Project Hyperion Design Competition

An Interstellar design challenge

CONTENTS

(...)

Humanity has overcome the great sustainability crisis in the 21st century and has transitioned into an era of sustainable abundance, both on Earth and in space.

Humanity has now reached the capacity to develop a generation ship without major sacrifices.

An interstellar starship flies by an icy planet in a nearby solar system. Going beyond the classical examination of the problem of interstellar propulsion and structural design, for a voyage lasting multiple centuries, ***what might be the ideal type of habitat architecture and society in order to ensure a successful trip?***

© Midjourney/Yazgi Demirbas Pech

INTRODUCTION

A generation ship is **a hypothetical spacecraft designed for long-duration interstellar travel,** where the journey may take centuries or millennia to complete. The idea behind a generation ship is that the initial crew would live, reproduce, and die on the ship, with their descendants continuing the journey until reaching the destination.

This type of ship is often envisioned as a **self-sustaining ecosystems, featuring agriculture, habitation, and other necessary life-support systems to ensure survival across multiple generations.**

Project Hyperion works on a **preliminary study** that defines integrated concepts for a generation ship. The study aims to provide an assessment of the feasibility of crewed interstellar flight **using current and near-future technologies.** It also aims to guide future research and technology development plans as well as to inform the public about crewed interstellar travel.

© Midjourney/Yazgi Demirbas Pech

TEAM COMPOSITION

Teams have to be multi-disciplinary. Each team must have:

// At least one architectural designer
// At least one engineer
// At least one social scientist
(sociologist, anthropologist, etc.)

* These are flexible denominations, please submit a short bio and team organization description

OBJECTIVE

The team shall design the habitat of the generation ship, including its architecture and society (See Guideline no.1 for further details).

The habitat of the generation ship and its subsystems, shown in Fig. 1 “The system to be designed”.

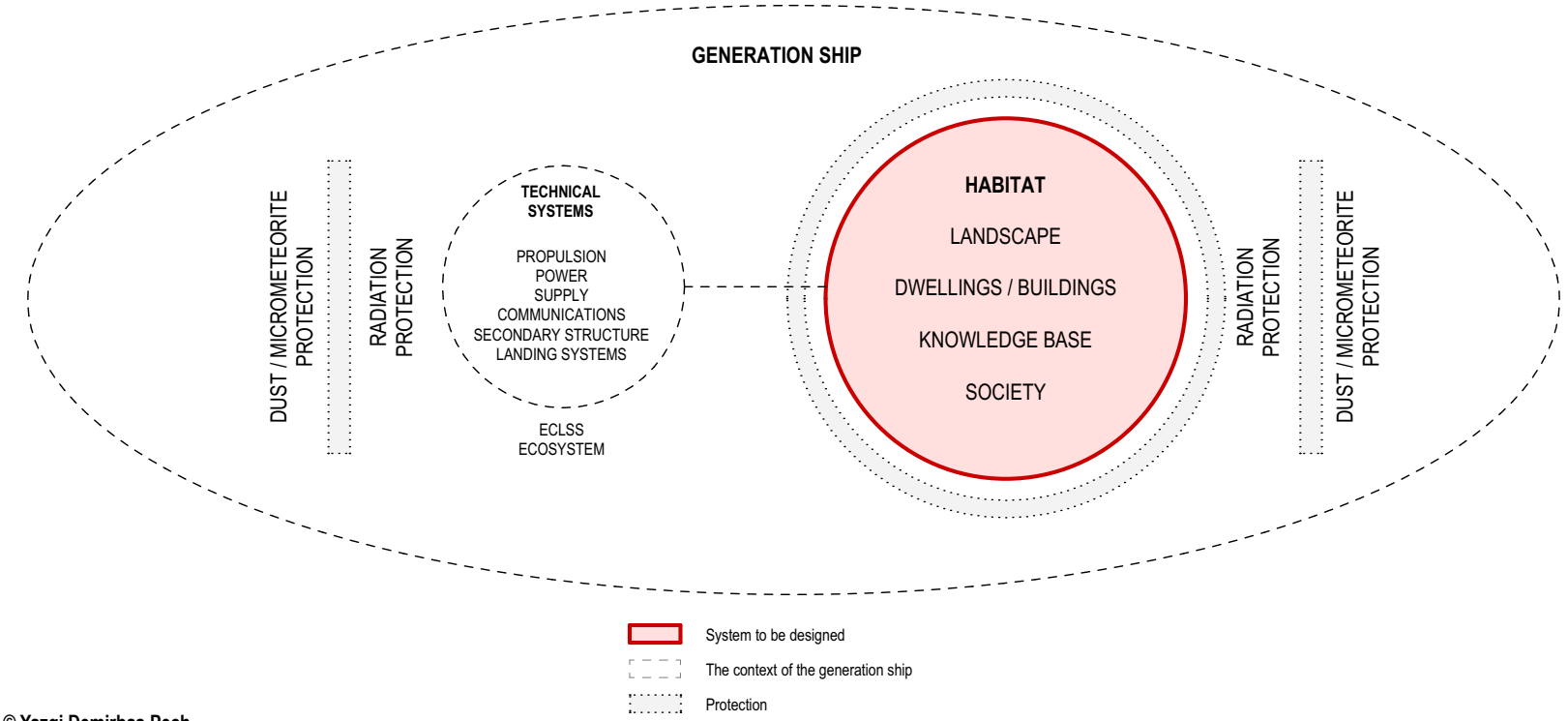


Fig. 1 : The System to be designed

BOUNDARY CONDITIONS

1 // Duration
The mission is designed to span 250 years, from launch to arrival at the target star system, with spacecraft achieving velocities of of a few %c to reach the nearest stars.

2 // Destination
The generation ship's target is a rocky planet equipped with an initial artificial ecosystem, established by a precursor probe or through panspermia methods. The environment requires no significant genetic or biological adaptations for human survival.

3 // Gravity
The habitat will provide Earth-equivalent gravity through artificial means, such as rotation. Some areas within the habitat will accommodate reduced gravity conditions for specific purposes.

4 // Atmosphere
The habitat will maintain atmospheric conditions similar to those on Earth, ensuring breathable air and stable environmental pressure.

(Refer to the ECLSS Guideline for further details).

5 // Radiation protection
Comprehensive radiation shielding will protect inhabitants from galactic cosmic rays and other space radiation hazards.

(Refer to the ECLSS Guideline for further details).

6 // Technologies
All onboard technologies must meet a minimum Technology Readiness Level (TRL) of 2.

(Refer to the ECLSS Guideline for further details).

7 // Impact protection
The habitat will be fortified to safeguard against micrometeoroids and interstellar dust impacts.

(Refer to the ECLSS Guideline for further details).

8 // Internal architecture
The architectural design should incorporate flexibility, allowing modifications such as reconstructing dwellings to adapt to evolving needs.

(Refer to the Architectural Guideline for further details).

>>>

© Midjourney/Yazgi Demirbas Pech

9 // Society size

Designed for 1,000 ± 500 people, ensuring stable living conditions for the mission duration.

10 // The society's structure

The society onboard will make selections along key cultural invariants, including:

// Language
// Ethics
// Social Roles
// The Supernatural
// Styles of Bodily Decoration
// Family Structure
// Course of Life Stages
// Reproductive Behavior
// Food Preferences
// Aesthetics
// Ultimate Cosmic Postulates

(Refer to the Social Guideline for comprehensive details).

11 // Essential Resources

The habitat must guarantee access to fundamental necessities, including clothing, shelter, and basic goods, for the entire journey duration.

12 // Means for knowledge transfer

Defined means of knowledge transfer will ensure continuity of expertise and education. The society will address potential knowledge loss compared to Earth, a challenge exacerbated by the reduced population size.

(Refer to the Knowledge Transfer Guideline for comprehensive details).

13 // Mass Optimization

The habitat's overall mass will be minimized without compromising safety, functionality, or reliability.

14 // Reliability and Redundancy

The habitat's systems will maintain reliability over the mission duration through robust design and redundancy, ensuring uninterrupted operation for 250 years.

REGISTRATION PERIOD

Competition announcement : 1st of November 2024

Registrations until: 15th of December 2024

Phase 1 Deadline : 2nd of February 2025

Phase 2 Deadline : 4th of May 2025

Winners Announcement : 2nd of June 2025

Q & A PERIOD

Until the 15th of December 2024

Q & A CONTACT ADRESS

info@i4is.org

PARTICIPATION FEE

· 20$ participation fee for registration

CASH AWARD

· 1st: $ 5000
· 2nd: $ 3000
· 3rd: $ 2000
· 10 honorary mentions

© Maciej Rebisz/Michel Lamontagne

DELIVERABLES FOR PHASE 1

A3 Project Booklet
Maximum 30 pages

It shall contain :

// Sketches, 3D renderings of the habitat interior and exterior
// Plans, sections, 3D diagrams that best describes the project (Scale is to decide by the team)
// Technical diagram describing the different components, subsystems, societal structure, etc.
// Evaluation criteria satisfaction matrix
// First order mass budget
// A short descriptive text of the project (1000 words max) Key design decisions shall be explained, including which alternatives and trade-offs have been considered.

** Participants are encouraged and will be supported in submitting their work to a journal for publication.

© Midjourney/Yazgi Demirbas Pech

DELIVERABLES FOR PHASE 2

A3 Project Booklet (Revised), Maximum 40 pages

A0 Poster: Vertical Orientation, max 200 mb, containing:

// 3D renderings of the habitat interior and exterior

// Plans, sections, 3D diagrams, that best describes the architectural and technical aspects of the project
(Scale is to decide by the team)

// Architectural detail drawing on the scale of 1/20 from a part of the project that best describes the design and material choices

// Technical diagrams describing the different components, subsystems, societal structure, etc.

// Power budget

EVALUATION CRITERIA

A // Architectural Evaluation Criteria

Logical integration of form, function, and aesthetics (Architectural Quality): Competitors must elucidate how the chosen volumes' forms functionally or aesthetically align with their core concepts.

Flexibility and modularity: Given the ship-city's multi-generational use, the modularity of designed spaces holds significance. Competitors must elaborate on the reasons and methods for incorporating flexibility and modularity into their designs.

Innovation & Technology: These factors are pivotal, and their influence on architectural design must be clearly defined.

Graphic quality: Deliverables should be presented in clear and comprehensible architectural graphic design.

B // Technical Evaluation Criteria

Gravity: The habitat shall provide Earth gravity via artificial gravity via rotation but parts of the habitat can have reduced gravity.

Protection: The habitat shall provide radiation protection (predominantly protection from Galactic Cosmic Rays) as well as micro meteorite and interstellar dust protection.

ECLSS: The habitat shall provide environmental control and life support: How are essential physical needs of the population provided? Food, water, air, waste recycling. How far is closure ensured?

Ecosystem: The ecosystem in which humans are living shall be defined at different levels: animals, plants, microbiomes.

Mass: The mass of the habitat shall be as low as possible.

C // Social Evaluation Criteria

The design must address the fact that interstellar voyages would be multigenerational. Both biology and culture must be accounted for on such a timescale. Design criteria include:

// Realistic multigenerational design considering the departure, travel and arrival population

// Capacity for the biocultural system to adapt to change over time

// Commentary on some expected changes to biology and culture over multiple generations

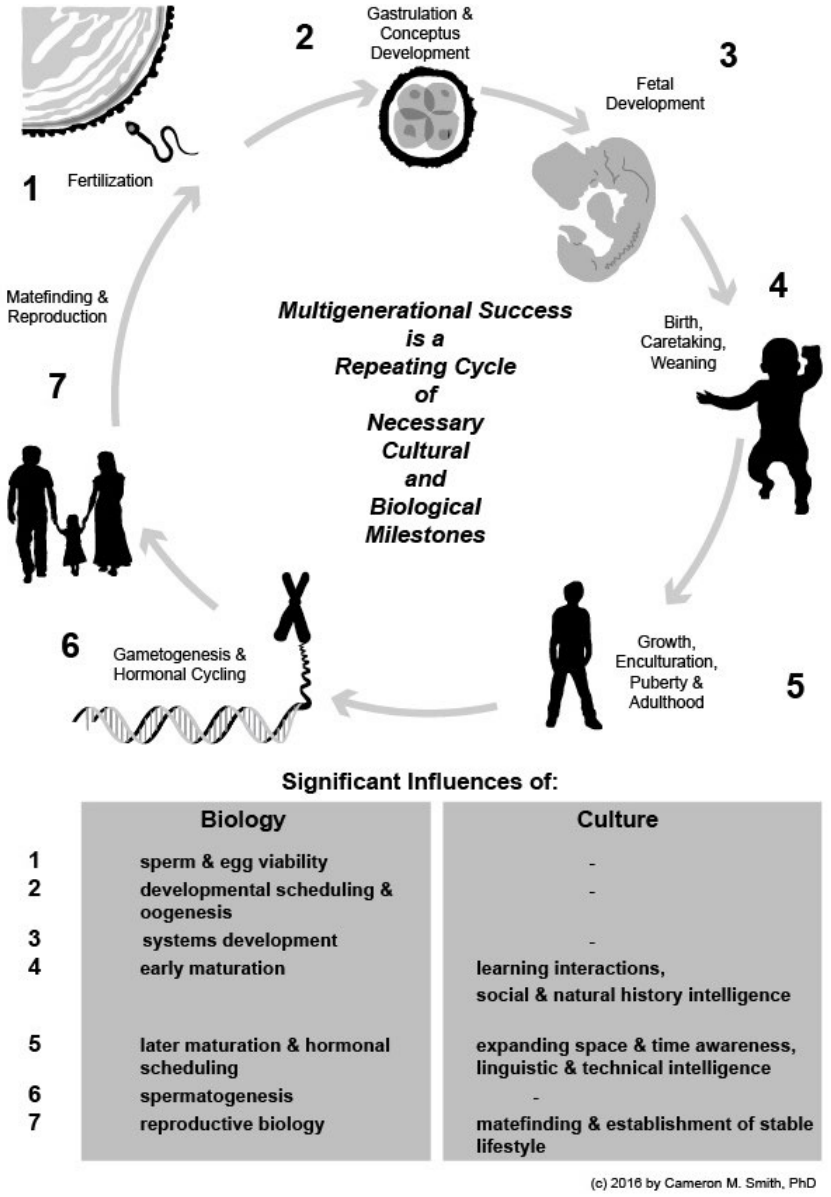


Fig. 2 : The challenges in maintaining biocultural health over multiple generations

ORGANISATION TEAM

Andreas Hein
Aerospace engineer

Yazgı Demirbaş Pech
Architect, Illustrator

Dan Fries
Aerospace engineer

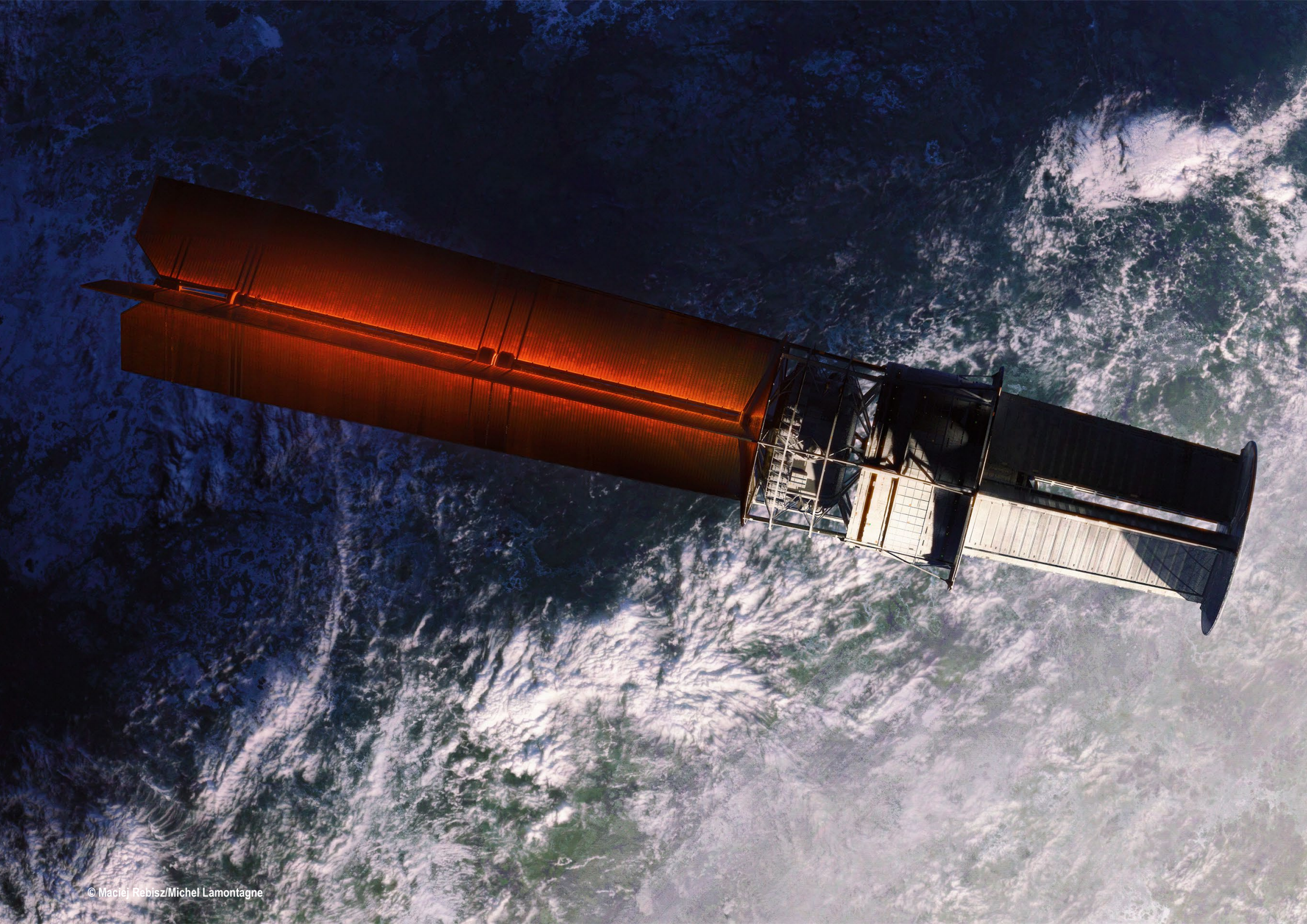
Michel Lamontagne
Illustrator, Designer

Cameron Smith
Anthropologist

Maciej Rebisz
Concept Artist

Steeve Summerford
Landscape Architect

Good luck, Ad Astra!


© Maciej Rebisz/Michel Lamontagne