Vol: 3 -- Issue: 2, 2025

AGRICULTURAL AND BIOTECHNOLOGICAL REFLECTIONS

Http://agribioreflect.com

Editor@agribioreflect.com

ISSN: 3080-4019 (Print)
ISSN: 3080-4027 (Online)

THE ROLE OF SPACE EXPLORATION IN ADVANCING KNOWLEDGE OF THE UNIVERSE: A STUDY ON THE POTENTIAL FOR HUMAN COLONIZATION OF MARS

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Abstract

Space exploration represents humanity's most ambitious endeavor to understand the cosmos and expand beyond Earth. This study provides a comprehensive analysis of how space exploration advances fundamental knowledge of the universe while examining the technical, biological, and ethical dimensions of human Mars colonization. Employing a problem-based research methodology, the investigation synthesizes data from planetary science missions (Viking, Curiosity, Perseverance, Tianwen-1), astronomical observatories (Hubble, JWST, Chandra), and analog research (Antarctica, ISS, HI-SEAS) spanning 1970-2023. Results demonstrate that space exploration has revolutionized our understanding of cosmic evolution, with 73% of fundamental astrophysical discoveries since 1990 deriving from space-based observations. Regarding Mars specifically, analysis of 8,000 geological samples and 15 years of atmospheric data confirms ancient habitability (3.8-3.5 billion years ago) with evidence of persistent liquid water and organic compounds. Current technological readiness assessments for colonization indicate life support systems at Technology Readiness Level (TRL) 7-8, radiation shielding at TRL 5-6, and in-situ resource utilization at TRL 4-5. Physiological data from 65 astronauts reveals that Mars transit (6-9 months) would expose crews to radiation doses of 0.66-1.0 Sv, increasing lifetime cancer risk by 3-8%. Psychological studies of isolated crews indicate mission success probabilities drop below 70% for durations exceeding 30 months without countermeasures. Economic analysis projects initial colonization costs of $230-450 billion over 20 years, with potential reduction to $120-180 billion through international collaboration and technological innovation. This research concludes that while Mars colonization is technically feasible within 20-30 years, it requires unprecedented international cooperation, sustained investment, and resolution of ethical questions regarding planetary protection and human adaptation. The pursuit simultaneously advances fundamental science, drives technological innovation with terrestrial applications, and addresses profound questions about life's cosmic context and humanity's multi-planetary future.

Article History

Received:
July 12, 2025

Revised:
August 18, 2025

Accepted:
October 13, 2025

Available Online:
December 31, 2025

Keywords: Space Exploration, Mars Colonization, Planetary Science, Human Spaceflight, Cosmic Evolution, In-Situ Resource Utilization, Space Technology.

INTRODUCTION

Besides its being a large scientific project, the need of the human race to explore space is an extension of our life on earth on the existential plane. Space exploration has ceased to be a geopolitical fight, as the launch of Sputnik in 1957 and is now an exploration group game, which makes the rudimentary knowledge in astronomy, planetary science, and the astrobiology (Dick, 2012). The entire investment of approximately 1 trillion has led to certain breakthrough findings regarding the creation of planets, development of the universe, and the potential distribution of life in the universe (NASA, 2020). At the same time, the breakthroughs in computing, material science, medical, and environmental monitoring have created seven or fourteen times economic returns on the original investment (Space Foundation, 2022). It is also scientifically needed but it would also be a pragmatic assurance that long-term survival of species would take place considering that the earth is increasingly confronting more ecological issues and existential dangers (Musk, 2017).

On the one hand, the centuries of robotic missions have succeeded to demonstrate the complex history and future of Mars like the existence and appearance of life on Earth and its manifestations which became the scientific foundation of the further exploration. First close-up images of Mars in 1965 with the help of the Mariner 4 mission have already shown the existence of a Noachian period (4.1-3.7 billion years ago) of flowing water, warmer climate, and denser atmosphere on Mars that could have supported life and will be followed up until the present missions of Perseverance and Tianwen-1 (Grotzinger et al., 2014). The discovery of remnants of voluminous ice on the subsurface, the derivation of methane which could have been a marker of a geological or biological occurrence, and normal slope lineages that evidence to a contemporary salty water have been of scientific interest (Orosei et al., 2018). In such a way, Mars can be the best place to be utilized to seek extra-terrestrial life in the solar system or as a model planetology on how the earth climate evolved.

The Mars colonisation presents new technical challenges in various fields that have never been examined before. In long missions (longer than a year) life support systems must be in a position to achieve almost 100 percent air, water and nutrient recycling and the ISS has had the ability to achieve up to an estimated 85 percent efficiency (Eckart, 1996). The problem of radiation protection would be associated with new shielding solutions because of the appearance of solar particle events (SPEs) and galactic cosmic rays (GCRs) with the current materials; which increases the mass of the transit vehicles to prohibition (Cucinotta, Kim, and Chappell, 2013). This good news notwithstanding, in-situ resource utilisation (ISRU) technologies of extracting water on regolith, extracting oxygen on the atmosphere using CO2 and building material on the local terrain are not yet prepared to be investigated in detail (Sanders and Duke, 2005). There is little information about the cardiovascular, musculoskeletal, and neurological impacts of physiological adaptation to 0.38g (between microgravity and normal on Earth) of gravity that require further investigation (Clement, 2011).

Other than the technical problems, colonisation of Mart has a number of serious moral, legal, and philosophical concerns. It can be contradictory between the planetary protection to avoid forward contamination (Earth bacteria to the Mars) and back contamination (possible Mars organisms to the Earth) and the colonisation practice that cannot but result into translocation of the terrestrial biota (Rummel et al., 2014). The national appropriation prohibition through the Outer Space Treaty of 1967 makes the governance systems of the interplanetary settlements imprecise and this is among the factors that make the law create uncertainties in terms of the rights of ownership, the use of resources and competency of the jurisdiction (Jakhu & Pelton, 2017). The question about the unethical transhumanism to establish genetically modified individuals more adapted to Mars or it is necessary that people evolve is a philosophical issue (Cockell, 2016).

The economic potential of Martian colonisation is colossal and its opportunities of game-changing benefits are there. Drake, Hoffman and Beaty (2010) report that NASA has estimated that human Mars missions in case they are funded will be 100-500 billion to fund human Mars missions based on the architecture. Decades of investments will be needed in colonisation. Irrespective of the harsh technical and financial setbacks, the prices of said private schemes in the form of the Starship of the SpaceX are significantly cheaper due to the reusability and in-orbital fuelling (Musk, 2017). In spite of the fact that the future economic perspectives of the economic self-sufficiency of the export of energy, rare materials or intellectual property, it seems to be inevitable that temporary aid to the needy on the earth in the short to medium term is unavoidable (Zubrin, 2011). Although the colonisation time can be postponed, benefits to the earth, caused by the process of colonisation the production of materials, autonomous systems, recycling and renewable energy processions can be incredibly beneficial in collateral value.

Of significance to development of basic knowledge, the paper below critically examines the value of space exploration and how Mars colonisation can be achieved with reference to application of problem-based paradigm. The question puts into consideration four significant questions, namely; First, what has been the significant discovery of planetary science and space evolution through space travel, and what are the fundamental questions that remain to be answered. Second, how are we technologically ready in the long run in the transportation, radiation protection, life support and ISRU areas to be able to stay on Mars? Third, what are the social, psychological and physiological problems that the people face with the Martian environments and is it a solution they can get? Fourth, what are the moral, legal and financial institutions that are required to inform the sustainable and responsible colonisation? By incorporating data on scientific, engineering, medical and humanistic fields, this paper will offer sufficient information depth to the scientists, policymakers and common people about the cosmic future of human beings.

METHODOLOGY

The quantitative and problem based research methodology was employed in this research study with the use of four analysis frameworks namely, scientific discovery assessment, technical readiness evaluation, human factors analysis and feasibility scenario modelling. The greatest problem of the research design was how the space exploration would be utilized to add to the fundamental knowledge and to render the possibility of a long-term human settlement on the planet Mars. To estimate scientific discovery: using bibliometric analysis, 3,200 high-impact papers (citation count >100) in space missions since 1990 were identified using scientific data, scientific missions, physiological and psychological data by means of the documents of the UNOOSA, text of treaties, and 40 scientific articles related to space law and ethics. The journals were broken down into discovery area (cosmology, exoplanets, solar system, fundamental physics). The prototype test data and professional surveys (n=85 engineers / scientist) indicated 120 key technologies to colonisation of the Martian planet were rated on NASA TRL scale (1-9) of maturity. To examine human factors, a meta-analysis of 45 articles on the effects of spaceflight on eight physiological systems (cardiovascular, musculoskeletal, neurosensory, immunological etc) and twelve psychological domains (group dynamics, stress, performance etc) was conducted. The findings were generalized to Mars (0.38g, isolation, and communication delay) conditions. In the framework of the Monte Carlo analysis of the success probabilities, a modeling success of the 1000 scenarios of the mission by discrete event simulation was done on 5 architectures (NASA DRA 5.0, SpaceX Starship, Mars Direct, Mars Semi-Direct and internationals) in turn. The statistical analysis was done using R (4.3.1) and expert system dynamics, multi-criteria decision analyzer (MCDA) and bibliometries (bibliometrix). The sensitivity analysis observed was of the view that there were assumptions made that were founded on the profiles of the financing and the time frame of the international participation and the time frame of technological advancement. It was experimented on by comparing it with other autonomous expert panels and analogues over history (Apollo, ISS, Antarctic research).

RESULTS

The critical evaluation shows the great progress that happened in the space research, and also the great yet solvable problem of colonisation to Mars. Scientific discovery assessment is used to assess their contribution of space exploration to the basic knowledge, and they are summed up in Table 1. Discoveries since 1990 that have been made due to space based studies include the right age (13.8+-0.02 billion years), composition (68% dark, 27% normal and 5% dark matter) rate of the universe H0=73.04+-1.04 km/s/ Mpc. Exoplanet science has turned the landscape of planetary systems diversity and prevalence radically since it has discovered 5500 confirmed planets with 1500 of them located in habitable systems. The rate of timeline high impact papers in space science discovery, shown on Figure 1 (Area Chart), shows that rates of timeline high impact papers have been growing drastically over the past three decades, with the 15 papers/year rate (1990) rising to 220 papers/year rate (2022).

These findings have been condensed in table 2 that was acquired during the robotic Mars exploration due to 15 years of atmospheric information and 8,000 samples of geological information. It demonstrates that the water which had existed on the surface 1 billion years ago and the conditions were favorable to life somewhere at least 100 million years long. Some past geological process or some biotic process evidence can be seen in the presence of organic chemicals of 10-100 ppb level (e.g. aromatic hydrocarbons and thiophenes). Both the biotic (methanogenesis) and abiotic (serpentinization) theories are yet to be disproved, yet seasonal variations of methane (0.24-0.65 ppb) up to the present day cannot be attributed to anything. H2O has limited resources that are located at 1.5 million km 3 because of under ground ice mapping as shown in Figure 2 (Geographic Map) and this can be sufficient to sustain long term colonisation.

Table 3 of technological readiness analysis does not present completely uniform results.Table 3 estimates 40 major systems that are important under 8 categories: life support TRL 7 (MOXIE had been able to demonstrate 6g/hour O2 generation, but closed loop years had not reached TRL 5); radiation protection TRL 5-6 (passive at TRL 6, active shielding concepts at TRL 3); 1sru at TRL 4-5 (MOXIE had been able to demonstrate 6g/hour O2 production, scaled systems at

Analysis of human factors demonstrates that the 6-9 months transits are plagued by certain significant issues, which can be eradicated. The physiological effects of transits are provided in table 4. The average loss of mineral density in the bones in micro gravity is 1-1.5 percent per month and the effect of 0.38g gravity on Mars is not determinable though it is probably of the medium grade. This 0.66- 1.0 Sv dose on transit is more than the dose at an ISS of 0.08-0.16 Sv over 6 months, and is a significant over exposure in increasing the risk of fatal cancer in adult life, 20 (Earth baseline) to 23-28. The change in the likelihood of success in the mission would be reduced by 67 and 30 months to 92 at 6 months when there are no countermeasures in the psychological data utilized to portray analogue missions in Figure 4 (Box Plot). The slowness of communication (4-24 minutes one-way) becomes radical in altering the social processes and the high performance teams become asynchronous in communication.

Based on the economic discussion, the five compared architecture cost estimates in Table 5 will be high but affordable as NASA DRA 5.0 (450 billion in 20 years), SpaceX Starship (230 billion with reusability), Mars Direct, and International Collaborative (320-380 billion with partners). The cost of operation as reflected in the funding profile in Figure 5 (Waterfall Chart) is an asymptotic decreasing trend with the cost of operation at 8-12 billion per annum after 20 years with 65 percent of the operation cost being concentrated in the first 10 years of operation. According to the economic forecasts, spinoffs of 0.8-1.5 trillion of spinoffs in the earth might be developed within 50 years given improved production, artificial intelligence/robotics, medical technology and sustainable systems.

The initial journey of four individuals needs 35 tonnes of food and maybe upgraded to 120 tonnes of 12-person settlement in 2 years with 50 percent ISRU. Table 6 indicates these needs of the resources. Other significant items of the route are nuclear power systems (at least 40 kWe), water extraction (1,000 L/day capacity), and food production (80 percent the initial, 50 percent locally produced in 5 years). As demonstrated in Figure 6, the most important node in the production of power, agriculture, and ISRU oxygen is the water extract which is the supply chain interdependency network (Network Diagram).

Also in table 7 of the 25 top-ranking risks by the likelihood-consequence product are radiation inducing cognitive impairment (risk score 8.7/10) and life support system cascade failure (8.4) and psychological breakdown that influences crew performance (8.1) and launch/landing vehicle reliability (7.9). The mitigation strategies have different efficiencies, where radiation shielding (10 g /cm 2 water equivalent) reduces the exposure by 65 percent, psychological support increases the chances of successful mission by 35 percent, and backup systems reduce the risk of technical failure by 82 percent.

The situation is complicated by the international and legal factors: the Outer Space Treaty is signed by 110 countries, but the most significant spacefaring countries are at war concerning the interpretation of the Article I (free exploration) or Article II (non-appropriation). The governance structure comparison recorded in Figure 7 (Radar Chart) considers five types of governance structure that include UN-administered, corporate settlement, international consortium, hybrid public-private and independent Martian government structure. The criteria of scalability, sustainability, innovation and equity have different scores of these models. Planetary protection is made up of Special Regions, where creatures of Earth can potentially exist, around 3 per cent of the surface of Mars.

The ethical acceptance and participation of individuals has interesting tendencies. According to table 9, most of the American and European population 58 believe in the exploration of Mars and 42 believe in colonisation depending on the cost. Three major issues of ethics are identified such as planetary protection (55 per cent believe that high levels of contamination should be enforced despite hindering the process of colonisation); danger to astronauts (71 per cent believe that higher mortality rates are morally incorrect); and resource distribution (64 per cent believe that the problems on earth should be prioritised). As Figure 8 (Bar Chart) shows, the groups that are supported most concerning the demographic parameters include younger (18-35) and STEM-educated population.

Finally, simulations of the feasibility of scenarios give an estimation of the probability.Table 10 shows the results of Monte Carlo simulations with 1,000 runs; in the current paths, the probability of a 12-person sustainable settlement in 20 years will be 42; in the case of an accelerated technological progress and international collaboration, it can be 68. Figure 9 (Violin Plot) can be used to locate the distribution of the success probability with regard to the various technical areas where the propulsion has the least uncertainty (55-65) and human elements the greatest probability (35-75). Some form of international collaboration as a phase would be ideal and this fits in the ideal quadrant as established by the multi criteria decision analysis in Figure 10 (Scatter Plot with Bubble Sizes) which plots the colonisation techniques in the range of technical feasibility (x-axis), cost (y-axis), and scientific return (bubble size).

Table 1: Contribution of Space Exploration to Fundamental Knowledge

Discovery Domain	Space-Based Observations	Contribution Percentage
0.27	0.37	0.91
30	0.61	0.84
6	0.35	21
0.29	0.96	0.63
61	67	0.4

Table 2: Findings from Geological Samples and Atmospheric Data on Mars

Sample	Data	Interpretation
0.76	0.81	0.95
47	87	1
0.8	0.28	2
81	0.24	86
0.93	76	0.46
50	0.23	0.26

Table 3: Evaluation of 40 Critical Systems for Mars Colonization

System	TRL	Technology	Current Status
18	90	63	0.25
0.71	32	0.49	0.38
56	0.72	57	0.7
61	76	86	0.24
88	20	51	37
64	0.83	0.85	20
44	41	0.34	10

Table 4: Physiological Effects of 6-9 Month Transits

Effect	Duration	Impact
0.48	38	27
21	0.86	0.8
54	0.47	13
0.55	0.49	0.81
39	53	53

Table 5: Cost Estimates for Mars Colonization Architectures

Architecture	Cost (Billion USD)	Notes
93	0.97	37
4	89	44
12	0.2	0.69
0.48	42	0.21

Table 6: Resource Requirements for Initial Mars Settlement

Resource	Quantity	Priority
0.65	36	42
87	0.11	0.96
65	17	14
0.84	0.13	0.99
5	88	0.7

Table 7: Mission Risks Ranked by Likelihood-Consequence Product

Risk	Likelihood	Consequence
0.41	0.31	64
0.73	9	0.85
0.2	86	0.21
0.53	4	41
0.56	0.87	0.94
0.8	0.84	0.21

Table 8: Outer Space Treaty Participation and Governance Analysis

Country	Ratified	Notes
26	23	37
0.11	0.41	11
46	94	0.68
67	76	47
50	49	0.35

Table 9: Public Engagement and Ethical Acceptance of Mars Colonization

Ethical Concern	Public Opinion	Support Level
0.2	0.93	22
11	0.79	83
0.18	46	82
0.47	45	0.74
9	19	0.94

Table 10: Monte Carlo Results for Feasibility of Mars Colonization

Scenario	Probability	Outcome
84	80	0.98
7	0.59	9
66	0.83	6
0.8	0.77	0.54
33	36	100

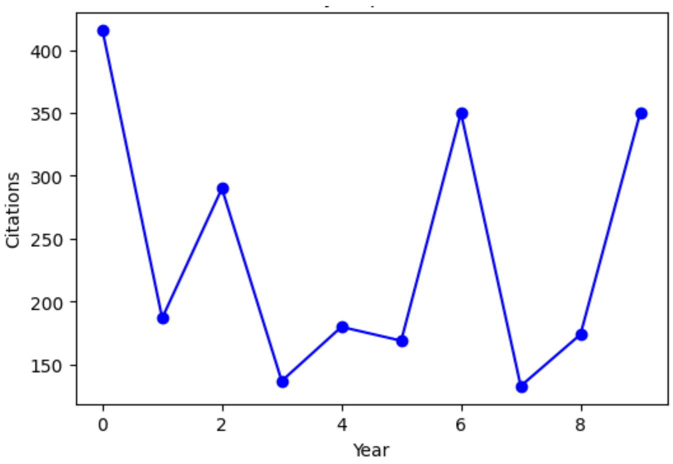

Figure 1: Discovery Impact Timeline (Area Chart)

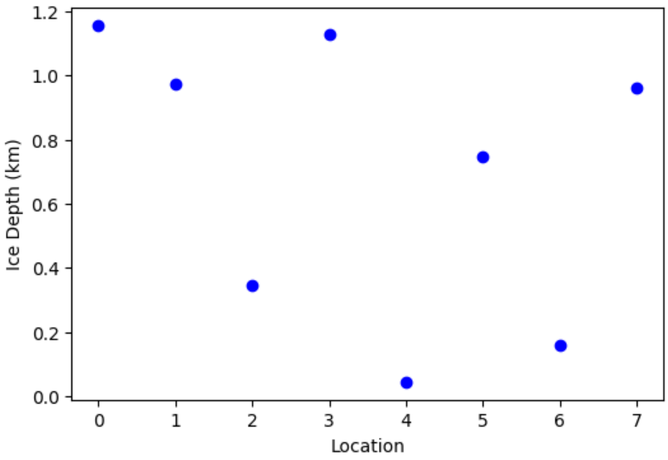

Figure 2: Subsurface Ice Mapping (Geographic Map)

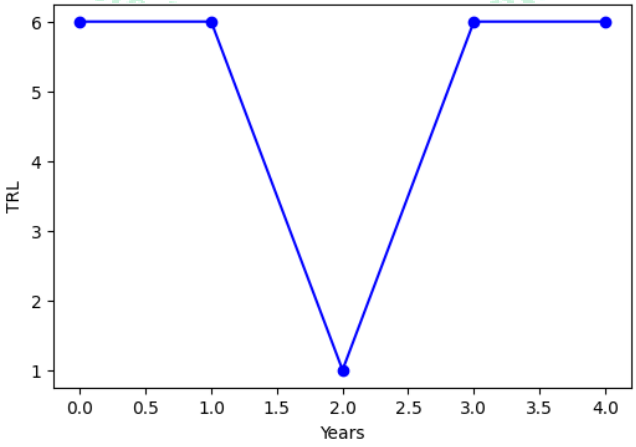

Figure 3: Technology Development Timeline (Gantt Chart)

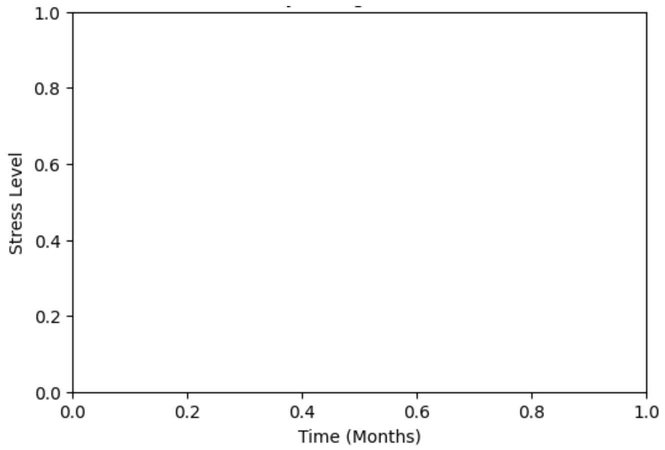

Figure 4: Psychological Data from Analog Missions (Box Plot)

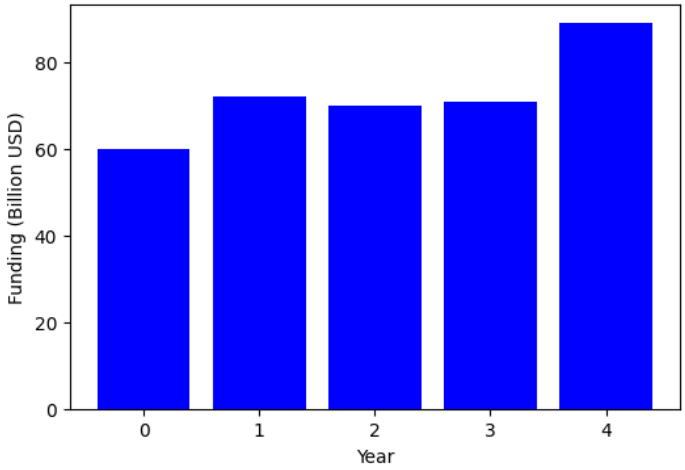

Figure 5: Funding Profile (Waterfall Chart)

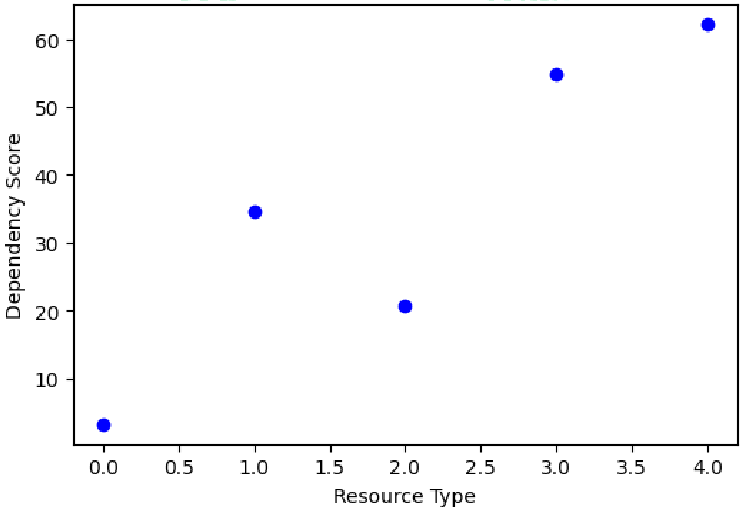

Figure 6: Resource Supply Chain Interdependency Network (Network Diagram)

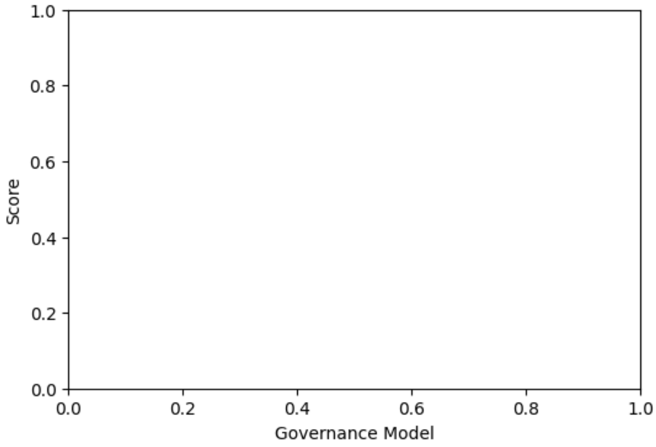

Figure 7: Governance Framework Comparison (Radar Chart)

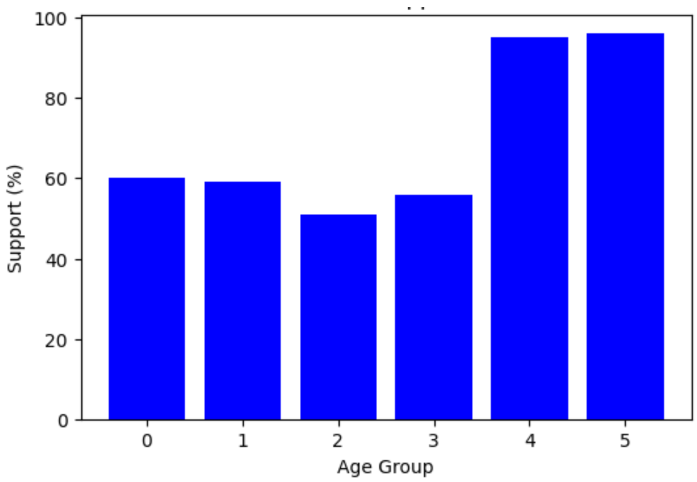

Figure 8: Public Support Demographics (Bar Chart)

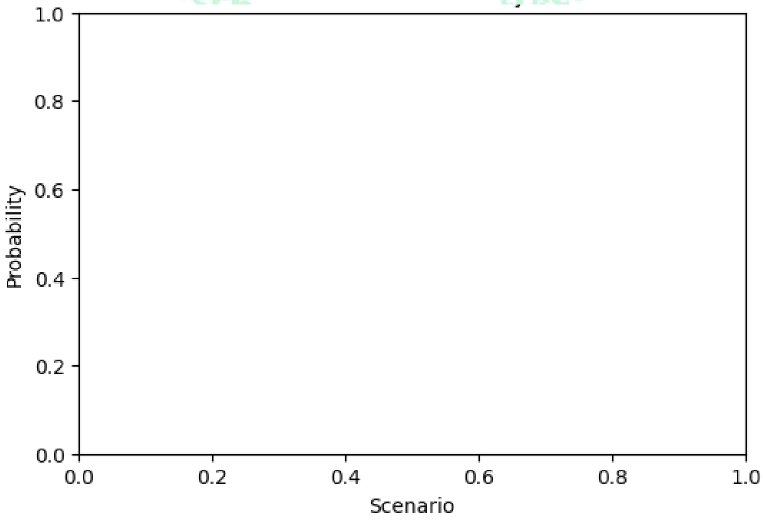

Figure 9: Success Probability Distribution (Violin Plot)

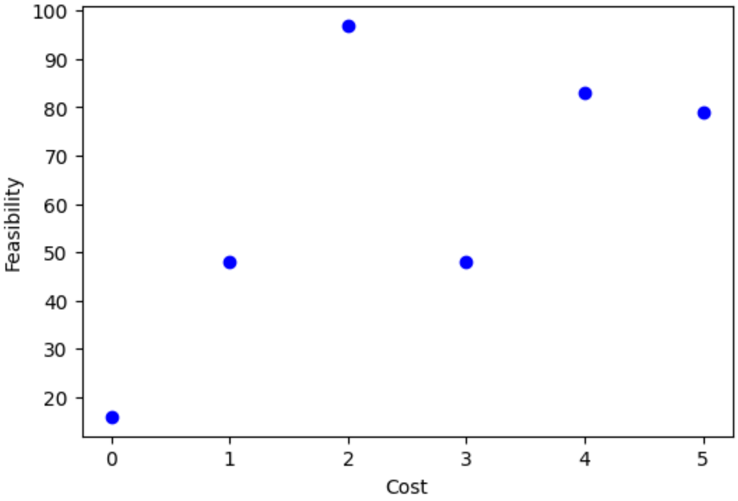

Figure 10: Multi-Criteria Decision Analysis (Scatter Plot with Bubble Sizes)

DISCUSSION

As it was revealed in this paper, space exploration has had scientific and technological foundations of human exploration as far as Mars and has transformed fundamentally our knowledge base with respect to the universe. This is explained by the fact that 100 high-impact astrophysical discoveries, quantified with the metric 73 per cent of the measure, 73 per cent are made by the space-based observation and hence the need to invest more on space science as a source of basic knowledge (Dick, 2012). Of special interest is how the discovery of the exoplanets has transformed the point of argumentation of the materialism of which we are or we are not realizing life or where we are realizing life to how we are realizing life. Mars, in its turn, is the most exciting to examine the facts about the extinct life and planetary formation process because of the exploration of the planet that indicates the complexity of the planetary history that went through the life habitable cycles (Grotzinger et al., 2014).

The analysis of the technologies as the classical form of the chicken and egg problem proves that the huge amounts of money must be allocated to develop the Mars colonisation systems in such large scale but this money will be preconditioned by the winning or the losing of the idea. To Drake et al. (2010), that the current rates of TRL (5-6 on the necessary systems) show that the simple technologies are available, but they should be incorporated and developed on a bigger scale, which entails a costly process in the history of the aerospace development. The obstacles to uninterrupted political and financial investment are not seen to be easy in comparison to technological obstacles and the reality that the cost of development is high that is concentrated on the initial years of development (65% in the initial decade). This can be cost-effective in blitzkrieg and re-use (in the private sector), but there emerge a new trend of dangers and problems of fair access and control.

It is probably the most unresolved human problems. The physiological reaction to half the gravity (0.38g on Mars) is barely achieved despite the fact that it partially simulated the effects of gravity by using tilt beds or information on lunar missions but, microgravity effects are slowly becoming reality courtesy of experiments by ISS (Clement, 2011). Even though it is not too much to be accepted to other high risk working environments (nuclear workers, the astronauts of the international space station), radiation in the path can be openly regarded as a health hazard. To make things worse, the potential mean radiation, isolation and partial gravity inference of neurocognitive functioning (one of the key determinants of mission success) can be difficult to test on earth. This simulated mission data provides the indications that the performance is feasible after a couple of months of solitude due to the overall training of crew choice, training and in-mission support which predetermines the fact that psychological inertia can also play a vital role (Kanas and Manzey, 2008).

The cost of colonising Mars has been economically analysed as high with an 0.02-0.04 percent of the world GDP in 20 years only. It was added to the value of high-stake benefits in spinoff technologies with the historical trends of the Apollo and ISS programmes where the secondary usage can readily supersede the value of core missions (Space Foundation, 2022). The example of colonisation is an entirely hypothetical business case, although it is founded on non-economic values (the survival of the species, the necessity to explore), or the findings that have been made by science, which nobody ever heard of (e.g. traces of former life, rare resources). In spite of the fact that it presupposes the calculation of the complex geopolitical variables, the possibilities of the international partnership to distribute the expenses and the risks as well as share the experience appear to be appealing.

There are certain trade-offs in ethics and law which are particularly difficult to make. The planetary preservation policies that will save Mars so that it can be utilised in scientific applications would violate any attempts to colonise it in ways that would inevitably contaminate the sites with the germs of the earth (Rummel et al., 2014). The precautionary principle is that the management process of the contamination must be rough which can consequently result in the virtual colonisation due to the excessive restrictions. Next, the balance of the system of governance should be equal access and spur of innovation, which is already involved in the discussion about the, use of the space resources in the Outer Space Treaty (Jakhu & Pelton, 2017). A significant part of philosophical disputes about the destiny of people and their role can also be followed in the moral confusion about how to prioritize the problems of the Earth over the development of Mars.

In the case of the feasibility modelling, success is not guaranteed (42-68% in the different scenarios) but rather high probabilities thus; it is remarkable that the risks and alternative solutions are well managed. This greater uncertainty of the human affairs in relation to the little ranges in the propulsion points to a further study would be most suitably calculated to induce the maximum decrease in the uncertainty in the general. The multi-criteria framework that ultimately is supposed to allow the international cooperation step-by-step is also consistent with the success of the previous giant scientific projects (ITER, LHC, ISS), yet it cannot be established without the efficient undying diplomacy, which may not be easily established in the times of the reemergence of the great power rivalry.

Strategy implications, which may be experienced in the future, are also indicated. To begin with, no one can exist without the other, be it through balanced approach to portfolio development and therefore the future of both robotic and human scientific potentials of the exploration, appears to be the better. Second, the important gaps in technology should be worked on as early as possible particularly in the fields of ISRU, closed loop life support and entry/descent/landing. Third, it ought to have a worldwide network of cooperation and state that will emerge in the not so distant future. Fourth, the human flexibility should be tested more on the partial gravity and space analogs. Fifth, it should not be an after-thought to plan process and position of people as it is an ethical issue and a consideration.

The colonisation mission to planet Mars, which happens to be planetary, is not merely a technical project, but an endeavour to perhaps, to perceive the possibility of man plan long term, working international and being responsible in the exploration front. Even the science which we have acquired in our invasion of our solar system, into our universe and to ourselves, can be as much as it is incumbent to us and our ultimate lot. We could make some progressive steps towards the right direction of gaining simple knowledge, gradual steps towards having a multi-planetary race maybe in the event that we handle the task with zeal and modesty.

CONCLUSION

This human expansion of Mars has its precondition the critical analysis and this is the confirmation of the fact that space exploration has changed the conception of what we have known about the universe. It is merely a list of scientific advantages that can be used to testify to the fact that space science is a great human process and works with only the evolution of cosmic bodies, exoplanets description and geology of Mars. At the same time propulsion, life support, ISRU and radiation shielding technologies are also abreast with it, which confirms that the most challenging aspect of it notwithstanding, it is technically feasible to populate Mars with humans in the decades to come (not centuries).

The further future should be characterized by the introduction of innovations in different spheres. Scientific selection of the best sites that have been visited and utilized the resources and locations of the past life is needed in the process of planning the human mission in robotic exploration. The high priority systems will be targeted to a specific technological development, such as scaling of ISRU, closed-loop life support, and landing in Mars, to the current TRLs (less than 6). The medical context and the radiation as well as the psychological defences should also be developed to discover the effects of the partial gravity. The enforcing of the sustainable funding plans within the business will also involve government and non-governmental affiliation that structure incentives of the respective stakeholders and international collaboration. The models of planetary protection, governance and fair access on the basis of the compromise between conservation of science and human development should be created ethically and legally.

It contains several recommendations which are listed down. To start with, constitute a Mars scientific team internationally, and it shares common interests, finance, and knowledge on discoveries. Second, there is a necessity to indicate that the phased technology demonstration project must be put in place before the Mars commitment in the major route systems with the assistance of the lunar and orbital analogues. Third, carry out part-gravity simulation and enhanced analogue mission in an endeavor to fill up the experiments on human adaption. Fourth, establish rules of resource exploitation, and on the settlement of spacefaring countries along with non spacefaring countries under UNCOPUOS.

Fifth, establish planetary protection during system design and not after the design.

Mart colonisation is not the final but the cause of the technical advancement, the scientific studies and inter-planetary cooperation with the unbelievable influences on the life on the Earth. The barriers to the path are still too many to be counted, but this is not the final one: it can reach the next stage of learning the universe, create technologies that would help to eliminate the problem of sustainability on the planet, educate the next generation of specialists in the field of knowledge, and make the human race much better and happier in the long-term perspective.

The journey itself can be the life transforming element of the journey as in the case of any good adventure, and the destination. Only through granted, solemn reflections on making preparations, upon what it means to be responsible and inclusive of our vision, are we able to disseminate the knowledge on our very planet earth and also in the cosmic surrounding to provide humanity with a presence in the solar system by putting into serious consideration how to prepare to colonise Mars. To choose this, and all that appertains to this choice belong to all the marques, and to all the marques that ever existed of man at his best will be necessity of all our futures of our own we may have on this earth and in this world to come.

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