Working towards A1 Report

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WEEK 6

Extra-/Terrestrial Architecture Graduation Studio

Planning

Towards A1

Week 8 Dec	Finish excel with room requirements, start making bubble diagrams
Week 15 Dec	Last week before holiday: **Define the RQ, scope, methods and theoretical framework.** Also optimize bubble diagrams.
Week 5 Jan	First draft of A1 report requirements, floorplan and volume drawings based on the optimized bubble diagrams
Week 12 Jan	Refining of main concepts and drawings so far. Draft of A1 presentation
Week 19 Jan	Week of A1. Finish presentation and report draft for the A1

Problem Statement

Define the problems

- Define the problems
- Find literature to support this and explain the problem
- Eventually also aim to tackle these problems in the sub questions of the RQ

https://bsmedia.business-standard.com/_media/bs/img/article/2019-07/18/full/1563434814-8966.jpg

Problem Statement

Transportation Costs

- Expensive to launch rockets
- Price/kg has decreased with reusable rockets
- Building materials are heavy

In Situ Resource Utilization (ISRU)

poses a solution by reducing the need for transporting materials from earth

https://upload.wikimedia.org/wikipedia/commons/thumb/d/d1/Falcon_Heavy_Demo_Mission_%2839337245145%29.jpg/960px-Falcon_Heavy_Demo_Mission_%2839337245145%29.jpg

Problem Statement

Hostile Environment

- Abrasive lunar dust
- Moonquakes
- Micro meteorites
- Radiation
- Solar wind
- Long lunar nights
- No atmosphere
- Temperature fluctuations

https://bsmedia.business-standard.com/_media/bs/img/article/2019-07/18/full/1563434814-8966.jpg

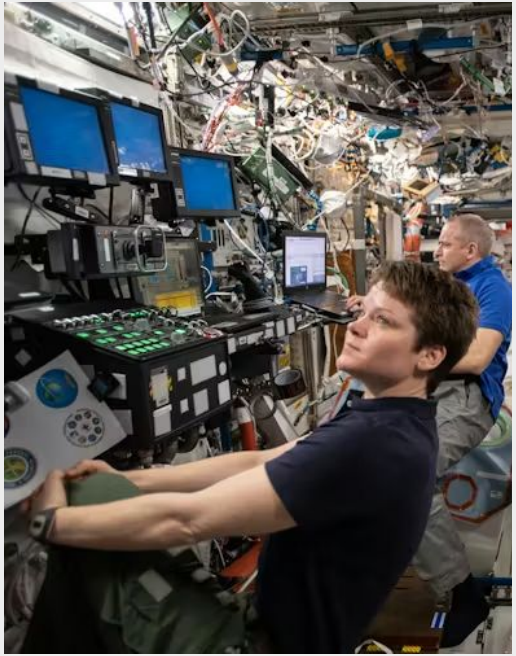
Lava Tubes

poses a solution by creating a protective cover from the environment in combination with the shelter provided by the habitat

Problem Statement

Mental Health

- Stuck with the same people
- High stress environment
- Away from family and home
- Little privacy



Biophilia

poses a solution by adding more greenery and reminding people of earth. Biophilic design can improve mental health.

https://images.theconversation.com/files/290398/original/file-20190831-166009-vom760.jpg?ixlib=rb-4.1.0&q=45&auto=format&w=754&fit=clip

Relevance

Why is this topic urgent/important?

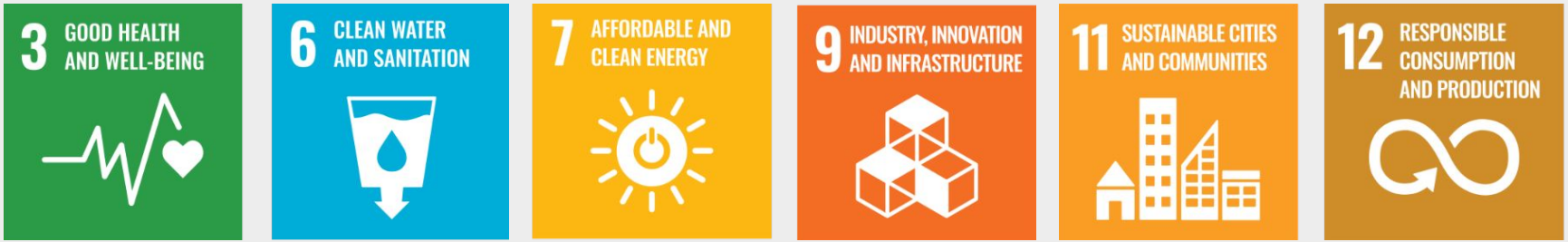
- Artemis missions I → IV are taking us to the moon in the coming years
- The project is a stepping stone in the larger journey to eventually colonise Mars

Not only relevant for space…

- Any innovations done in space could have its knowledge transferred for earth applications
- UN Sustainable Development Goals

Relevance

Relevant UN Sustainable Development Goals



Find the SDGs that are relevant to your project and use them as a narrative guide →
This can help justify its relevance outside of space exploration as well

Objective & Motivation

Objective

- To design a functional, safe and effective ISRU lunar habitat
- To explore biophilia and 3D printing
- To create a habitat not just for surviving but also living
- To contribute to the study of future space habitat designs
- Help innovations in different UN SDGs

Motivation

- Personal interest in space
- 3D printing is still relatively underutilized in architecture → I want to explore the potential
- Cool to be on the cutting edge of future developments
- Biophilic design is transferable to projects on earth as well

Research Question

“How can **biophilic design** principles be adapted to a lunar lava tube habitat using **ISRU 3D-printed** architecture to support astronaut **mental health** and **well-being**?”

Sub-Questions

- What is biophilic design?
- What is ISRU and why is it important for lunar base development?
- How can 3D printing be leveraged for biophilic design?
- How does biophilia improve mental health and wellbeing?
- What are the challenges of living on the moon?
- To what extent do lava tubes provide protection against the moon's environment?
- How can computational design and topology optimization be applied to the structure to get a more biomorphic design?

Scope

TEAM SIZE	6 person team, rotate 3 at a time for knowledge transfer	**LOCATION**	South pole → Shackleton
MISSION TYPE	Longer term research missions on the south pole of the moon	**MATERIAL**	3D printed lunar regolith
TIMELINE	First lunar base already established. Now in the longer term stay phase.	**BUILD**	ISRU 3D printing - laser sintering?
DESIGN	Different aspects: human-centric, biophilic, circular, computational, advanced manufacturing, life support systems, etc.		

Methods

- Case study examples
- Literature
- Different types of Computational Design and Optimization
- Workshops and experiments

Methods

SECTION SUB HEADER OF RELEVANT METHOD

Example picture or case study

Have each subsection explaining a different method of design like circularity, computational, advanced manufacturing, human-centric design, etc. It is important to explain what the specific method is, the literature and perhaps a case study that support it, and why this specific method is relevant to your project

E.g. we did a workshop where we designed a lighting panel and used advanced manufacturing through the use of a robotic arm. The reliance on robots for building is something we will implement when building on the moon. This is supported in the literature as seen in...

Theoretical Framework

- Relevant literature?
- Taking biophilic design principles as the framework?
- For now it is quite linked to the method
  - Each method you use may have its own framework and supporting literature.
  - E.g. advanced manufacturing wil look at a very different framework than human-centric design

Summary

Clear:
- Problem statement
- Relevance
- Objective & Motivation
- RQ and sub-RQ

Less clear:
- Scope (need to define better)
- Methods
- Theoretical framework