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Multi-Level Challenges in a Long-Term Human Space Program. The Case of Manned Mission to Mars

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Abstract:
Yuri Gagarin has started the first time in human history the manned mission in space when his *Vostok* aircraft successfully achieved Earth orbit in 1961. Since his times, human space programs did not develop too much, and the biggest achievement still remain landing on the Moon. Despite this stagnation, there are serious plans to launch manned mission to Mars including human space settlement. In out paper, we are going to identify and discuss a couple of challenges that – in our opinion – will be a domain of every human deep-space program.
Keywords: Manned space program, mission to Mars, human space settlement, multilevel challenges.

1. Introduction

In our paper, we are going to discuss a couple of challenges that – in our opinion – are a domain of short-term and long-term manned space mission. Our analysis is supposed to be universal for any possible manned space mission. However, due to currently announced and realized arrangements, we focus on planned manned mission to Mars. We are going to identify and to discuss the following

challenges that are the fields of possible risks for such a mission. They include three following fields of risk: (2) rationale for manned mission to Mars, (3) legal challenges, and (4) medical, physiological, and psychological challenges.

Our paper is not a detailed study of mentioned particular challenges. This is rather a kind of roadmap that may be useful to show how complex and challenging is the idea of manned space mission to Mars at various stages of its development.

2. Rationale for Manned Mission to Mars

2.1. Political Challenges

We may start from enough obvious remark. Every space program when analyzed only in financial terms, must be rejected when compared with every action and policy focused on solution of any earthly challenge. Because today the main sponsors of space programs are public space agencies directed by politicians, political leaders decide about their budgets in the context of all available resources. Obviously, political leaders are prone to follow short-term perspective marked by political calendars of elections. History of Mars space programs in NASA is a good illustration how political and economic tensions affected and affect plans of long-term space programs [7].

One of economic challenges for every space agency is a tension between currently realized short-term and/or cheaper programs on the one side, and the idea of realization one, large and long-term space program, on the other side. Obviously, there are some long-term programs including unmanned missions that can be cheaper than relatively short-term manned mission to Mars. Space agency must make a risky and responsible decision in regard to its strategy. Focus on smaller, easier, and cheaper tasks – mostly when all of them include unmanned missions – makes possible avoiding of economic, political, and social risk. On the other side, such strategy opens space for its competitors who can win the next space race – manned mission to Mars. One big manned space program gives a chance but – when failed – takes a risk of collapse of all tasks realized by agency.

2.2. Human Mars Settlement as a New Homeland for Human Species

It is difficult to find efficient and reasonable justification for such risky and unpredictable task like manned mission to Mars, mostly due to the mentioned high cost and political reasons. In our opinion, there is only one theoretically strong argument that could be used to justify such a mission. We mean the idea of human space settlement as an attempt to look for new human base when further life on Earth will not be possible. On the one side, such kind of justification sounds rational. On the other side, we find this argument very weak due to the following reasons.

2.2.1. Internal Catastrophe

In regard to earthly catastrophes including atomic war, overpopulation, epidemics, or environmental pollutions, human base on Mars will not be any alternative solution. Firstly, we must assume that the mankind will be able to build successfully permanent base on Mars before any possible catastrophes on Earth will happen. Secondly, living on Mars will require permanent life support system. Such a system will be an obvious limitation for human liberty and activity, and it makes human life uncomfortable and risky. Such life conditions do not seem to be better and/or more comfortable than simultaneous life on post-catastrophe Earth. Thirdly, let us assume that both mentioned conditions will be fulfilled. Even in a such scenario, we find another challenge that makes successful human settlement on Mars unlikely. Human Mars base will not be self-sustainable at least through many years. Permanent supply chain from Earth will be necessary. Paradoxically, catastrophe on Earth that is here considered as an argument for human space base, will be simultaneously an obstacle and danger for such a mission. It is likely that the mankind threatened

by some kind of catastrophe on Earth will not be able to take care on any space program including such costly activities like sending humans and supplies to Mars.

2.2.2. External Catastrophe

Another kind of catastrophes refers to external factors that are independent on human activity. Among them we can identify short-term and long-term catastrophes. Relatively short-term catastrophes include asteroid impact on Earth. Such impact can destroy human life. However, Mars will not provide better anti-asteroid protection due to the fact that thinner Mars atmosphere will protect against asteroids in lower and weaker level. Long-term catastrophe means the death of Sun that will occur probably in 5 billion years. Even if human species will survive next 5 billion years, life on Earth and possible human life on Mars will be destroyed. In such a scenario, only human settlement beyond the solar system could provide shelter for humanity.

2.3. Private Companies and Commercial Exploration of Space

Commercial exploration of space is currently getting increased. One of current examples is participation of commercial companies in cargo supplies for International Space Station and launching satellites. This is only small part of possibilities that space offers for private companies. There are discussed such possible fields of commercial exploration of space like space (mostly asteroid) mining or space tourism. Space tourism includes mostly journey on Low Earth Orbit (LEO) but – dependently on possibly increasing technological advancement – it may include journey on Moon, Mars, and/or other objects. Besides journeys, space tourism includes also hotels that may be built on LEO and/or Moon and Mars. Obviously, we should be aware that – as Chris Impey points out – space tourism will be a hard task also due to required extreme health conditions that currently are available only for astronauts [6, p. 76].

We may assume that humans will explore commercially space in all possible ways if such exploration will be technologically possible and will provide more benefits than costs [1]. There are no reasons that could exclude such a scenario. However, the current challenge for highly advanced commercial exploration of space are high costs and high risk. It seems that successful commercial exploration of space requires not only joint effort of many private companies but, first of all, the real chances for success. Successful space program is a long and incremental task that requires many years of effort that is continued from generation to generation. Such long-term scenario makes this effort highly challenging for private companies that are focused on relatively short-term benefits. For this reason, public space agencies that are focused on realization of public missions not oriented on financial profits, seem to be necessary investors. Public space agency is just a guarantee of continuation of space program. However, the problem is that commercial activity is not oriented for the good of the entire mankind. It would be hard to assume that public space agency funded from public sources will support and guarantee commercial activity. We find here financial and political vicious circle. Private companies are not interested in costly space exploration when such activity is still too risky and too unpredictable. Public space agencies that could provide support and guarantee continuation of space program, cannot finance orbital hotels and space tourism.

We argue that the idea that commercial exploration of space opens room for development of human space settlement program and will drive space development [4], is overestimated. This is possible but highly improbable scenario. Advocates of commercial space exploration argue that space research programs including manned space missions will evolve as some kind of side-effects of commercial activities. This scenario is based on assumptions that private space investors will be prone to invest more and more in space exploration. For instance, they may start their space investment in hotels on LEO, and they will develop it until hotels built on Moon and Mars. However, one catastrophe and one failure connected with paying high compensation may finish private space enterprises. In contrast to them, public space agencies are definitely more resistant to

such failures. It seems that at the current, technologically definitely undeveloped stage, public space agencies are the unique guarantee and supporter of long-term space program.

3. Legal Challenges in a Mission to Mars

We want to underline that the issue of space law is a broad field that includes a lot of topics: from current earthly regulations including, among others, legal rules in particular parts of ISS or space patent law [14], to possible future legal systems and forms of governance in human space settlements [2], [3]. In this subsection, we argue that the question of space law applied to future manned mission to Mars and human Mars base is not a trivial task. It will be a big challenge due to the fact that Mars will be beyond any efficient earthly execution. First of all we have consider, that probably the real long-term Mars space project will be organized surely by several space agencies and maybe private companies, so that means at the same beginning several quite different legal systems. We can see that all together project participants will have to face the first challenge of cooperation on the field of legal rules. If we look back to the history of mankind, there was not a similar situation. Usually one nation (country) "discovered" a new lands brings there first of all – own legal system. New times (space challenges) required new rules, of course firstly that will required also common political decision of states involved in space agencies.

Within this broad set of legal challenges during Mars mission, we identify at least the three following ones: (1) current earthly regulation of space exploration and space research development, (2) human attitude towards Mars, and (3) legal rules within and between colonies on Mars.

3.1. Space Exploration and Space Research Development

As we discussed it before, for obvious financial reasons space exploration versus space research development debate is mostly a domain of political discourse. However, this issue involves important legal challenges. We find here at least two fields that should be expressed and protected by space law.

Firstly, increasing potential of private companies including Space X requires strict legal regulations. One of issues is an attempt to demarcate the border between field of opportunities and rights of private and public companies. In situation when private companies get advantage over public agencies, they should follow strict rules in regard to use and to explore space – from LEO to Mars. Another challenge arises here. To what extent private companies can be restricted by law in situation if they will be the unique agents available to explore space? To what extent their activities can be subordinated to attempts and goals of the public?

The second challenge is a need of legal regulations of possible areas of space activities. It should include also possible technologies that can be developed and applied. Consider, for instance, nuclear energy as a possible propulsion. We can easily predict possible the worst scenarios that can happen when nuclear energy will be applied to space exploration. One of issues is the scope of technologies and solutions that could be accessed by private companies. One of questions is if we can permit private companies to use all possible sources of energies including nuclear one. It is worth remember about the following environmental context that can be associated with future space exploration and human space expansion. If future life on Earth will be threatened by some catastrophes and dangers, highly advanced space industry – private or public – can use its technological advantage to control and/or to subordinate the entire Earth or at least some of its poorest part. Such a part may be easily exploited. One of the worst of possible scenarios is aggression of that agency that gets technological advantage over others. Phil Torres discusses future scenarios of wars between various civilizations in space [13]. We may find parallel in shorter time perspective when various space agencies and/or private companies can use their technological advantage to subordinate and exploit others.

3.2. Human Attitude Towards Mars

This topic is currently discussed mostly by philosophers. They discuss it in ethical terms and they consider, among others, the value of Mars itself, human rights to explore and exploit space, human attitude towards any forms of life on Mars (for instance, any possible microbial life) and the risk of contamination Mars by humans [8], [9], [10], [11]. There is no doubt that we need strict and precise legal rules that will protect and shape ways of living and exploration of Mars. "The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies" enacted in 1967 was the result of space race between the US and Soviet Union. Its enacting was affected by recent space achievements and occurred two years before the first Moon landing. The further space expansion was soon stopped. The US, mostly due to war in Vietnam, drastically limited NASA budget and declined the plan of permanent human base on Moon [6]. The current period in human space program is a period of stagnation and even recession. The unique human activity from many years in space is only service at International Space Station. Despite this stagnation, we should be aware that in near future space exploration may increase mostly due to commercial interest in space activity. Then, mentioned Treaty enacted in 1967 should be updated to the current challenges.

3.3. Legal Rules Within and Between Colonies on Mars

Currently planned manned mission to Mars becomes a new space race. The first country who will prepare successful manned mission on Mars, will be in a privileged position. Such country will have right to establish his own rules. However, the bigger challenge is a risk of conflict between competitive space agencies when the first successful country will occupy the best part of Mars. It is worth to have in mind that not all parts of Mars or Moon surface are available for human exploration and human settlement. Differences refer to such parameters like landform or ice and mineral resources. Privileged access to particular location is of high value. In case of Mars, it may provide access to resources, or protect against strong and long dust storm. In case of Moon, good location means lower energy consumptions when a given base will have access to peaks that provide "eternal light" (exposition to the Sun light almost through the entire year) [5]. The challenge is what kind of institutional solutions would work. Possibilities include independent missions, joint collaboration, or even international superior institution that would be a central authority for space [1].

4. Medical, Physiological, and Psychological Challenges

In this last subsection, we want to enumerate possible challenges associated with human physiological and psychological conditions. We are not going to discuss technical details appropriate for medicine, biology, or psychology. We are going to emphasize possible ethical, legal, and social challenges possibly affected by human deprivation in space.

4.1. Ethical and Moral Concerns on Human Enhancement

We argue that the program of human enhancement, philosophically associated with transhumanism, should be applied to space research program. We mean opportunities of genetic and pharmacological modification of future deep-space mission astronauts. Such modification may refer to make human body and psyche more resistant to unfriendly space environment. Program of human enhancement may go step further and may mean artificial selection of people to receive desirable futures.

4.2. The Value of Human Life

We predict that the value of human life will be overvalued. It is very likely that in space, it will not be the value of life rooted in Western, democratic, liberal tradition. It seems that space mission will be purely goal and success oriented, not human oriented. Value of individual human life in hard space environment will be difficult to protect in dangerous situations. Such a risk may be a domain of manned space mission to Mars from the beginning.

Another kind of challenges may appear in a long-term perspective. Human reproduction on Mars is necessary for permanent long-term settlement. Let us assume that despite the risk of failure affected by cosmic ray and microgravity [12], human reproductive processes on Mars will be possible technologically and physiologically, and they will work correctly. Due to hard living conditions strongly dependent on life support system, strictly limited possibilities of migration and mobility, and probably highly limited resources, human sexual and reproductive life may be limited and controlled. We predict that social engineering and artificial sexual selection focused on preference for particular, carefully selected traits in future offspring, may be a domain of social and bioethical life in human settlement on Mars.

5. Conclusions

For obvious reasons, the current concerns of space program planners and associated scientists are focused on technological and medical challenges. The first, still hard criterion is to build safe means of interplanetary transport, and to protect astronauts against all environmental challenges in space. We cannot start manned mission without providing these fundaments. However, as we wanted to show, the manned deep-space program including human settlement affects plenty of various challenges at all stages, from the current planning including coping with ethical and legal considerations or political and financial responsibility, to such topics like human reproduction on Mars and the risk of social engineering.

References

1. Bruhns, S. & J. Haqq-Misra. A pragmatic approach to sovereignty on Mars, *Space Policy*, 38, 2016, pp. 57-63.
2. Cockell, Ch. S. (ed.). *Human Governance Beyond Earth. Implications for Freedom*, Springer, 2015.
3. Cockell, Ch. S. (ed.). *Dissent, Revolution and Liberty Beyond Earth*, Springer, 2016.
4. Elvis, M. Let's mine asteroids – for science and profit, *Nature*, 2012, 485, p. 549.
5. Elvis, M., T. Milligan & A. Krolikowski. The peaks of eternal light: A near-term property issue on the moon, *Space Policy*, 38, 2016, pp. 30-38.
6. Impey, Ch. *Beyond: Our Future in Space*, New York, London: W. W. Norton & Company, 2015.
7. Lambright, W. H. 2017. Relay leadership and long-term policy: The case of Mars, *Space Policy* 42: 1-7.
8. Milligan, T. Common origins and the ethics of planetary seeding, *International Journal of Astrobiology*, 15 (4), 2016, pp. 301-306.
9. Milligan, T. & J. S. J. Schwartz. *The Ethics of Space Exploration*, Springer, 2016.
10. Persson, E. *The Ethics of Space Exploration*, Conference Paper, 2015.
11. Persson, E. Ethics on an uninhabited planet, In. K. Szocik (ed.), *Human factor in a mission to Mars*, Springer, 2019 (*in preparation*).
12. Szocik, K., R. Elias Marques, S. Abood, A. Kędzior, K. Lysenko-Ryba & D. Minich. Biological and social challenges of human reproduction in a long-term Mars base, *Futures*, 100, 2018, pp. 56-62.
13. Torres, P. Space Colonization and Suffering Risks: Reassessing the "Maxipok Rule", *Futures*, 100, 2018, pp. 74-85.

14. Wachowicz, M. E. & M. Bury. Space technology transfer problems in the context of protecting the space heritage, *Space Policy*, 2017, http://dx.doi.org/10.1016/j.spacepol.2017.08.001.