Can Deep Altruism Sustain Space Settlement?

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Abstract Space settlement represents a long-term human effort that requires unprecedented coordination across successive generations. In this chapter, I develop a comparative hierarchy for the value of long-term projects based upon their benefits to culture, their development of infrastructure, and their contributions to lasting information. I next draw upon the concept of the time capsule as an analogy, which enables a comparison of historical examples of projects across generational, inter-generational, and deep time. The concept of deep altruism can then be defined as the selfless pursuit of informational value for the well-being of others in the distant future. The first steps toward supporting an effort like space settlement through deep altruism would establish governance and funding models that begin to support ambitions with intergenerational succession.

1 Introduction

The prospect of human settlements on Mars is becoming increasingly technologically feasible. Efforts by SpaceX, Deep Space Industries, Planetary Resources, and other private space corporations now fall in rank with government space agencies such as NASA, ESA (European Space Agency), JAXA (Japan Aerospace Exploration Agency), IRSO (Indian Space Research Organization), RFSA (Russian Federal Space Agency, or Roscomos), and CNSA (China National Space Administration). Many of these corporate and government entities are developing successive plans to visit asteroids or Mars within the next few decades [Seedhouse 2010, NASA 2015], which are beginning to show prospects for economic gain in addition...
to scientific return. These recent developments all suggest that Elon Musk’s vision of human civilization becoming a “multiplanetary species” \cite{Musk2017} could be realized in the coming centuries.

Technological advances that enable humans to settle on another planet or extract resources from planetary bodies must be matched by parallel advances in civilizational ethics. A lack of moral progress risks the danger of perpetuating the problem of the commons and other harmful colonial attitudes as human civilization ventures into space. Land use policies on Mars must account for the finite extent of resources while also respecting the non-appropriation principle of the Outer Space Treaty that restricts national claims to sovereignty \cite{Haqq-Misra2015}. New governance models, either by modification of the Outer Space Treaty or by the creation of new international institutions, can promote solutions to the equitable sharing of Mars and other space-based resources \cite{Ehrenfreund2015, Cockell2015, Haqq-Misra2016, Bruhns2016}; however, implementation of any such idea would require commitment and cooperation from most of the major space-faring nations as a minimum. Nevertheless, establishing sustainable space settlements will require that humanity begin advancing its ethics in tandem with technology, prior to the arrival of the first humans on Mars.

Innovative approaches to fundraising, charitable giving, and other means of financing can further enable long-term and intergenerational initiatives such as space settlement. Corporations like IBM, Lloyd’s of London, and the Swedish National Bank all hold experience in maintaining business tradition and financing ventures over decadal timescales and longer, while organizations like the Rockefeller Foundation and the Carnegie Corporation have promoted the advancement of knowledge through charitable contributions for more than a century. Crowdsourced models could also provide sustained funding for space settlement or other long-term scientific initiatives, such as the search for extraterrestrial intelligence (SETI). Specialized financial products could be tailored toward individual scientific objectives or development goals, such as a lottery bond debt security, which could provide a regular stream of income to ambitious projects while also providing consumers with a direct return on investment \cite{Haqq-Misra2018}. The success of commercially-driven space settlement will inevitably require tremendous financial foresight that could benefit from a donor, group, or crowd willing to invest in the distant future of humanity.

In this chapter, I define the concept of “deep altruism” as ambitious human efforts with high informational value across millennial timescales that do not provide direct benefits to the initial benefactor. I begin by drawing upon the analogy of a time capsule, which represents an abstraction of a long-term human effort with the intention of providing value to future generations. I then define a relative value scale based upon cultural, structural, and informational motivations. I next consider historical and contemporary examples of the completion time for projects across generational, intergenerational, and deep time. I conclude by discussing the feasibility of establishing a space settlement based upon a deep altruistic funding model.
2 Time Capsules

The time capsule serves as an example of a long-term effort with altruistic intentions, which highlights some of the unique challenges in approaching altruism across deep time. The Oxford English Dictionary defines “time capsule” as “a container used to store for posterity a selection of objects thought to be representative of a particular moment in time.” Time capsules represent an attempt at preserving value from a particular time in history for the benefit of other people in the future.

The concept of a time capsule today usually refers to an object constructed with intention, in order to purposefully commemorate a particular time by preserving the value of its memory. Archaeological discoveries also provide scholars today with new information, but such discoveries rarely encounter concerted efforts of cultures from the past attempting to communicate with us today. The first deliberately constructed time capsule, the “Century Safe,” was featured at the 1876 World’s Fair in Philadelphia, which established the modern tradition of intentional time capsules.

Time capsules can further be distinguished by the intended future audience, which corresponds to the length of time that the capsule must remain preserved. “Target-dated” time capsules specify a particular length of time (e.g., a century) when the capsule will eventually be opened; “deliberately infinite” time capsules are preserved in perpetuity until future generations eventually decide to open the capsule [Jarvis 2002]. Both types of capsules can suffer from the lack of complete information, such as including toys or trinkets without explanation of their significance, which limits the value of the objects to historians. An ideal time capsule constructed today, to maximize future value, should include a “full set of cultural-technical information drawn from the whole of human world culture” with a “10,000-year target span date” [Jarvis 2002]. Other features for an effective time capsule include the existence of redundant copies to protect against loss, as well as electronic access to the contents in order to increase transparency and maintain interest.

A time capsule with a target date that approaches millennial scales or longer serves as an illustration of a general altruistic effort that operates over deep time. Short-term time capsules with a target date on the scale of decades could provide direct benefit to people who were living when the capsule was sealed. A longer-term time capsule with a target date on the scale of a century would not necessarily benefit the individuals who sealed the capsule, but their grandchildren or great-grandchildren would likely benefit from the value of opening the capsule. A time capsule with a target date on a deep time scale of millennia or longer would represent a genuine altruistic effort, as the individuals or community that sealed the capsule would likely have no direct connection to the people opening the capsule. A time capsule motivated by a sense of deep altruism would seek to provide relevant and contextual information to humanity’s distant descendants.

The problem of preserving the contents and knowledge of a time capsule over millennia poses similar challenges to other long-term projects attempted across history. The settlement of space, including the development of permanent human habitats and even the terraforming of an entire planet, will require unprecedented cooperation and coordination across deep time. As with the time capsule, any long-term
effort like space settlement must maintain informational relevance and sustain operations across generations in order for its future value to be realized.

3 Cultural, Structural, and Informational Value

In order to further unpack the concept of deep altruism, I define a framework for comparing the relative benefits derived from long-term human projects. The investment cost in a long-term project is not necessarily a reliable indicator of its realized value, as seemingly inexpensive items may show themselves to be priceless when retrieved by its future recipients. Apparent success of a project today is also not a reliable indicator of future value, as human civilization will likely evolve its infrastructure and preferences across the next millennium. Instead, I draw upon value theory to establish a comparative scale for long-term projects based upon the ultimate type of value realized by future generations. Value theory is a broad approach in ethics for defining relative degrees of goodness, benefits, or other desirable features, which enables comparison of the relative value of objects or actions even if further quantification is difficult. For this analysis, I develop a specific hierarchical approach toward valuation of long-term projects based upon cultural, structural, and informational value. This value hierarchy is summarized as a pyramid chart in Fig. 1 with culture at the base, structure in the middle, and information at the apex.

Fig. 1 The hierarchical relationship between cultural, structural, and informational value provides a framework for comparing the relative value of long-term human projects.

The first level of cultural value refers to a long-term project that is primarily concerned with aesthetic factors, the preservation of tradition, and other features central to the group’s identity. A project motivated by cultural value would seek to enable future descendents to experience similar, or greater, appreciation of the originating culture. Cultural value resides at the foundation of the value hierarchy...
because culture is inherent to all human activities. Thus, the remaining levels in the value hierarchy necessarily include culture in addition to other value considerations.

Structural value is the second level, which describes a long-term project that is primarily concerned with the preservation of materials, buildings, or other engineering feats. Structurally motivated projects require diligent maintenance in order to preserve the integrity of the original construction for future descendants. Many structures are intended primarily for utilitarian purposes, such as shelter or storage; the long-term preservation of such structures can be accomplished by active efforts by governments, individuals, or private organizations. However, some structures are more strongly linked with culture, such as religious temples, burial sites, or ancestral shrines. The value hierarchy therefore includes an intermediate level on the culture/structure boundary to account for structures that are maintained by time-tested cultural traditions.

The final level of informational value represents the realization of culture and structure to provide long-lasting benefits to human knowledge. A project motivated by informational value would seek to build upon knowledge traditions to enable future generations to solve major problems. Informational value provides tools and methods that enable solutions, whereas cultural value only provides a means of preserving information. Some projects involve significant engineering and management innovation in order to support the acquisition of knowledge, as is increasingly required by “big science” projects in physics, astronomy, and materials science. The value hierarchy therefore includes an intermediate level at the structural/informational boundary to account for physical structures that support efforts at achieving new knowledge.

This three-tiered hierarchy of cultural, structural, and informational value provides a relative scale for ranking long-term human projects across history. The purpose of such a relative value scale is not to judge the historical merits of any of these efforts; instead, this approach enables an analysis of the factors that enable the successful preservation of each type of value across deep time.

4 Completion Time

History is abundant with examples of long-term projects conducted across generational, intergenerational, and deep time scales. The completion time for such projects is defined as the amount of time between the initial conception of the idea and its final execution, analogous to the duration of a time capsule. Some projects include a target date for completion after a finite amount of writing, construction, or analysis—similar to a target-dated time capsule. Other projects are deliberately maintained in perpetuity, with no intention to cease operations, comparable to a deliberately infinite time capsule.

A range of historical and contemporary examples of long-term projects is shown in Fig. 2 with completion time on the horizontal axis and value on the vertical axis. Fig. 2 is intended to be an illustrative, rather than comprehensive, collection
of projects conducted over generational, intergenerational, and deep time with cultural, structural, and informational value motivations. This visualization of successful long-term projects enables a comparison of the factors required for sustaining altruistic activity over deep time.

Fig. 2 Examples of long-term human projects plotted as a function of total completion time versus value, where the value is categorized as cultural, structural, or informational.

4.1 Generational Time

Projects that occur within a single generation have a completion time between about 10 to 100 years. Generational time efforts often have a target date for completion, usually with the intention of finishing within the lifetime of the project’s originator. The Lord of the Rings trilogy by J. R. R. Tolkien was written in stages over a period of 12 years, which represents a decadal-scale work of cultural value that still persists in completed form today. The Great Pyramid of Giza is an example of a work of structural value, which took about 20 years to build. Informational projects can also have a finite duration, such as the 30-year construction time to build the Large Hadron Collider, the world’s most powerful particle accelerator. Likewise,
the Human Genome Project required 13 years of collaborative research to obtain a complete mapping of all human genes. Successful generational time projects with a finite target date usually allow the originator to personally experience the full value upon completion, even if the final product persists for much longer.

Some generational projects are deliberately infinite by design and could extend into longer intergenerational timescales. The Rolling Stones is the longest continuously-performing rock band, founded in 1962 and still performing with some of its original members; conceivably, the franchise could persist beyond the lifetime of the individual band members. One of the longest-running intentional communities in the US is Sunrise Ranch, operated by the Emissaries of Divine Light since 1945. The golden records on board both Voyager spacecraft, launched in 1977, contains encoded knowledge about Earth and its inhabitants that will continue drifting through interstellar space indefinitely. The ozone hole is slowly recovering as the human use of chlorofluorocarbons (CFCs) has declined, but projections indicate 70 years or longer before the Antarctic ozone layer recovers to pre-1980 levels. Deliberately infinite projects necessarily begin at the generational scale, but if they are successful then they will continue beyond the lifetime of the originator to be tended by the next generation.

### 4.2 Intergenerational Time

The completion time for intergenerational projects is about 100 to 1,000 years. Intergenerational time efforts may have a goal or objective but not necessarily a reliable target date for completion. The time between the writing and canonization of the New Testament was about 350 years; although the text has been faithfully preserved, the original authors of most of the New Testament remain unknown. Many cathedrals, such as St. Peter’s Basilica in the Vatican, took a century or longer to construct, while the Angkor Wat temple complex in Cambodia was built in stages over a period of 400 years. The Tower of Pisa took 199 years to build in three stages, showing evidence of sinking with the completion of each floor. The Chichen Itza building complex of the Maya took about 400 years to construct, which remains a draw for tourists today. Many intergenerational structures and cultural artifacts still provide value for people today, even if for different purposes than intended.

Other intergenerational projects have maintained deliberately infinite operations, with no defined point of completion. The Library of Congress is one example of a robust infrastructure that has sustained the acquisition and cataloging of human knowledge for over 200 years. with the 150-year old Foreign & Colonial Investment Trust holding the record for being the longest-running investment fund. Educational institutions such as the University of Bologna and Oxford University have managed to sustain their structures and operations for nearly a millennium. Institutions that manage to maintain deliberately infinite operations across multiple generations, while successfully adapting to change, will eventually approach the threshold of deep time.
### 4.3 Deep Time

A project that operates within deep time has a completion time of 1,000 years or longer. Deep time efforts must contend with dramatic shifts in geopolitics, changes in the Earth system, and other factors that remain less volatile at shorter timescales. Structures such as Stonehenge were constructed in stages over about 1,500 years, perhaps with a general goal but likely no target completion date. The Great Wall of China was built, extended, and repaired by multiple dynasties over about 2,000 years, with the goal of protecting the northern border from invading armies. Finite duration projects that operate over deep time represent long-lasting organizations that were able to maintain culture and engineering tradition over the course of drastic historical changes.

Deliberately infinite deep time projects require careful attention by successive generations in order to preserve knowledge that would otherwise be forgotten. Unlike structural value, which can persist even if the founding culture becomes extinct, cultural value can be lost if not preserved through written and oral tradition. The Ficus Bonsai Tree at Crespi, Italy, is among the oldest in the world and has received daily care for the past 1,000 years. Similarly, the genealogy of Confucius has been dutifully preserved for 2,500 years, enduring through numerous dynasties and political revolutions. Such deliberately infinite efforts at preserving culture seem likely to continue for the foreseeable future, as long as people continue to recognize their value.

Few, if any, human ambitions have successfully managed to realize informational value across deep time. Contemporary efforts to enable the human settlement of space represent a deep time ambition to achieve informational value. Space settlement is an infinite duration project that will likely be developed in stages, with an idealistic goal of enabling self-sustaining human populations that no longer require support from Earth. The timescale for achieving an initial human presence in space may be generational, but any long-lasting space settlement must successfully traverse deep time in order to demonstrate its autonomy. Even more audacious ideas to terraform a planet like Mars, so that it could sustain plant life and a breathable atmosphere, represent a deep time effort with a finite target date; however, transforming an entire planetary system would take 10,000 years or longer of patient monitoring in order to reach the desired climate state. If any such plans for the permanent human settlement of space actually do begin to take shape, then they will represent the first intentional effort at pursuing informational value across deep time.

### 5 Deep Altruism

I can now revisit the definition of deep altruism, drawing upon the relative value scale for long-term projects and the discussion of completion time. The word “altruism” is defined by the Oxford English Dictionary as “disinterested or selfless concern for the well-being of others, especially as a principle of action.” In the con-
text of long-term projects over deep time, altruism refers to selfless concern for the well-being of others in the distant future. The preservation of cultural tradition can include altruistic elements, but such efforts do not necessarily foster new methods of systematically increasing total well-being. Conversely, altruistic pursuit of informational value can expand knowledge and enable solutions to problems that significantly improve the quality of life. Deep altruism can therefore be defined as shown in the box below.

**Deep altruism** is the selfless pursuit of informational value for the well-being of others in the distant future.

The assortment of projects in Fig. 2 show a lack of examples with informational value and millennial completion time, although such an approach is necessary for the daunting task of settling space. However, many projects beginning today are motivated by altruistic intentions, with target dates that approach deep timescales. The Clock of the Long Now is being constructed with the intention of keeping time for 10,000 years; the clock is being funded by Bezos Expeditions and currently resides on land owned by Jeff Bezos. The Letters of Utrecht is a collective poem carved into cobblestones along the city’s streets, with a new letter added every Saturday. The Letters of Utrecht began in 2012 and is intended to continue in perpetuity—or as long as the citizens of Utrecht permit. A record-setting organ performance of “As Slow as Possible” composed by John Cage is underway at the St. Burchardi church in Germany, with the first note beginning in 2001 and the piece reaching a finale in 2640. Although all of these efforts presently have been able to secure enough resources to maintain operations, they are still in the initial generational phase where the project originators are still alive and involved. The long-term success of these and other altruistic efforts will require effective succession between generations in order to transition into intergenerational and deep time.

Why would an individual or organization choose to engage in deep altruism? Reciprocal altruism features in many instances of biology, as natural selection pressures can operate against individuals who choose selfish or cheater behavior in cooperative groups [Trivers 1971]. Non-reciprocal altruism seems to be a unique feature of humans (and possibly a few other primate species), with a less obvious explanation for the evolutionary benefits of selfless concern for even complete strangers. Understanding non-reciprocal altruism remains an ongoing area of research, with some analyses suggesting that social distance can correlate to expectations of reciprocal altruism [Brinkers & den Dulk 1999, Takahashi 2007]. Others find that a fraction of a population may be inclined to act with non-reciprocal altruism, even if the majority chooses otherwise [Johannesson & Persson 2000]. Deep altruism similarly features an extreme degree of non-reciprocity, with no direct benefits to the originator—who may even be long forgotten by the future recipients of the completed effort. Musk and Bezos represent wealthy individuals who aspire to leverage their resources toward bold ambitions that they will not personally see to conclusion. Perhaps they hope to secure their names in history through such grand investments,
but possibly they are also motivated by the desire to improve human civilization’s capabilities of intentionally cooperating across intergenerational and deep time. A benefactor acting out a sense of deep altruism requires a vision for the species that extends beyond their own life; such a person may be motivated by the desire to alleviate suffering in the world, to increase the sustainability of civilization, or other global objectives that remain beyond the capability of any individual or generation to solve. Altruism in general, and deep altruism in particular, may be a uniquely human response to the problems elicited by civilization itself. Selfless action for the well-being of others across deep time might be one of the only available approaches for building a better long-term future for humanity.

6 Conclusion

Deep altruism remains a viable option for supporting human ambitions to settle space, as long as the initial benefactor can effectively transition the management, leadership, and vision of the effort to subsequent generations. Deep altruistic projects have a duration that is effectively infinite, as the succession of operations across generations is more critical to success than estimating a completion date. Any effort based upon a deep altruistic model must effectively communicate the vision that inspired the founder, and likewise must establish a secure source of funds that can also persist across generations. Wealthy individuals and institutions could conceivably finance such ventures, as long as they consider the benefits to the distant future as an adequate justification for investment today.

From the perspective of space settlement, which necessarily must operate with deep time in mind, the antithesis to deep altruism can be approximated as “deep egoism.” A mindset fostered by deep egoism would assess the value of long-term investment by its propensity to benefit self, kin, colleagues, and descendants over others. The calculated return on investment for some asteroid mining ventures is predicted to exceed trillion of dollars; although these profits may not be realized by today’s investors in asteroid mining technology, this conventional funding model would shunt the resulting wealth to the hands of individuals or organizations intended by the first investors. A long-term effort at extracting space resources for the purpose of building corporate or government wealth could be another approach to improve humanity’s ability to operate over long timescales. It is important to note that deep egoism could conceivably sustain long-term efforts such as space settlement. For-profit entities face their own internal or external pressures to continue sustaining operations as long as they remain profitable; such pressures can drive innovation and allow companies to adapt to changing market pressures and new technology. Deep egoism could even motivate efforts across deep time and will likely be a significant driver of the near-term human exploration of space. Deep egoism resonates more strongly with modern capitalist ideals, although such an approach would risk failure if it is unable to continually provide a return on investment.
Can Deep Altruism Sustain Space Settlement?

Humanity can take steps toward enabling altruistic efforts over deep time scales. Government and private granting agencies could develop competitive funding programs with decadal and longer performance periods in order to promote intergenerational pursuits of informational value. Wealthy individuals and organizations also hold the resources to establish their own long-term efforts by planning for intergenerational succession from the start. Crowdsourcing provides yet another approach for the general public to engage in supporting long-term efforts, with tools such as online crowdfunding and distributed consensus decision-making models providing the foundations for crowd-driven deep altruism. Striving toward informational value across intergenerational timescales will pave the way for extending such pursuits into deep time.

Space settlement will unfold in a piecewise manner, likely by a combination of government and private actors with a range of motivations. Commercial interests remain an important driver of the near-term space economy and could be a significant factor in developing the physical infrastructure required for space settlement. But deep egoism alone may be insufficient to sustain space settlement across millennia. If humanity genuinely intends to develop permanent settlements on Mars and in space, then it will inevitably be forced to develop new institutional governance models driven by deep altruism.

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