

How can engineers pave the way for humans to transcend as a potential extraterrestrial civilization?

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"Space exploration is not just about reaching the stars. It's about pushing the boundaries of human potential and engineering the future." Currently, only a handful of nations expend on space exploration, with the Global Space Budget recorded as \$546 billion, which accounts for merely a fraction of the Global Economy¹. The gravity of the situation is understood by few, even when it has a significant impact on the future of human existence. Furthermore, with the extensive scientific developments in the past century, have humans genuinely reached a state of maturity? Referring to the views of Nikolai Kardashev, we are in the midst of integration as a Type 1 civilization². This stage is characterized by a technical adolescence, where our advancements are significant yet still predominantly confined within the boundaries of our own planetary system.

In the grand scheme of cosmos, our steps are merely too small to leave a tangible impact on the future of our species. To elucidate, only a dozen individuals have ever walked on the moon's surface, and the red planet remains untouched by organic matter³.

This is where engineering plays an essential role. Some perceive it as magic, but it is just the art of controlling the forces and materials of nature for the benefit of the human race⁴. Since the era of space race, engineers have meticulously ensured structural efficiency and integrity, according to trajectories and other requirements. In contrast to Scientists, engineers have worked on fuel-efficient models, navigating pragmatic challenges with limited resources. This reminds me of the Mars Orbiter Mission by the Indian Space Research Organization⁵, which I gathered through a film named "Mission Mangal."⁶ Although I had seen rocket launches on television before, they never showed me the complexities of the work behind the scenes. The narrative not only piqued my curiosity but also

¹ Space Foundation, 'The Space Report', *Space Foundation*, 2023, <https://www.spacefoundation.org/2023/07/25/the-space-report-2023-q2/>, (accessed 28 December 2023)

² M. Bartels, 'The Kardashev scale: Classifying alien civilizations', *Space.com*, 2021, <https://www.space.com/kardashev-scale>, (accessed 28 December 2023)

³ M. Kaufman, *First Contact, Scientific Breakthroughs in the Hunt for Life Beyond Earth*, 2011, p. 80, <https://www.simonandschuster.com>, (accessed 21 December 2023)

⁴ H. Gordon Stott, 1907, http://www.ieeeehg.org/wiki/index.php/Henry_Stott, cited in J. Shelton, 'What Engineers do', *theengineeringcommons*, 2014, <https://theengineeringcommons.com/episode-57-what-engineers-do/>, (accessed 28 December 2023)

⁵ Indian Space Research Organisation, 'Mars Orbiter Mission Profile', *isro*, 2014, https://www.isro.gov.in/mission_mars_orbiter_mission_profile.html, (accessed 25 December 2023)

⁶ Mission Mangal. Dir. J. Shakti, India, 2019

inspired me to delve into the fundamental shortcomings of the industry and sparked a stream of ideas in my mind.

My anticipation is that nanotechnology in engineering can redefine space exploration. It cuts costs by making payloads lighter and therefore enabling spacecrafts to travel further. This approach was exemplified by the recent Mangalyaan mission⁷ and can be extended to more gigantic projects. In addition, there may be advances in material science leading to novel materials that can overcome existing space travelling barriers.

Thinking about these possibilities, I recall Abraham Maslow's hierarchy of needs⁸, and Charles Darwin's Theory of Natural Selection⁹. It's about envisioning a world where our technological advancements align with our survival instincts. Imagine a world where we do indeed reach a suitable exoplanet. Could humans adapt to the environment the planet propagates? The necessity of genetic engineering and artificial intelligence in adapting to alien terrains cannot be overstressed. Human beings could be genetically modified to become more resilient to various conditions present on planets such as radiation or low gravity¹⁰. Adaptive AI systems could help design space suits which may protect astronauts under various atmospheric conditions.

Engineers have the responsibility of reconciling utopian aspirations with pragmatic realities as we stand at the threshold of this new frontier. It is a pilgrimage that goes beyond space reaching out for its own stars as well as appreciating what we could potentially turn into if given a chance outside this world where we were born.

⁷ ISRO, 'Mars Orbiter Mission Profile', *isro*, 2014, https://www.isro.gov.in/mission_mars_orbiter_mission_profile.html, (accessed 25 December 2023)

⁸ A. Harold Maslow, 'A Theory of Human Motivation', *academia*, 1943, https://www.academia.edu/9415670/A_Theory_of_Human_Motivation_Abraham_H_Maslow_Psychological_Review_Vol_50_No_4_July_1943, (accessed 25 December 2023)

⁹ C. Darwin, *On the Origin of Species, by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*, 1859

¹⁰S. Morgan "Genetic Engineering." New York: Evans Brothers Press. 2003. Print.

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