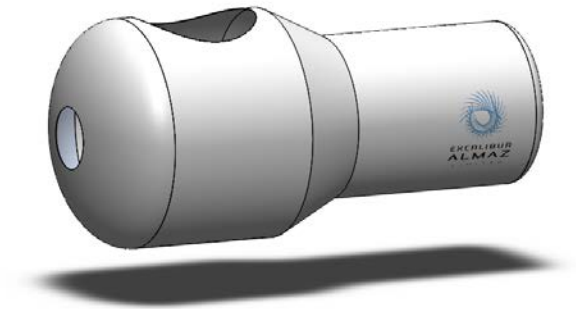
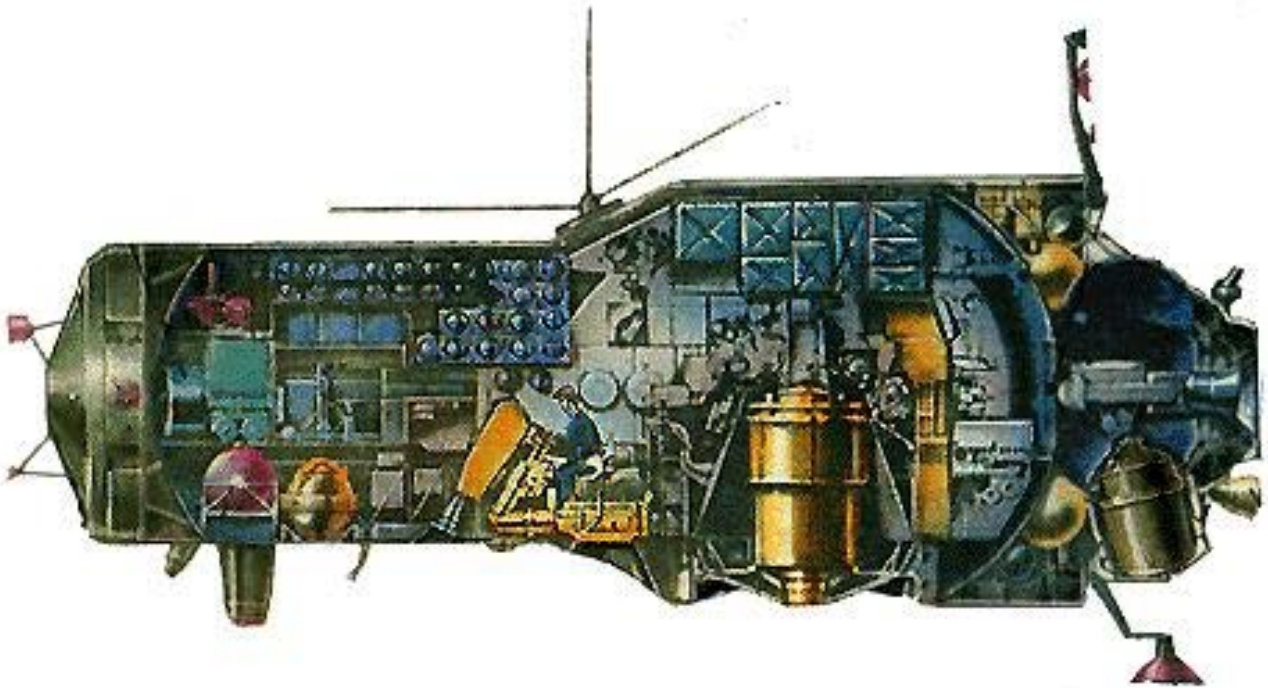


SALYUT

SPACE STATION

Anastasia Prosina, Austin Kulhanek, Ayda Uraz, Tamalee Basu



Historic Salyut Space Station used for international reconnaissance to be redesigned for commercial use

FRAMING THE PROBLEM

VISION

USERS

CONOPS
USER EXPERIENCE

DESIGN DRIVERS

VOLUME STUDIES

ZONING/DESIGN CONCEPT

RESEARCH STUDIES

EVACUATION/EMERGENCY

NEXT STEPS

AGENDA

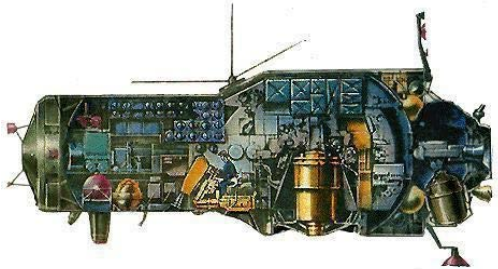


Photo courtesy of Excalibur Almaz

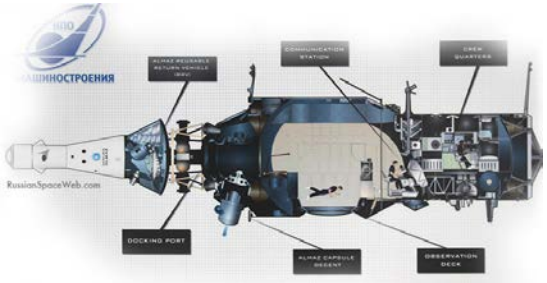


Photo courtesy of Excalibur Almaz

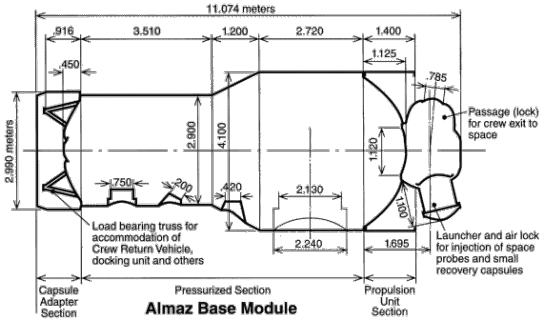


Photo courtesy of Kerbal Space Program

Vision

To design a beautiful environment with advanced technologies, aimed at providing a luxurious experience for clients.

Mission

To undertake the research and development of systems, users, and future design

Goals

- Obtain studies and examine systems and subsystems
- Optimize design of each system, looking into future technologies
- Evaluate requirements and optimize user experience
- Create beautiful, intuitive, simplistic design

vision

mission

goals

VISION - MISSION - GOALS

Tourist

Goals : want unique, one-of-a-kind experience (even in space)

Challenges : operations, safety, training, comfort of gravity

Behaviors : willing to take risks

- Billionaire age distribution: 6% age 35-44

Photo courtesy of Elon Musk tweet

Research Group

Goals : to work efficiently and effectively

Challenges : working in microgravity conditions, power and technical requirements

Behaviors : creative, task-oriented, technically competent

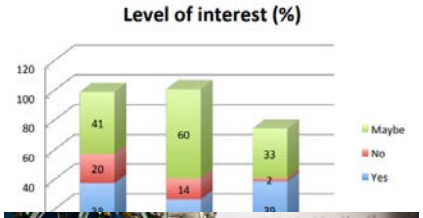


Photo courtesy NASA

Unmanned Research
(robotic)

Goals : to manufacture in microgravity environment

Challenges : working from earth, operating robotic arm, adapting equipment, power and technical requirements

Behaviors : focused, task-oriented

Photo courtesy of Alarmy

Crew
(optional)

Goals : to operate fully functioning station. Serve as space host to guests

Challenges : responsibility, time management, cultural barrier with guests

Behaviors : task-oriented, stress mitigation, calm

Photo courtesy NASA

Duration of Operations

Manned R&D (30 days)

Tourism (2 weeks)

Manned (Tourist and R&D):

Unmanned:

- Reviewing Operations from Mission Control

Tourist:

Zero G games and dance

Photos/ Video Calls

Telescope with audio guide

Cooking

Space Champagne

Painting in Space

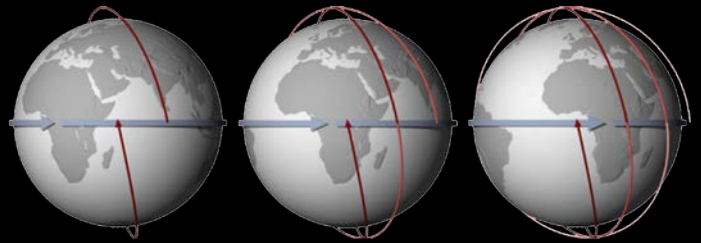
- VR Space flight drone
- Interstellar “message in a bottle”
- “Astronaut work”
- “Solar radiation drill”

R&D:

- Pharmaceutical
- Technology Development
- Earth and Space Science
- Human Resources
- Education
- Physical Sciences
- Biology/ Biotech
- Materials manufacturing
- Miscellaneous

USER EXPERIENCE

- Radiation concerns: affect human health & digital equipment performance
- 200 -1000 km high

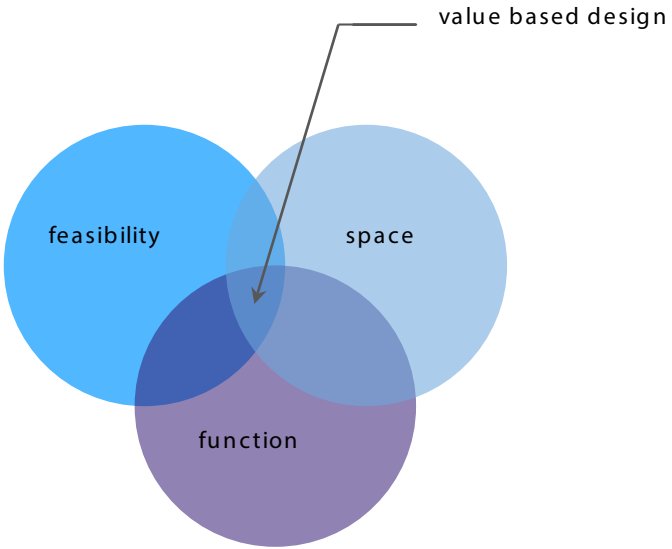


ORBIT - SUN SYNCHRONOUS POLAR ORBIT

KEY INSIGHTS

DESIGN LIMITATIONS

DESIGN CONCEPT



VALUE BASED DESIGN :
To affect valuable change, design solutions must acknowledge the spatial limitation, functions, and feasibility in space. Only then can we strategically design for underlying greater value.

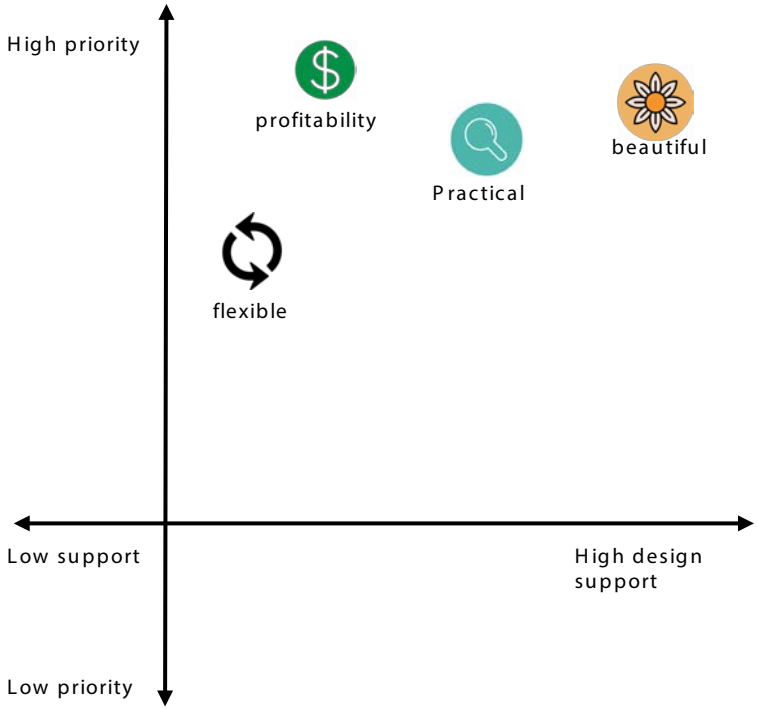
DESIGN DRIVERS

Key insights from stakeholder

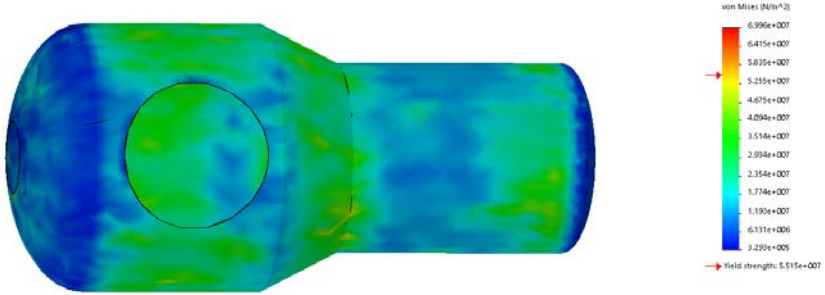
- Adaptable space for different users, flexible design
- Low upfront cost and profitability
- Beautiful, luxurious aesthetic
- Simple, practical solutions

Limitations

- Restricted volume
- Restricted shell
- RRV holds up to 6 people



DESIGN DRIVERS



The likelihood of failure is 1.85 times greater

Extensions of the existing support structure is feasible however it would it would take a way a significant amount of space from an already small cabin

- Factor of safety for a single window shell is .78
- Factor of safety for a two window shell .43

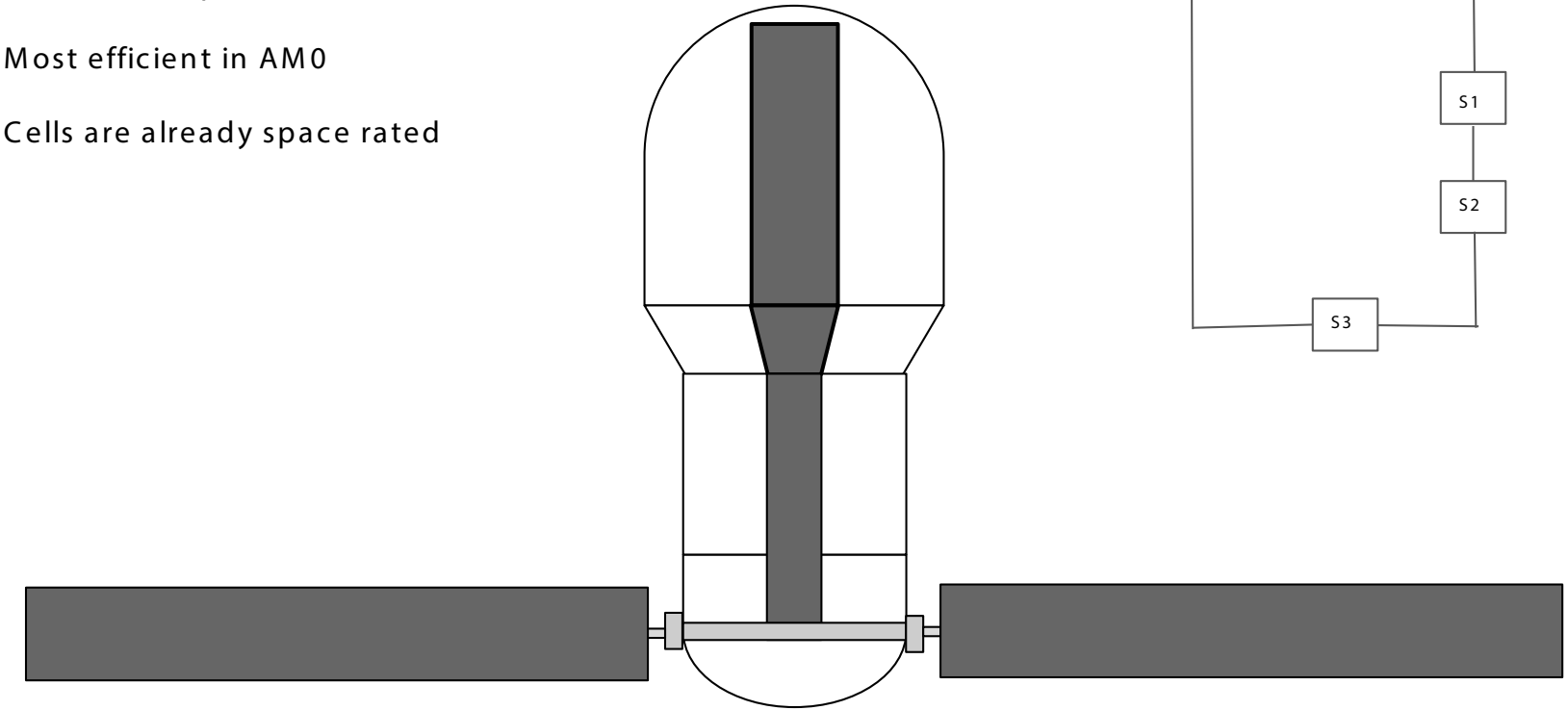
STRESSES ON SYSTEM

GaAs Gen 4 Solar Array

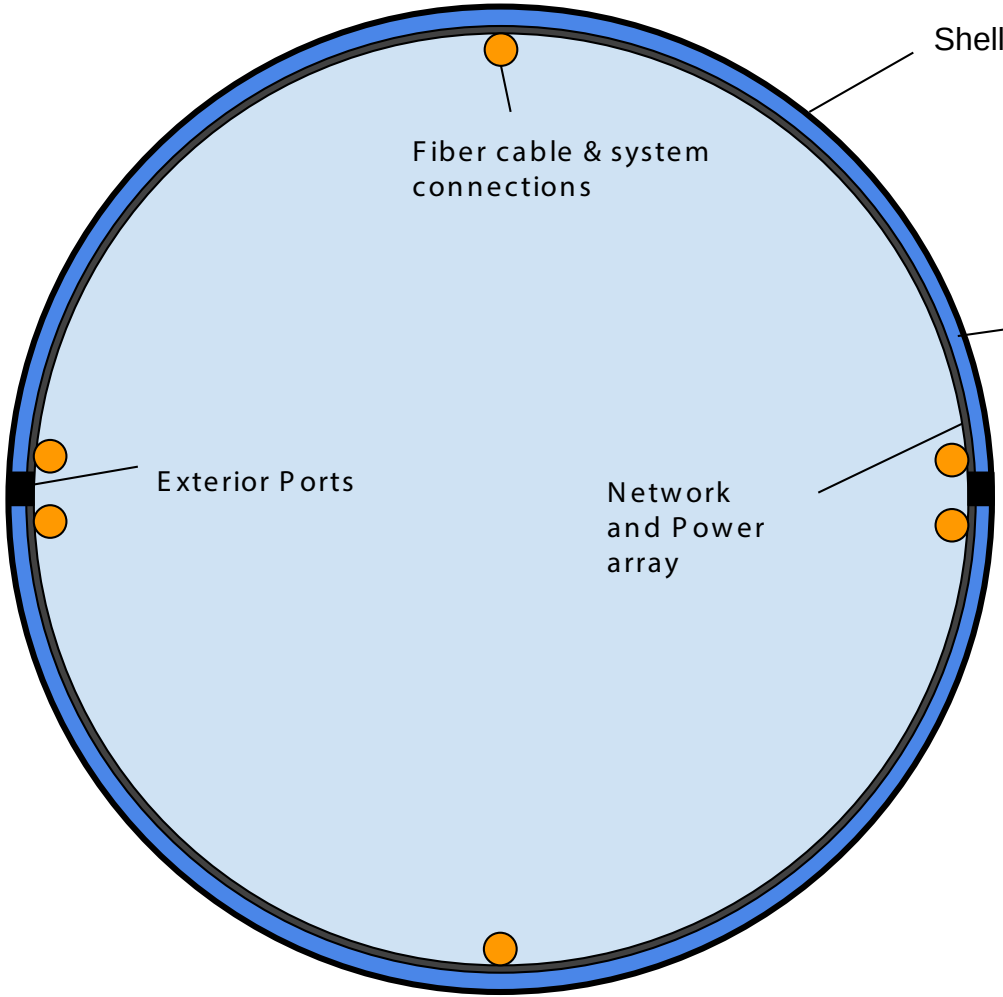
- Current configuration would produce 10 kW

Most efficient in AM0

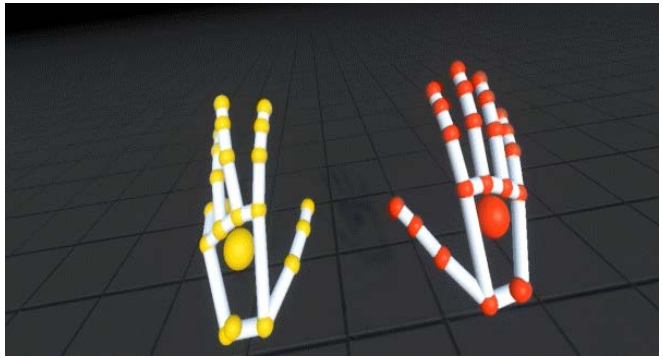
Cells are already space rated



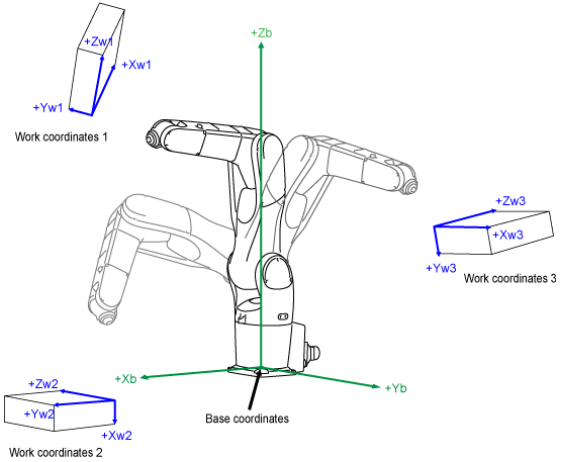
Simplified Electrical System



Overall layout of subsystems



Motion tracking of hand movement



Repeats motion to robot

Robotic arm will be on track that runs the length of the Salyut

Future challenges will be to overcoming the delay of communication time

ANTHROPOMORPHIC ROBOTS

Master - Salyut Space Station Volume Standards

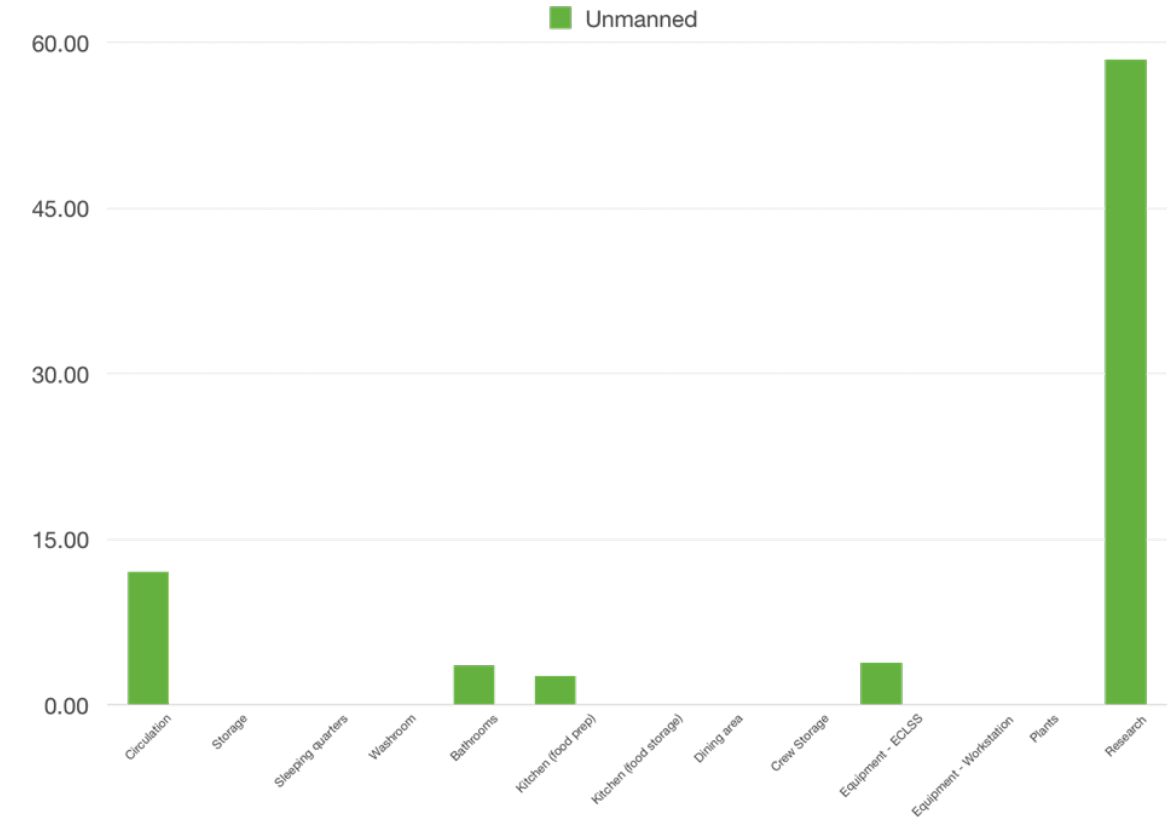
SPACE TYPOLOGY	VOLUME (CUBIC METERS)
Circulation (30% of volume)	24.1
Storage (20% of volume) *	16.1
Human	
Sleeping Quarters per person (m^3)	5.4
Washroom (adaptable space)	5.0
Bathroom (each)	1.8
Kitchen - food prep	2.6
kitchen - food storage (2 week duration)	Select for number of people
Dining area	Select for number of people
Personal Stowage	Select for number of people
Equipment	
ECLSS 3 racks	3.8
Workstation - research	1.2
Workstation - controls, communications, switching, management.	0.0
Research Specific	
Research *	Varies
Others	
Plants	0.20

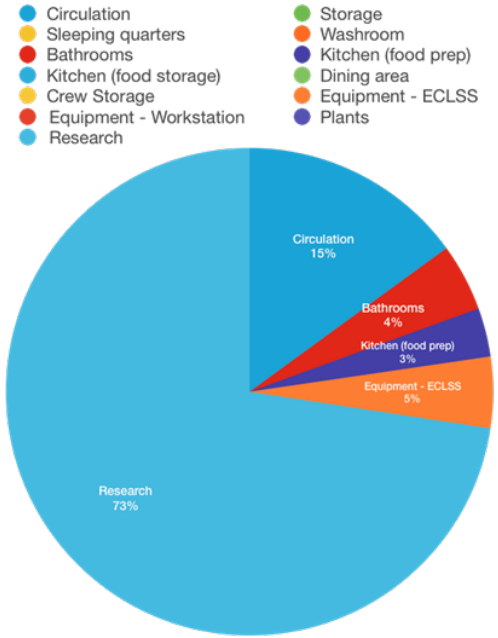
	Unmanned	Research & development	Tourists (2 persons)	Tourists (4 persons)	Tourists (6 persons)
Circulation	12.05	24.10	24.10	24.10	24.10
Storage	0.00	16.10	16.10	16.10	16.10
Sleeping quarters	0.00	5.40	10.80	21.60	24.00
Washroom	0.00	0.00	0.00	0.00	0.00
Bathrooms	3.60	3.60	3.60	3.60	3.60
Kitchen (food prep)	2.60	2.60	2.60	2.60	2.60
Kitchen (food storage)	0.00	0.48	0.72	1.68	2.16
Dining area	0.00	0.00	1.16	2.33	3.00
Crew Storage	0.00	0.19	0.38	0.76	0.76
Equipment - ECLSS	3.80	3.80	3.80	3.80	3.80
Equipment - Workstation	0.00	1.20	0.00	0.00	0.00
Plants	0.00	0.00	0.20	0.20	0.20
Total Volume	22.05	57.47	63.46	76.77	80.32
Research	58.41	22.99	17.00	3.69	0.00
Total Salyut volume	80.46	80.46	80.46	80.46	80.46

VOLUME STUDIES

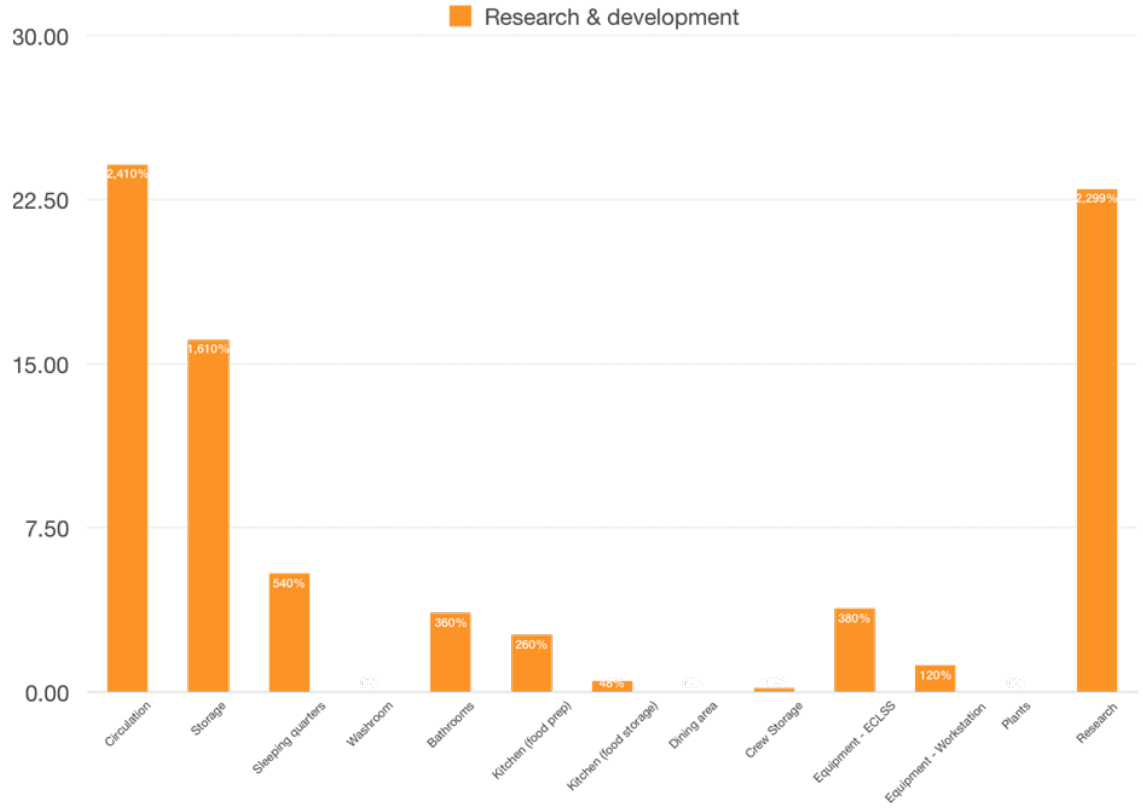
overlapping space & functions

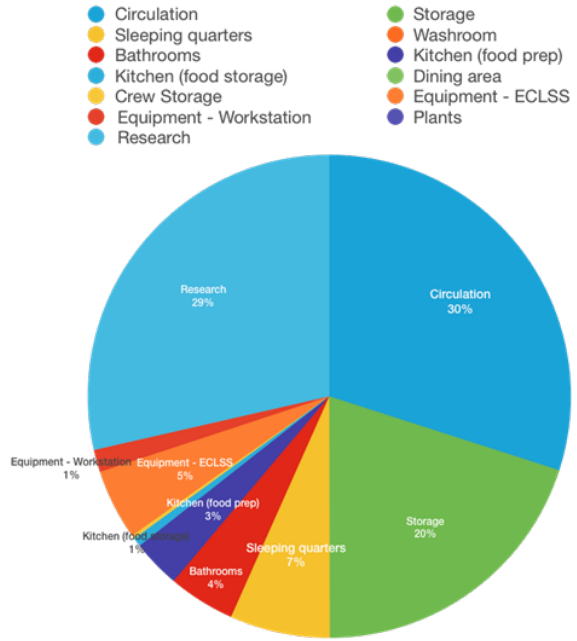
	CIRCULATION	STORAGE	STORAGE (for ancillary)	SLEEPING QUARTER	WASHROOM	TOILET	KITCHEN FOOD PREP	KITCHEN STORAGE	DINING AREA	ECLSS	WORKSTATION	RESEARCH EQUIPMENT	PLANTS
Circulation (30% of volume)		NO	NO	YES	YES	NO	NO	NO	YES	NO	YES	NO	NO
Storage (20% of volume) *			NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO
Storage -for ancillary spaces,				YES	YES	NO	NO	YES	YES	NO	YES	NO	NO
Sleeping Quarters per person (m^3)					NO	NO	NO	NO	NO	NO	NO	NO	NO
Washroom						NO	NO	NO	NO	NO	NO	NO	NO
toilets each							NO	NO	NO	NO	NO	NO	NO
kitchen - food prep								YES	NO	NO	NO	NO	NO
kitchen - food storage									NO	NO	NO	NO	NO
Dining area										NO	MAYBE	NO	NO
ECLSS 3 racks											NO	NO	NO
Workstation												NA	NA
Research *													NO



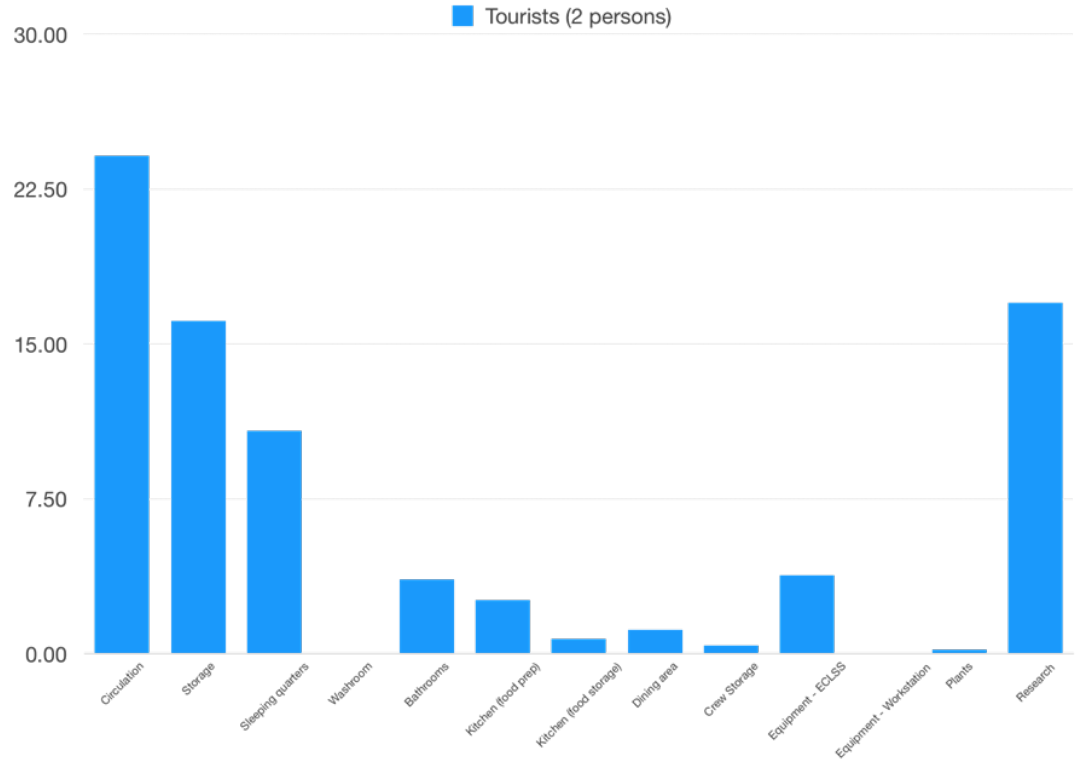


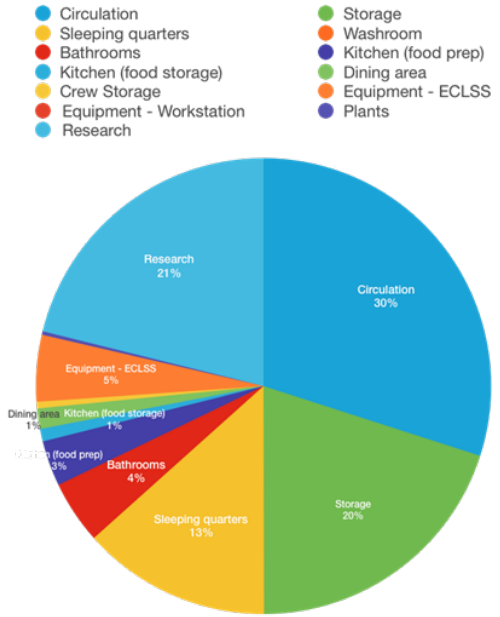
VOLUME STUDIES - UNMANNED



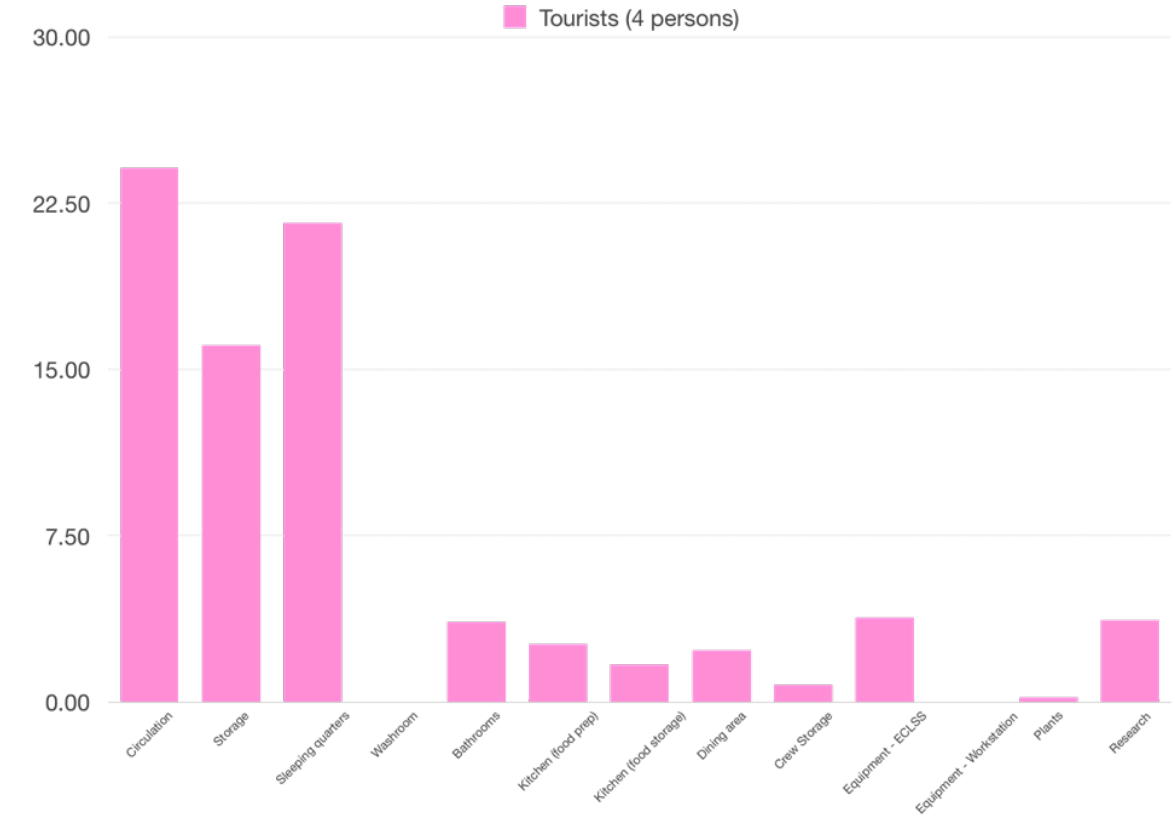


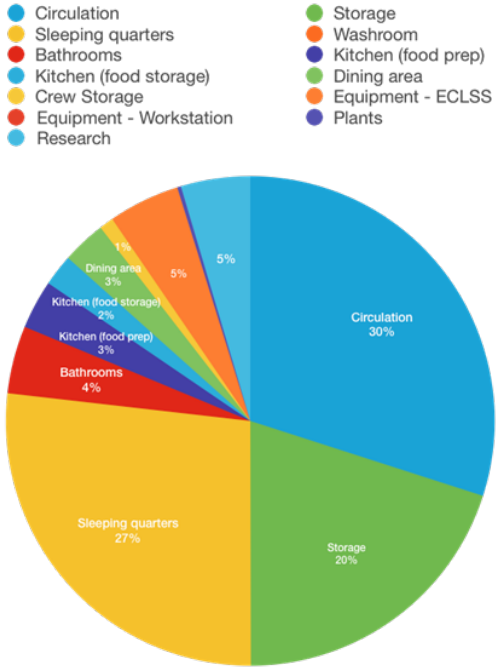
VOLUME STUDIES - R&D



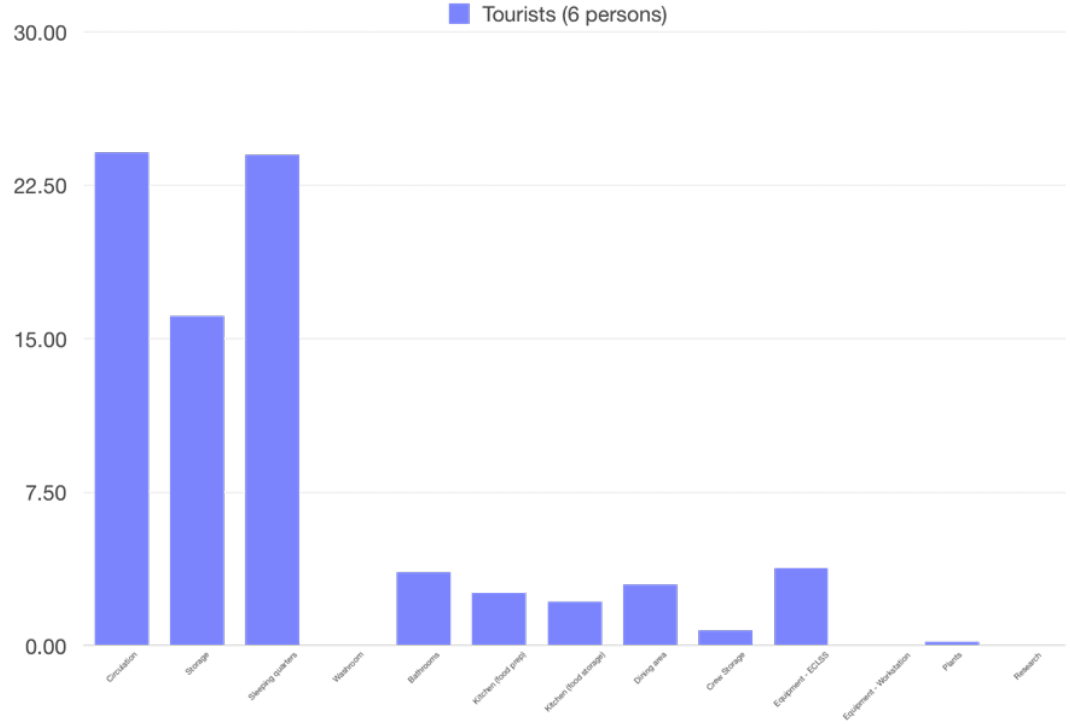


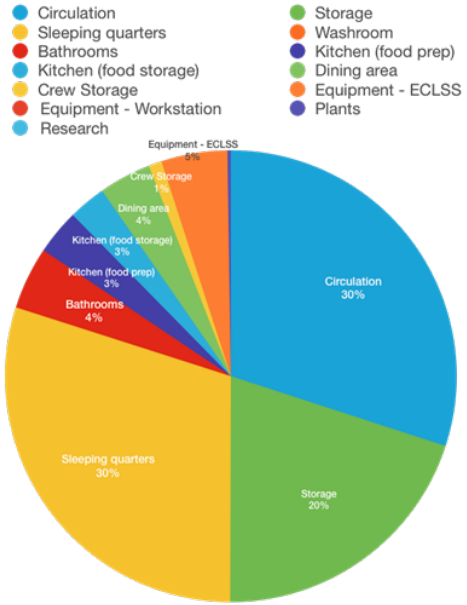
VOLUME STUDIES - 2 PEOPLE



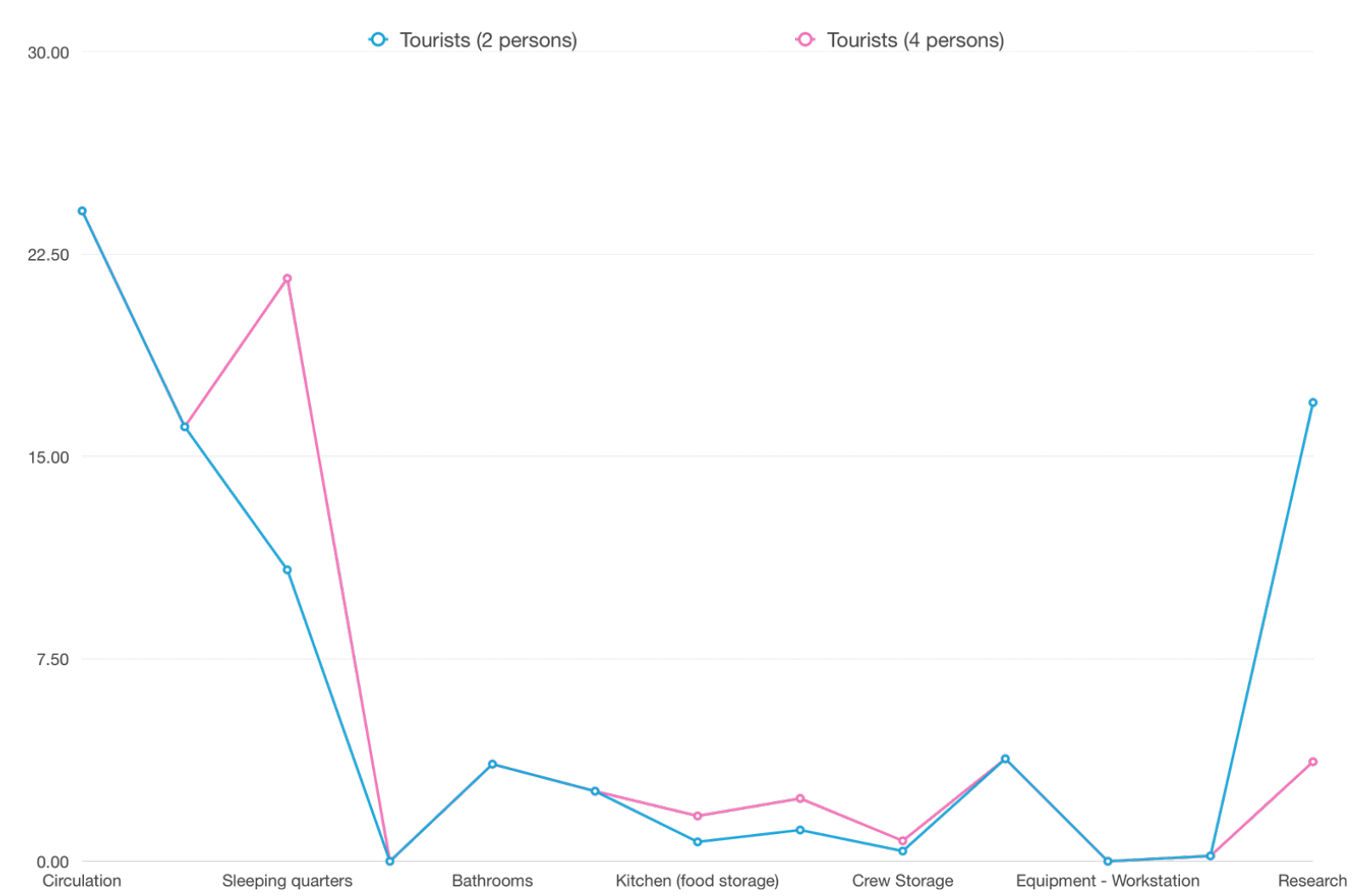


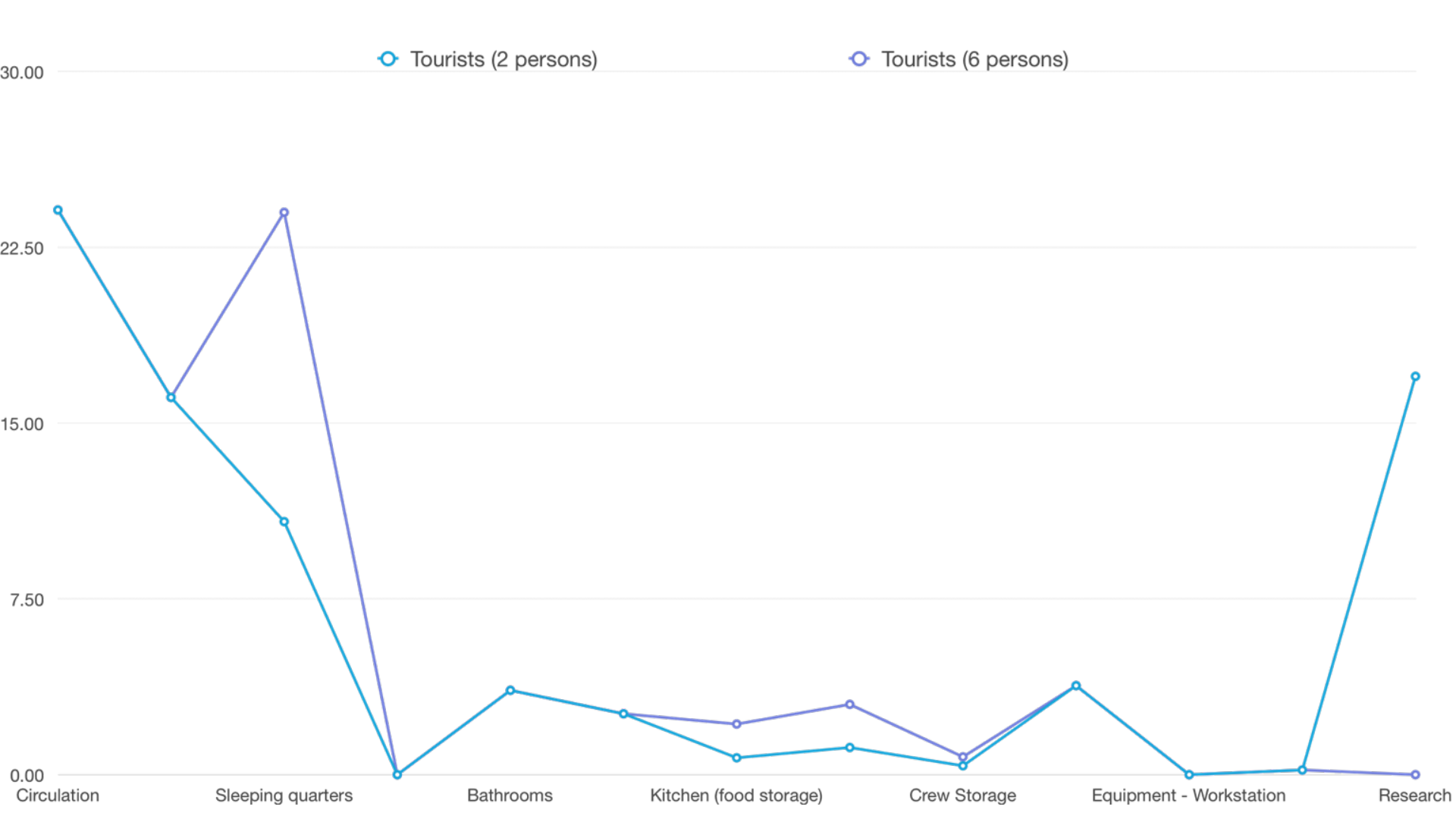
VOLUME STUDIES - 4 PEOPLE

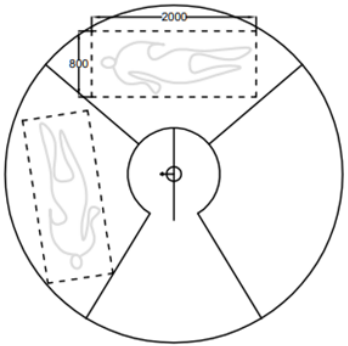


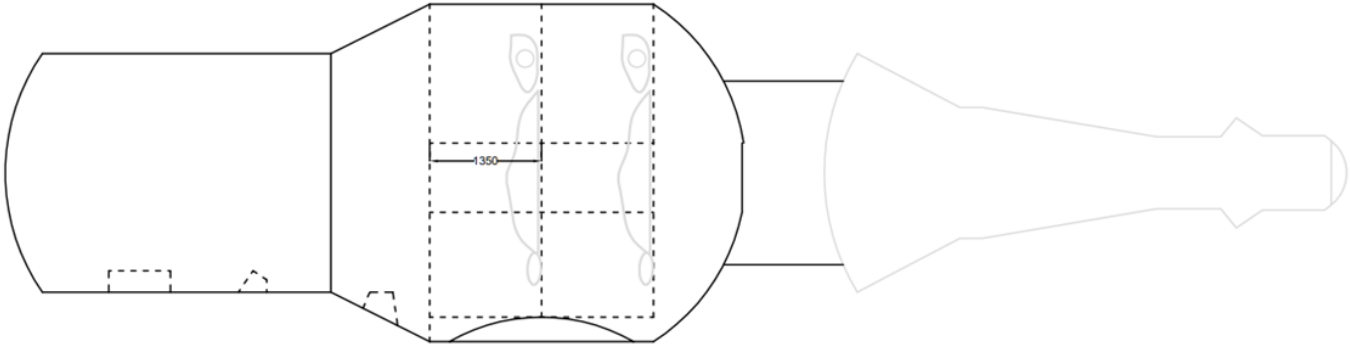


VOLUME STUDIES - 6 PEOPLE

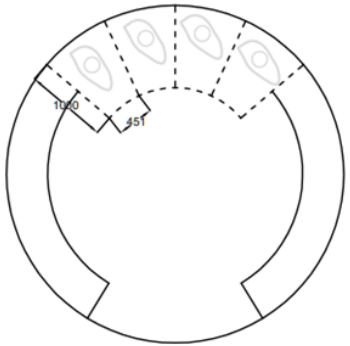

Tourists (2 persons)
Tourists (4 persons)
30.00
22.50
15.00
7.50
0.00
Circulation
Sleeping quarters
Bathrooms
Kitchen (food storage)
Crew Storage
Equipment - Workstation
Research

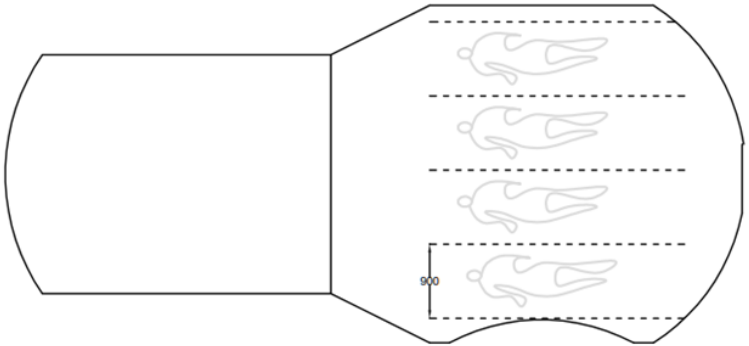

Tourists (2 persons)
Tourists (6 persons)
30.00
22.50
15.00
7.50
0.00
Circulation
Sleeping quarters
Bathrooms
Kitchen (food storage)
Crew Storage
Equipment - Workstation
Research





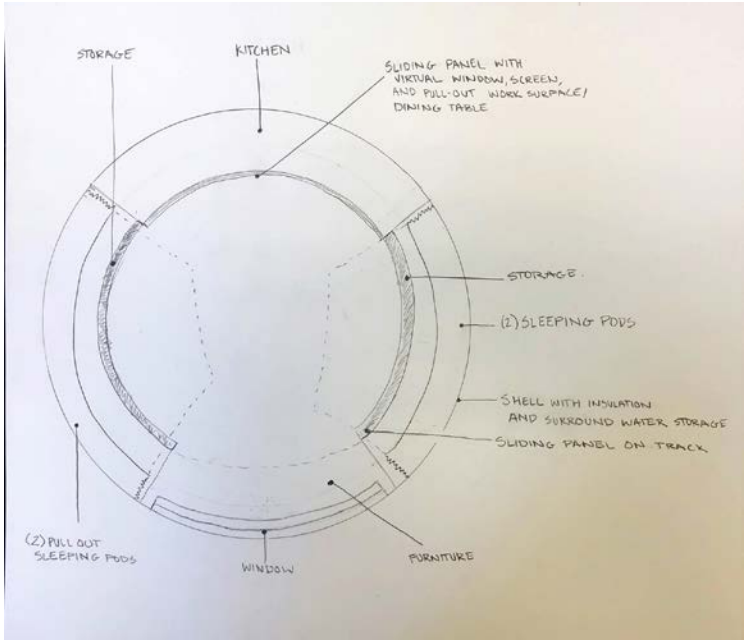
Option A

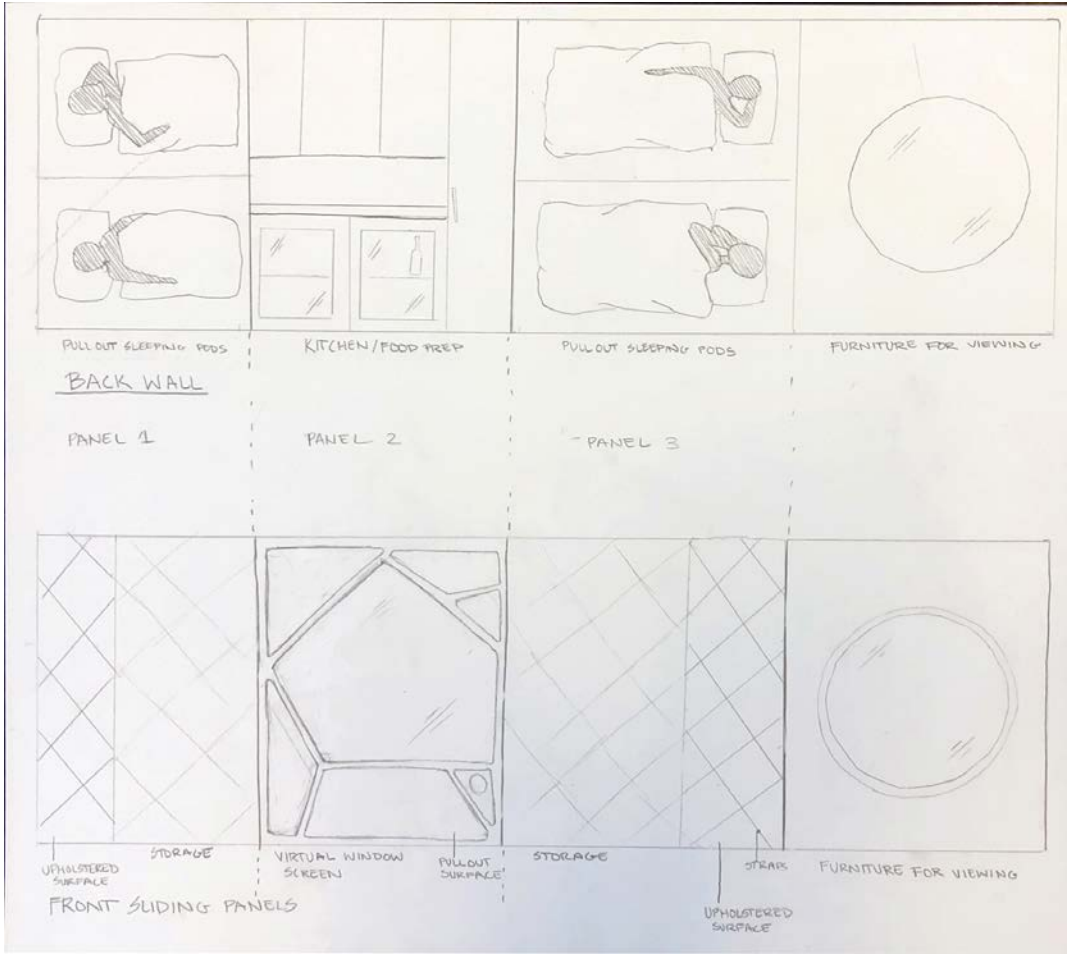




Option B

ZONING - VOLUME STUDIES





DESIGN CONCEPT

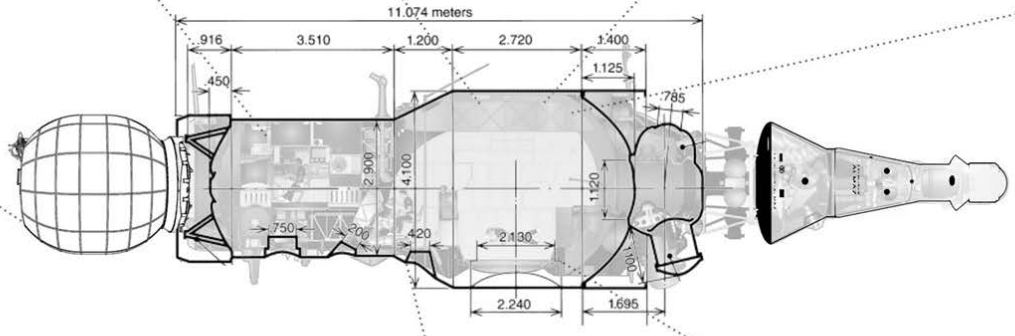
Bathroom

Kitchen

Virtual Windows/ Telecom/ Workstation

Plants in Space

Equipment



Storage

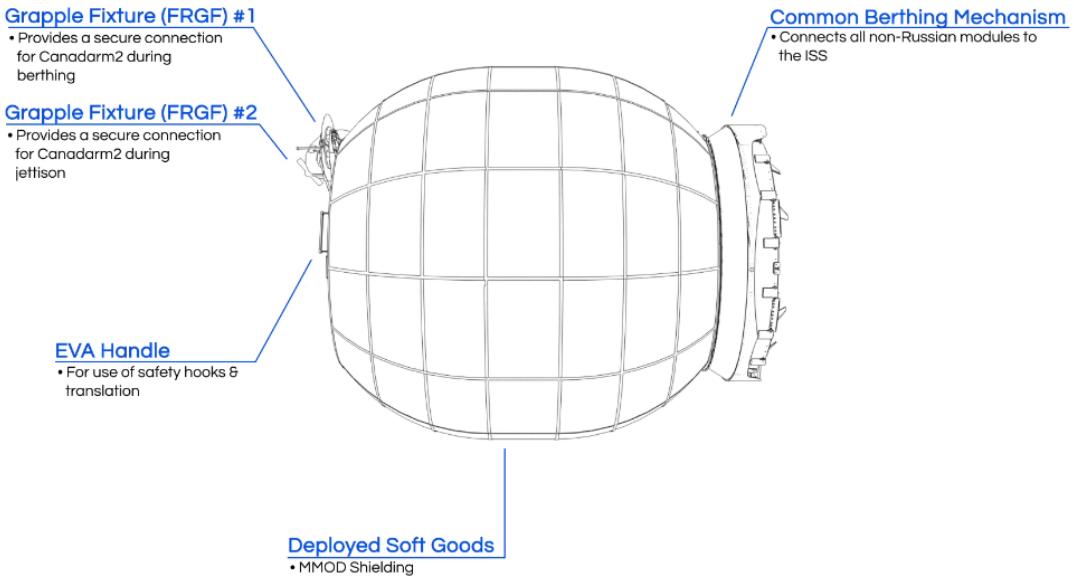
Projection in BEAM

Telescope

Sleeping Pods

ZONING - THE DESIGN

If honeymooners are on board, it is considered they will sleep at the BEAM separate quarter increasing the visual comfortability for sleeping to the rest of the tourists



Volume -
Packed - 1.4 cubic m.
Unpacked - 16 cubic m.

Length -
Packed -2.16
Unpacked -4.01

Diameter -
Packed -2.36
Unpacked -3.32

Mass - 1400 kg

Launched with Spacex Dragon Trunk

Launched fully equipped at 1/10th size

INFLATABLE ATTACHMENT: BEAM

- Separate distinct zone for entertainment in order to diversify the tourists activities (playing games, artworks)
- Honeymooners place: no any other tourists would disturb, smells and sounds isolation
- Spatial expansion of the station to provide decent rooms
- Projections inside: stars, floating islands, earth, watch movies

BEAM FUNCTION

Possible solutions

- Negative pressure bed for fluid shift to lower body
- Increase comfort and sleep quality by adding magnets to the sleeping bag on either side. It will then a pad made of ferrous material . This will **mimic the sense of gravity** as magnets pull the body against the pad by cradling, rather than being tethered or restrained. It should also **restore the loss of magnetic field** of earth. Magnets' inherent health benefit are well documented and are currently being used in the health industry.
  Benefits are reported with stress, mood, inflammation, insomnia, orthopedic healing, pain management, circulation and allergies which are some of common problems astronauts experience in space.

playfoam

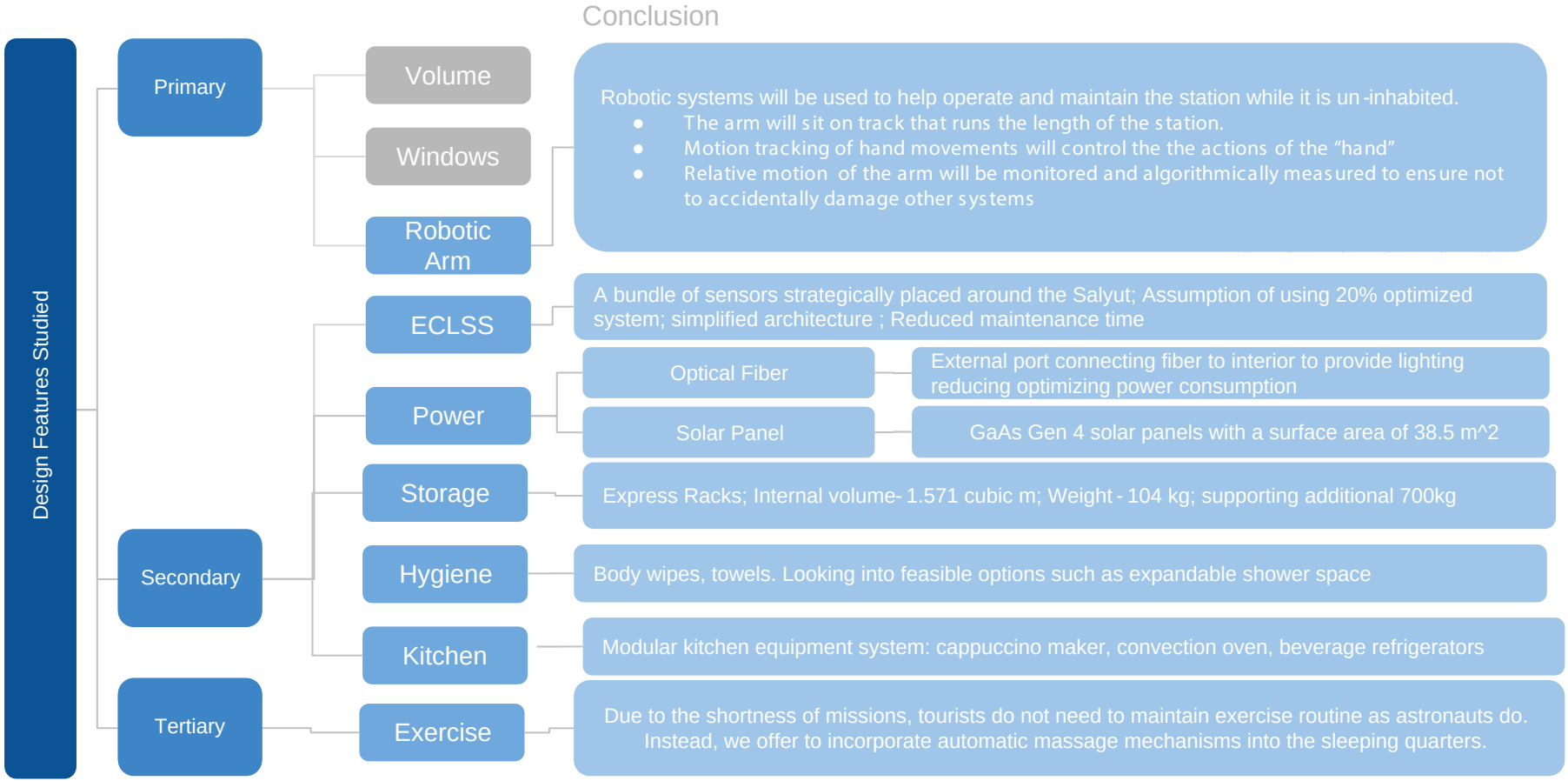
DOUBLE BED QUARTER FOR COUPLES

ZERO G ART

A part of the Interview with a space artist:

Nahum, what did you want to achieve with this zero gravity flight in terms of art?

The intentions of the project were to explore gravity, this universal force on the planet that has shaped us, and everything we know here, by changing our perspective on it through its absence.



STUDIES OVERVIEW -

smell

noise

Visual crowdedness

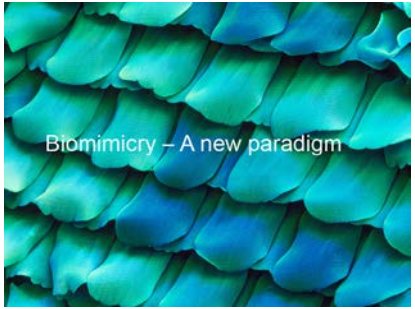
STRESSORS: PHYSICAL AND PSYCHOLOGICAL

Biophilic design refers to humans innate connection to nature and natural processes to improve health and well being of spaces we live and work in.

+Psychological, Spatio -social, Sensory benefits

Works in hand with **Attention Restoration Theory** (asserts that people can concentrate better after spending time in nature, or even looking at scenes of nature)

water stimuli



organic

light/direct connection

materials

Non -direct connection to nature, stimuli

AESTHETICS, BIOPHILIA

In the event of **sudden decompression** it is very quickly no longer a problem for the any crew or passengers.

In order to plan for **small emergencies with passengers,** more than likely the instructions would be to put on **temporary oxygen masks** (In the event of less rapid decompression) and provide any **necessary first aid** . Then put on flight suits and make an emergency descent to earth.

In the event there is **only crew** on board, if at all possible they would be given guidance on how to manage any problem or to make an emergency descent to earth if the problems are too severe.

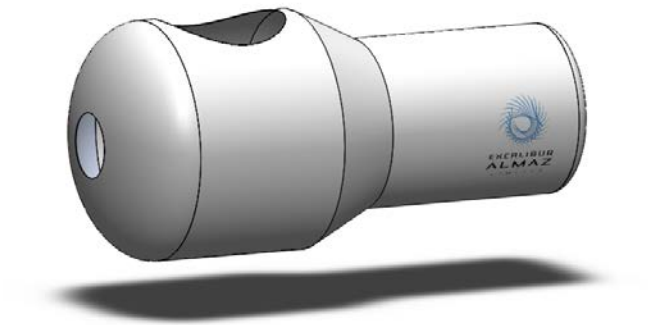
More research is necessary.

Next Steps

PHASING FOR LAUNCH

TRANSITIONS BETWEEN USERS

DEVELOPING DESIGN



THANK YOU