near future following the needs of space development, expected, but not yet available technologies will enter the scene and may represent a paradigm shift in space, allowing a strong and growing space based economy. Currently, the space elevator remains a distant goal from both technological and operational standpoints. However, its potential introduction signifies a paradigm shift in space accessibility, promising significantly reduced costs and increased payload capacities. Its implementation forecasts the development of a space-based economy spanning the entire solar system, encompassing planets, moons, selected asteroids, and comets. This vision sees space evolving into a platform for a multiplanetary society. This article aims to explore various scenarios enabled by space elevator technology, extending beyond Earth to integrate it into traveling settlements as essential infrastructure. Possibilities include assembling space settlements in geostationary terminals and implementing space transportation systems with a cruiser-feeder concept, where the elevator serves as a crucial link between planetary surfaces, cruisers, and container transportation systems. Furthermore, it involves utilizing the elevator to deflect asteroid collisions, assemble traveling settlements, and establish space factories using deflected asteroids as sources of raw materials. The envisioned space economy has the potential to surpass the terrestrial one, potentially generating quadrillion-dollar figures to benefit humanity on a grand scale. While these goals are ambitious, leveraging space elevator technology can expedite the process, offering immediate benefits and facilitating the establishment of a multiplanetary society that integrates both humans and AI-powered artificial beings.

Keywords: space elevator, multiplanetary society, space settlements, space factories, asteroid impact protection

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Introduction

The anticipated return to the Moon, with plans to establish a lunar base, marks the beginning of a new era in space exploration. This era follows the initial, foundational phase during which groundbreaking technologies were tested and milestones like the Apollo missions, the International Space Station (ISS), the Space Shuttle, and various robotic missions throughout the solar system were achieved. We are now entering the second phase the operational phase paving the way for even more ambitious endeavors, such as Mars terraforming, space settlements, the development of a solar system economy, and eventually, interstellar exploration (Figure 1).

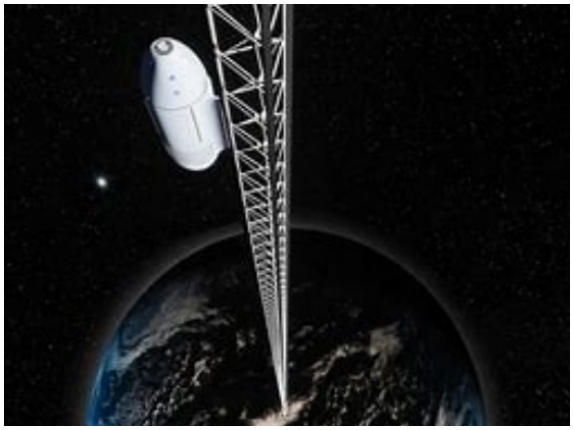

Figure 1 Space elevator geoterminal.

In this operational phase, many essential technologies have already been developed and merely require refinement. While some advancements in space-related fields are still expected and necessary, these emerging technologies could herald a paradigm shift in space development. This article explores two such technologies: the space elevator and space settlements. Currently, these concepts remain in their infancy, with numerous breakthroughs needed to bring them to fruition. On NASA's Technology Readiness Level (TRL) scale, which ranges from 1 to 10, we are at level 2. However, this should not discourage us from discussing and speculating about their potential applications and the new capabilities they could introduce, particularly in promoting the emerging space economy. The space elevator represents a revolutionary transportation infrastructure, while space settlements could serve as critical logistical hubs. Together, they will be instrumental in humanity's manned exploration and utilization of space during the third phase of space development. Space colonization should be viewed not only as an opportunity to address existing global challenges but also as a tool to solve them. Space development will bring wealth to our planet and its inhabitants, creating new opportunities, jobs, and goals. It will invigorate and expand the global economy, ultimately transforming our understanding of humanity's role on Earth. Our planet and society currently confront an array of global challenges, spanning social, environmental, and potential catastrophic issues. These challenges have evolved from the exponential growth of the past century and have been exacerbated by the increasing demands of the new one. We firmly believe that innovative tools emerging from technological progress should play a pivotal role in addressing these challenges and improving our overall situation. The primary objective should be

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to leverage these advancements not only to confront challenges but also to revolutionize entire economies, fostering significant progress in our journey toward a better world. As an illustration, poverty, one of the most pressing global social challenges, can be overcome by generating wealth, thereby translating into job creation at all levels. Achieving such results requires expanding the existing economy on an unprecedented scale. Space development and the establishment of a multiplanetary economy and society emerge as key drivers for this expansion, offering the potential for an order of magnitude growth in our current economic conditions. Simultaneously, the space elevator, as a fundamental player in this scenario, has the potential to represent one of the most effective instruments for achieving such a purpose. It's crucial to remember that seemingly straightforward inventions, such as the 19th-century elevator, have had the power to transform our cities. The introduction of the third dimension through elevators enabled the construction of skyscrapers, high rises, and various building types, forever altering our cityscapes and the way a city functions. Similarly, the space elevator has the potential to create a transportation infrastructure that would provide cost-effective access to space while accommodating heavy payloads, fundamentally changing the rules of the game. In fact, since the creation of an expanded multiplanetary economy is the primary goal as an efficient way to address the global challenges threatening our society, we aim to explore the various possibilities and benefits that an instrument like the space elevator could generate for this purpose. Let us delve into a scenario where the space elevator could make a difference in unexpected utilization, opening doors to a multiplanetary society and economy starting in the 21st century.[1]

Scope of work

"Our primary mission and focus should be to address global challenges, encompassing both social and environmental aspects, through the development of a space economy leveraging the capabilities of the space elevator." On the environmental front, we aim to create a planet free from pollution and carbon emissions, restoring the natural ecosystem and phasing out the use of non-renewable materials. Simultaneously, from a social perspective, our vision is to foster an exponentially expanded economy capable of eradicating poverty, addressing global challenges, and enhancing overall human well-being, providing opportunities for a wealthier and healthier life to all. Our mission is to accelerate the establishment of a multiplanetary society through the development of efficient and affordable equipment and infrastructures for transportation and settlement. The proposed space elevator, with the estimated possibility to reduce space accessibility costs from the existing 1500$ per Kilogram to a figure less than 10$ per kilogram at LEO orbit and from 12250$ per Kg to about 500$ per Kg at Geostationary orbit will represent a game changer and stands as one of the fundamental instruments to achieve these missions and goals. With this article we aim to paint a scenario where space elevators become commonplace infrastructures, facilitating seamless access to and from celestial bodies and enabling a space economy to encompass our entire solar planetary system.[2]

The scenario

This article aims to explore the myriad possibilities and analyze specific fields transformed by the introduction of space elevators in a future multiplanetary society. The key focus is on developing a space economy that leverages space infrastructure on selected celestial bodies, including the utilization of spaceships equipped with space elevators to spread these infrastructures throughout the solar system. A critical aspect is defining the role of our planet in a future planetary economy, along with other celestial bodies and space-based settlements. Recognizing the uniqueness of Earth, we emphasizes the importance of preserving, restoring, and enhancing our planet to return it to pristine conditions, adapting to future situations, population growth, wealth distribution, and various activities. This entails eliminating or reducing activities that have contributed to the current poor environmental conditions. While Earth undergoes restoration, Mars is proposed to be terraformed to adapt to terrestrial conditions, and other celestial bodies would be made habitable through underground terraforming. The creation of an economy based on their exclusive resources is envisioned. The human presence is identified as the primary driver for the expansion of the space economy, with all life support requirements and human needs acting as catalysts for multiplanetary economic activities. The future multiplanetary society presents numerous scenarios influenced by different parameters that require in-depth analysis. Here we aims to identify and prioritize the most significant parameters, showcasing the substantial impact of the space elevator's contribution to the envisioned multiplanetary future.[3]

Space infrastructures

To enable an efficient space economy, the construction of space infrastructures supporting all activities is imperative. These infrastructures can be categorized into two types:

i. Transportation System: The transportation system relies on space elevators and ground bases at selected celestial bodies, as well as space-based installations.

ii. Space elevator: Space elevators, serving as cost-effective transportation systems for space access, are envisioned as essential infrastructure on major celestial bodies.

These space elevators consist of several fundamental components (Figure 2):

i. Ground terminal: The primary function of the ground terminal is to serve as the base station for the space elevator. However, depending on its location and purpose, it can assume various roles. In non-terrestrial applications, the space elevator ground terminal could evolve into a local ground base that expands alongside the development of local activities.

ii. Cables and cabin equipment: The cables and cabins play a pivotal role in the space elevator's functionality. Different functions may require varying specifications; for instance, space factories might demand larger cabin capabilities.

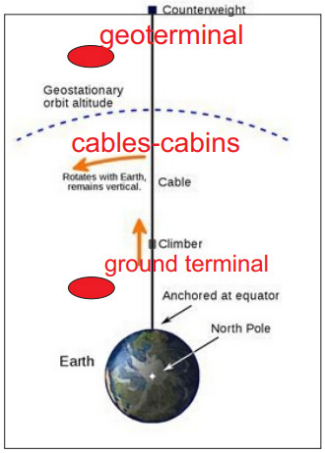

Figure 2 Space elevator components.

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Geolocation Terminal: The geolocation terminal serves as a designated point equipped to construct settlement-type facilities through an assembly facility. Beyond its primary function, it becomes a central hub for a range of activities, including serving as a spaceport for solar system transportation, maintenance facility, space hotel for tourists and workers, healthcare center, food production site, power generation station, and more. A space elevator consist of a cable fixed to the equator and reaching into space. A counterweight at the upper end keeps the center of mass well above geostationary orbit level. This produces enough upward centrifugal force from Earth's rotation to fully counter the downward gravity, keeping the cable upright and taut. Climbers carry cargo up and down the cable. For terrestrial purposes the geoterminal is located at 35K Km from the surface of our planet. The geolocation terminal emerges as a multifunctional facility integral to the overall success of space elevator operations. In the subsequent sections, a detailed analysis will explore how these components can be modified to fulfill specific requirements, showcasing the adaptability and transformative potential of space elevators in addressing the diverse needs of celestial bodies within our solar system.[4]

Space transportation system

The envisioned space transportation system revolves around a cruiser-feeder combination. Feeder spacecraft transport cargo and passengers between ground bases on Earth and other celestial bodies, connecting with cruiser spacecraft following permanent cycling trajectories between these bodies. While currently proposed with single spacecraft, the future vision involves integrating the space elevator infrastructure into this system, utilizing it for the feeder function. The space elevator would efficiently transport payloads between ground bases and geoterminals. Geoterminals would be equipped with spaceports, warehouses, and maintenance facilities for cruisers, along with specific functions tailored to their unique requirements, eventually serving as components of space settlements. Furthermore, the incorporation of space elevators into traveling settlements could transform ground terminals into local bases, supporting further developments (Figure 3).

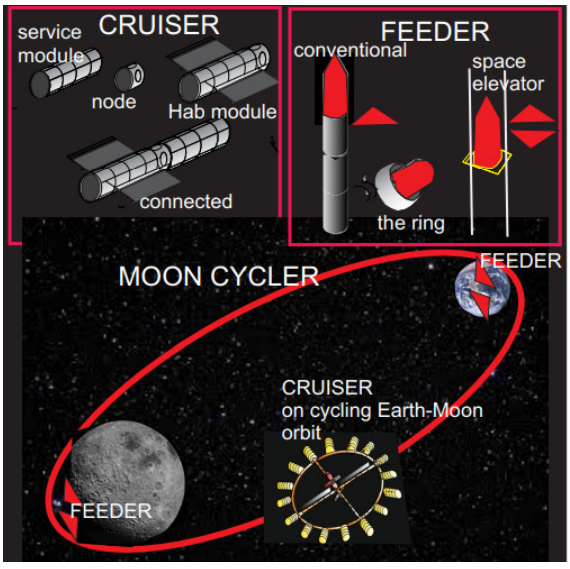

Figure 3 Cruiser feeder system.

Space Container System Integral to the transportation system is the space container system, responsible for transporting cargo and passengers between terminals, space settlements, and ground bases. Space elevators play a crucial role in facilitating the transfer of containers between the surface and geoterminals, forming the foundation for various human activities, including mining, metal processing, manufacturing, and efficient transportation systems. A solar system network of geoterminals on different celestial bodies, connected to the ground level through space elevators, complements the space transportation system. Space tugs, designed for single or multiple containers, move goods and passengers between bodies, including space stations and settlements. Space containers serve as the fundamental cargo components, facilitating their transfer between ground and space bases in varying quantities (Figure 4 & 5).[5]

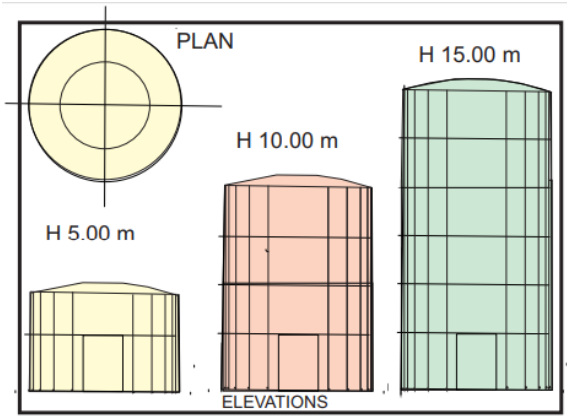

Figure 4 Modular containers.

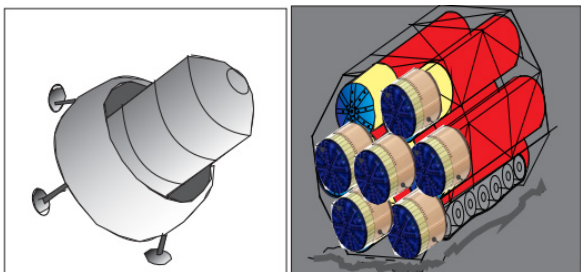

Figure 5 The ring and Constellation.

System overview

Single System- "The Ring": Feeder or cruiser spacecraft designed to transport a single container. Multiple System- "The Constellation": Modular system containing a central propulsion, fuel, and navigation systems to transport several containers. Structured as a network between terminals, forming an efficient and flexible transportation system. This integrated space transportation and container system, with the support of space elevators and geoterminals, envisions a comprehensive network facilitating the movement of cargo and passengers within our solar system.[6]

Space settlements

The feasibility of establishing human settlements in space and on chosen celestial bodies represents a groundbreaking frontier in space development. Proposing a paradigm shift, these settlements could be manufactured on Earth and efficiently assembled in geostationary orbit, facilitated by space elevators, thereby creating an entirely new industry. This approach positions space settlements as pivotal instruments for space development, capable of supporting human life with advanced terrestrial life support systems and facilitating sophisticated manufacturing activities for celestial body exploitation.

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The integration of space elevators in the construction process enables the creation of modular space settlements on our planet at a low cost, utilizing advanced technology akin to existing shipbuilding operations. These modules can then be transported by space elevators and assembled in geoterminal stations or in settlements connected with the space elevator. Since the connected settlement would represent the optimal solution for terrestrial space settlements, it allows low-cost transportation for all space activities performed in space. From these stations, space settlements can be dispatched to their designated destinations, fully equipped to initiate the exploitation of a new celestial body or follow a predetermined trajectory in any solar system location. The winning combination could be the space elevator with space settlements as geoterminals that would allow the benefits of terrestrial technology and capability in outer space at affordable conditions (Figure 6).[7]

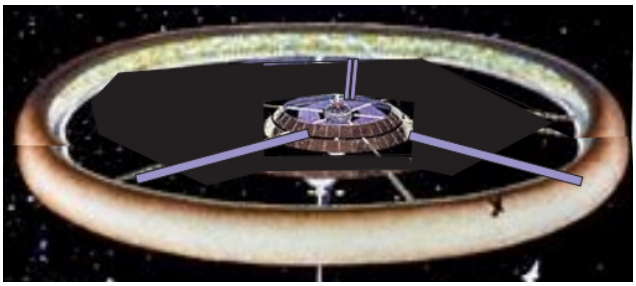

Figure 6 Geoterminal with space settlement.

Traveling space settlements equipped with space elevators

Some traveling space settlements may be equipped with space elevator facilities, further facilitating the development of selected celestial bodies. Together with the settlements, the space elevator facilities would be built on our planet and delivered by space elevator to the geoterminal where they would be assembled in a proper facility. Once arrived at their destination, such settlements would deploy the space elevator, utilize its ground terminal as a local base, and be immediately operational. The construction of space settlements is envisioned to evolve into a major industry, starting on Earth and expanding to future space facilities that utilize non-terrestrial materials. This transformative approach not only opens the door to unprecedented human presence beyond Earth but also establishes a foundation for sustained space exploration and utilization (Figure 7).[8]

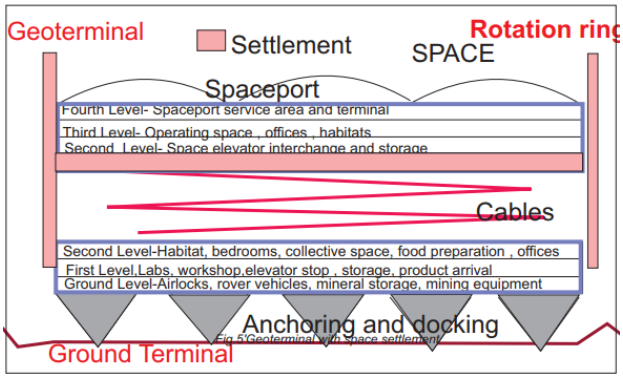

Figure 7 Space elevator terminals.

Space factories

In the broader context of addressing global challenges, our mission is to curb, if not eliminate, the use of non-renewable resources on Earth by importing essential materials from space. This approach aims to restore our planet to pristine conditions, mitigating pollution, and reducing the carbon footprint. Simultaneously, it paves the way for the creation of a new multiplanetary society, offering numerous benefits for humanity. At the heart of this transformative mission stands the proposed space elevator, serving as the primary instrument to achieve these ambitious goals. This innovative solution addresses the urgent challenges our planet faces and provides a pathway to sustainable resource utilization (Figure 8).[9]

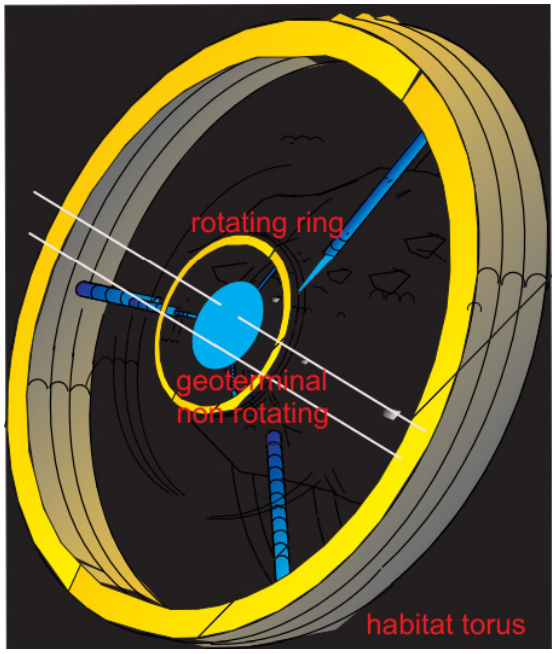

Figure 8 Settlement at geoterminal.

The concept: Millions of asteroids and comets are available in the solar system and could satisfy future requirements for centuries to come, even in an expanded multiplanetary society. Utilize small deflected NEO asteroids as raw material resources to be delivered to a geo orbital mineral processing and manufacturing plant, attached to a multiple cabin space elevator that would initially support the space manufacturing assembly in geo orbital position and further on transport all finished manufactured products to our planet.[10]

Utilization of resources: The relentless and escalating consumption of non-renewable minerals to fuel economic growth poses a threat to our planet's resources. With the current trajectory, Earth's finite resources could deplete within a few decades. In an expanded multiplanetary economy with exponentially growing mineral demands, a strategic solution is imperative.

Procuring minerals from asteroids and comets: The proposed solution involves tapping into the vast reserve of small asteroids and comets scattered throughout the solar system. These celestial bodies hold immense wealth in the form of minerals needed to sustain and fuel our economy. This approach not only addresses the resource scarcity on Earth but also offers the opportunity to restore our planet to pre-industrial Revolution conditions, preserving the natural ecosystem and mitigating the adverse effects of pollution.

The enormous potential: Millions of small asteroids and comets, readily available in the solar system, represent a colossal reservoir of essential minerals. By harnessing the potential of these celestial bodies, we can secure a sustainable supply of resources, simultaneously alleviating the strain on Earth's limited reserves and promoting responsible resource management for future generations. In summary,

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the concept of space factories, coupled with the utilization of resources from asteroids and comets, presents a groundbreaking solution to the challenges posed by the depletion of non-renewable resources on Earth. The proposed space elevator serves as the linchpin in this ambitious endeavor, offering a transformative and sustainable path toward a new era of resource utilization and planetary stewardship.

Space property law requirements: Recognizing the vast economic potential of minerals in space, particularly within asteroids, it is imperative to establish comprehensive legal frameworks before initiating any asteroid deflection and mining activities. The complexities of space property law require international agreements to regulate ownership and resource utilization (Figure 9).[11]

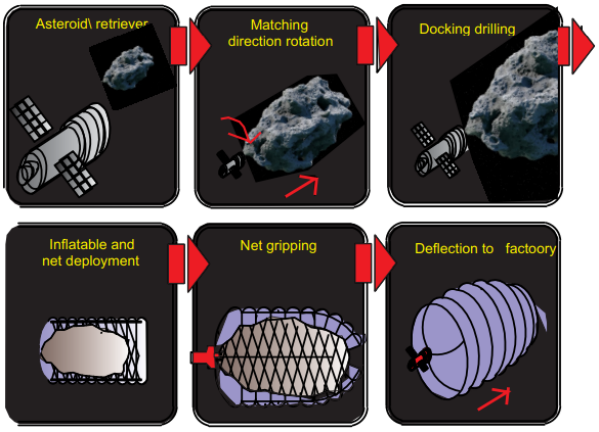

Figure 9 Asteroid deflection flow diagram.

The space factory: This facility will be constructed following the design principles of space settlements, aiming to recreate all terrestrial conditions, including atmosphere, temperature, and gravity. It will take the form of a donut, featuring several functional levels inside while rotating around a central hub. This rotation will ensure centrifugal force at the perimeter walls, creating gravity close to 1 to support human habitat. The Mission to achieve the planned goals as described above, let's analyze the general activities needed and their sequence.

1. Build a space elevator facility in a convenient location for future operations.
2. Based on the type of product, the terrestrial final assembly facilities, and the market's location, select the most appropriate location with good ground access, either by truck or rail, to the transportation network to install the space elevator ground terminal.
3. The main components of the space elevator must be specifically designed for their tasks, which include receiving raw materials, transforming them in space, and delivering finished products to our planet (Figure 10). Specifically:

Ground station: The ground station terminal must contain all mechanisms and equipment related to the space elevator. It should feature a large warehouse and storage area to receive the pods from the geolocation, disassemble them, prepare the packaging, and ship those using automated high AI robots. Due to the high requirements, the cabin capacity of 170K per year may not be sufficient. In case of no improvements from the space elevator designers, a multicabin solution will be needed. Ten cabins would allow 1700K tons, making the presence of the space factory more reasonable.

Geo terminal: The geoterminal must contain its basic functions, such as the needed connections with the space factory, storage areas for receiving the finished products for delivery to the ground station, including spaceports for the space transportation system, as well as facilities for human personnel. Depending on the business plans, other functions may be operative in the terminal.

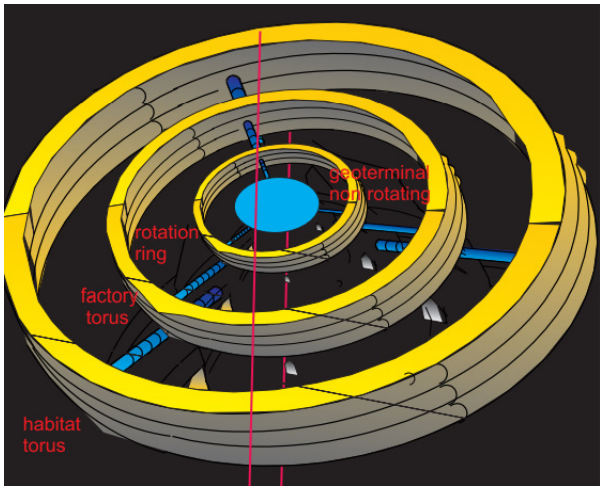

Figure 10 Geoterminal with space factory.

Operational activities

The factory is operational, the activities could be classified as follows:

Phase 1: Retrieve a small selected asteroid for raw materials.

i. Small asteroids initially (up to 50 m diameter) will be captured by the retriever vehicles of the space factory, deflected, and delivered to the storage and processing facility of the manufacturing torus.

ii. To enable such activity, asteroid deflection technology will be a fully developed business activity, automatically performed by manufacturing retriever vehicles that can rendezvous with the asteroids, adjust their speed, direction, and rotation, if existing, dock, and capture them.

iii. Once secured, the retriever would change their direction to the desired one. During the return trip to their base, robotic systems will start mining, processing the ores, and manufacturing needed products so much manufacturing will be ready upon arrival where they will be stored in the construction facilities.

Phase 2 - Arrival and further processing activities in space factory (Figure 11).

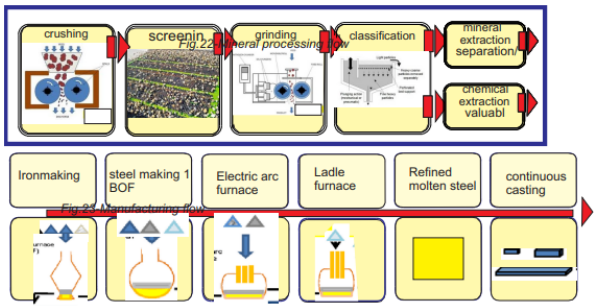

Figure 11 Mineral processing flow.

Production of metals and alloys

Manufacturing of metal-based products: In accordance with the origin of the materials, different processing facilities and

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methodologies will be necessary. As soon as the raw materials arrive at the storage facility, they will be separated by mineral type and processed at the nanodimension to be atomically reassembled for needed materials and alloys, and later for manufacturing needed products. Mineral processing follows mining and prepares the ore for the extraction of valuable metals in the case of metallic ores and produces commercial end products such as iron ore and others. The mineral transformation equipment will consist of mini steel foundries that will initially separate the single materials in accordance with their quality and further utilize those needed to manufacture sheet coils, pipes, and beams. The sheet metal will be further molded according to product requirements.

Phase 3 - Delivery of products to terrestrial ground terminal

The final activity to be performed utilizing the space elevator with multiple cabins to allow greater payloads.[13]

Power generation

Goals: Create a space power generating system for affordable and universal utilization, and develop a safe method for delivering such power to our planet. Concept: Develop a solar space power generating system featuring photovoltaic fields located in space's geosynchronous orbit. Utilize the space elevator for both its construction and its technology to facilitate delivery. Our mission with this proposal is to outline a scenario where space elevators support the generation of space solar power. This involves delivering and assembling solar satellites in space and subsequently transmitting the generated power to ground stations through added power cables integrated into the space elevator infrastructure. This approach aims to eliminate unsafe and heavy polluting ground facilities (rectennas) and alleviate our planet from the environmental impact of heavily polluting power generation activities. Our goal is to enable the affordable, non-polluting, abundant, and safe utilization of space-generated energy to address current and future energy requirements on Earth. Simultaneously, by providing inexpensive power to all, we aim to enhance societal conditions in the face of global challenges such as poverty, contamination, resource depletion, and economic hardships. The proposed space elevator and its technology serve as the primary instruments to accomplish these missions and their associated goals (Figure 12).[14]

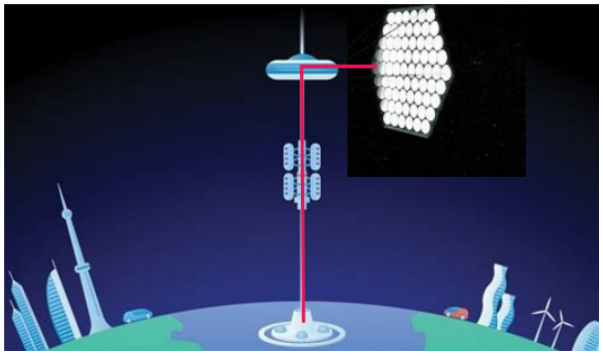

Figure 12 Solar power connected system.

Space tourism

In light of the recent developments in space tourism, exemplified by Virgin Galactic and Blue Origin, which have successfully carried a few passengers to suborbital altitudes for short durations, the space elevator presents an opportunity to transport dozens of passengers in a low-risk environment through specifically designed cabins. This opens up an entirely new market, potentially supported by a hotel resort connected to the geoterminal station and the potential settlement. This resort could offer food and lodging to tourists for several days, with the exciting possibility of excursions to the Moon.[15]

The ark

The possibility to have the space elevator capabilities in a recent future may allow us to perform several unique missions that may be necessary to face global challenges. At present the human species is living in a single planet. This allows several possibilities of extinction such as: Asteroid impacts, world deadly pandemics, earthquake and tsunamis of global reach, abc and civil wars, air, water and soil contamination to render our planet unlivable, climate change , space disease, hostile alien invasion, Artificial Intelligence takeover and more. For this reason we believe that by utilizing the space elevator capabilities, high volumes to space at low costs, we could propose a potential system to allow the preservation of human society in case of emergencies that could produce an extinction. The ark will be an independent traveling space settlement, built in geoorbit thanks to the space elevator, with terrestrial life support conditions , including 1 G gravity, to store most terrestrial plants seeds and animal embryos, (insects, reptiles, mammals , birds, marine) including human for future bringing to life event in case of need represent the scope of this proposal. Such miniworld is designed to preserve and recreate terrestrial life, human culture, history and technological data, for the possibility of the loss of the entire body of information due to catastrophes (Figure 13).[16]

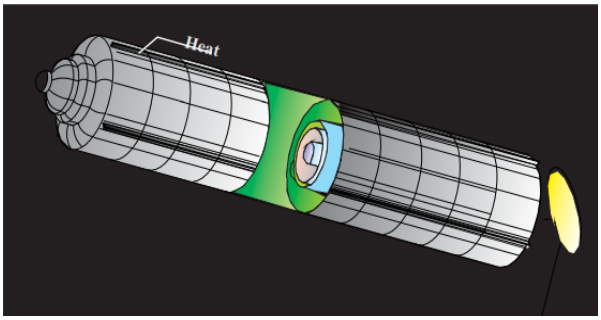

Figure 13 The Ark traveling settlement.

The impactor

An asteroid impact with our planet is a permanent threat. Scientists have established that large near-Earth asteroids (bigger than 1 km diameter) have the potential to cause geologic and climate effects on a global scale, disrupting human civilization, and perhaps even resulting in extinction of the species. Smaller near Earth Objects in the 140 meter to 1 km size range could cause regional up to continental devastation, potentially killing hundreds of millions. Impactors in the 50 to 140-meter diameter range are a local threat if they hit in a populated region and have the potential to destroy city-sized areas. Only recently our society has find out the risks that our civilization may run unless, with new technology, we act to eliminate such challenge. For this purpose, the defense of our planet against asteroids or comets impacts, we believe that the features of the space elevator, could change the rules of the game and allow to position in Earth orbit a large body, composed of hundreds of heavy steel modules to form a bullet shaped mass over 120 m long, equipped with propulsion system, navigation and communications, rocket engines and fuel tanks to be directed toward incoming asteroids to impact and deflect their trajectory if and when needed. It could also be equipped with nuclear weapons that at contact would shatter the asteroids to smaller

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pieces rendering them not dangerous anymore. Such impactor could be assembled in space, at the geolocation of the space elevator, that would deliver heavy metal modules, to be assembled in orbit, to form the bullet shaped body (Figure 14).[17]

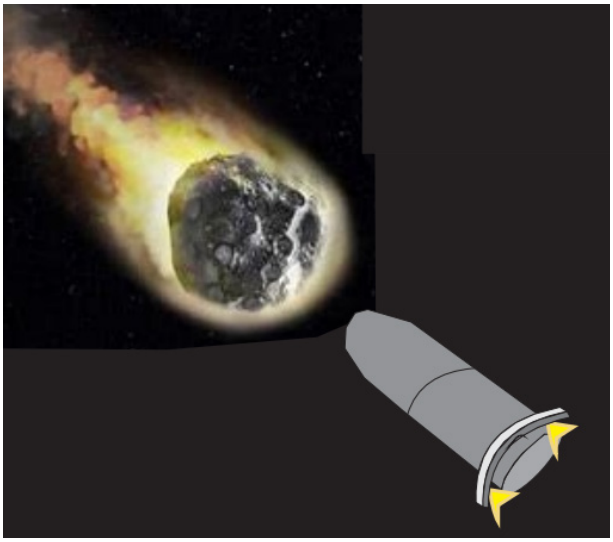

Figure 14 Impactor to deflect asteroids.

Figure 15 Drone swarm from space battle station.

The future

A multiplanetary society with a network of settlements in the entire solar system would create a quadrillion economy, since humans will be involved with their requirements like life support systems, food production, health care, residence, transportation and more. Through underground terraforming many worlds will be developed and human expansion in the solar system will be assured thanks to the many new opportunities offered to mankind. The expanded economy will bring wealth to everybody and will solve most global challenges actually threatening our planet. At the same time many other advances will be possible such as health care, governance, education, manufacturing, and many more, since space expansion and its technological requirements will push forward most sectors of our society in a continuous progress. The final goal, once the solar system will be developed, will be the more ambitious of them all, interstellar travel. In the future we may have all new technologies that would allow such step and reach a potential galactic society.[19]

Defense

The militarization of space is an inevitable consequence of the expansion of space activities. Although not politically correct, we must confront the reality that such developments will revolutionize defense forces globally. Traditional army, navy, and air force structures may be rendered obsolete by the potential of space-based weapons, leveraging the capabilities of the space elevator. The space elevator could facilitate rapid and efficient deployment of space-based weapons, enabling the elimination of entire naval fleets or tank columns in a matter of minutes through the use of space-based weapons, drone swarms, or accurate cruise missiles. The devastating impact of space-based nuclear weapons could pose a significant threat to humanity. To prevent such scenarios, international treaties should be urgently considered, banning the deployment of nuclear weapons in space, with stringent controls to enforce compliance. Orbital battle stations represent another component of a space defense system. Constructed on advanced Earth facilities, delivered by the space elevator, assembled at the geoterminal location, and later distributed in appropriate operational Low Earth Orbit (LEO) or Geosynchronous Earth Orbit (GEO) positions, these stations will likely become crucial elements of future defense infrastructure. Taking proactive measures now through diplomatic efforts and international agreements can help mitigate the potential risks associated with the militarization of space (Figure 15).[18]

Conclusion

The envisioned future involves the establishment of a sustainable and prosperous multiplanetary society, with space elevators serving as a crucial element in fostering a space economy that addresses global challenges and transforms our approach to space development by providing an affordable transportation infrastructure and supporting a settlement network . Detailed exploration of these concepts is provided in our comprehensive proposal. In the prospective quadrillion-dollar space economy briefly outlined here, our society is poised for a complete revolution driven by technological advancements and innovative products. These include automatic flying cars, sustainable construction, self-sufficient green power generation systems, domestic hydroponics cultivation, brain-computer interfaces, personal assistance bots, increased lifespan, and more. The introduction of the space elevator and its associated consequences represents yet another transformative opportunity with some possibilities previously discussed since it would allow and promote an integrated multiplanetary economy. The expanded space economy will not only offer unexpected opportunities but also generate wealth for the entire global population, fostering a new social system based on collaboration between AI advanced bots and humans. Considering that space is more suitable to machines than humans, not needing expensive life support systems for survival, its development, in an integrated functional, human-machine relationship way, will represent the ideal location for a combined activity. This symbiotic relationship, where AI bots and humans cooperate for common interests, holds the promise of reshaping societal dynamics but also the challenge of AI dominance if not properly controlled. Given its game-changing potential, the introduction of the space elevator can be viewed, at this stage, as a potential Singularity being instrumental to the human expansion in the solar system in a functional and affordable way. This technological shift has the capacity to disrupt our society in unforeseeable ways, opening up new horizons and possibilities

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that demand careful consideration and ethical contemplation as we navigate the path toward a future shaped by space exploration and innovation. A multiplanetary society, based in an integrated human machine relationship, will represent the end result of this phase of human civilization preparing the stage for a further and practically endless step: interstellar travel to allow an interstellar society.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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