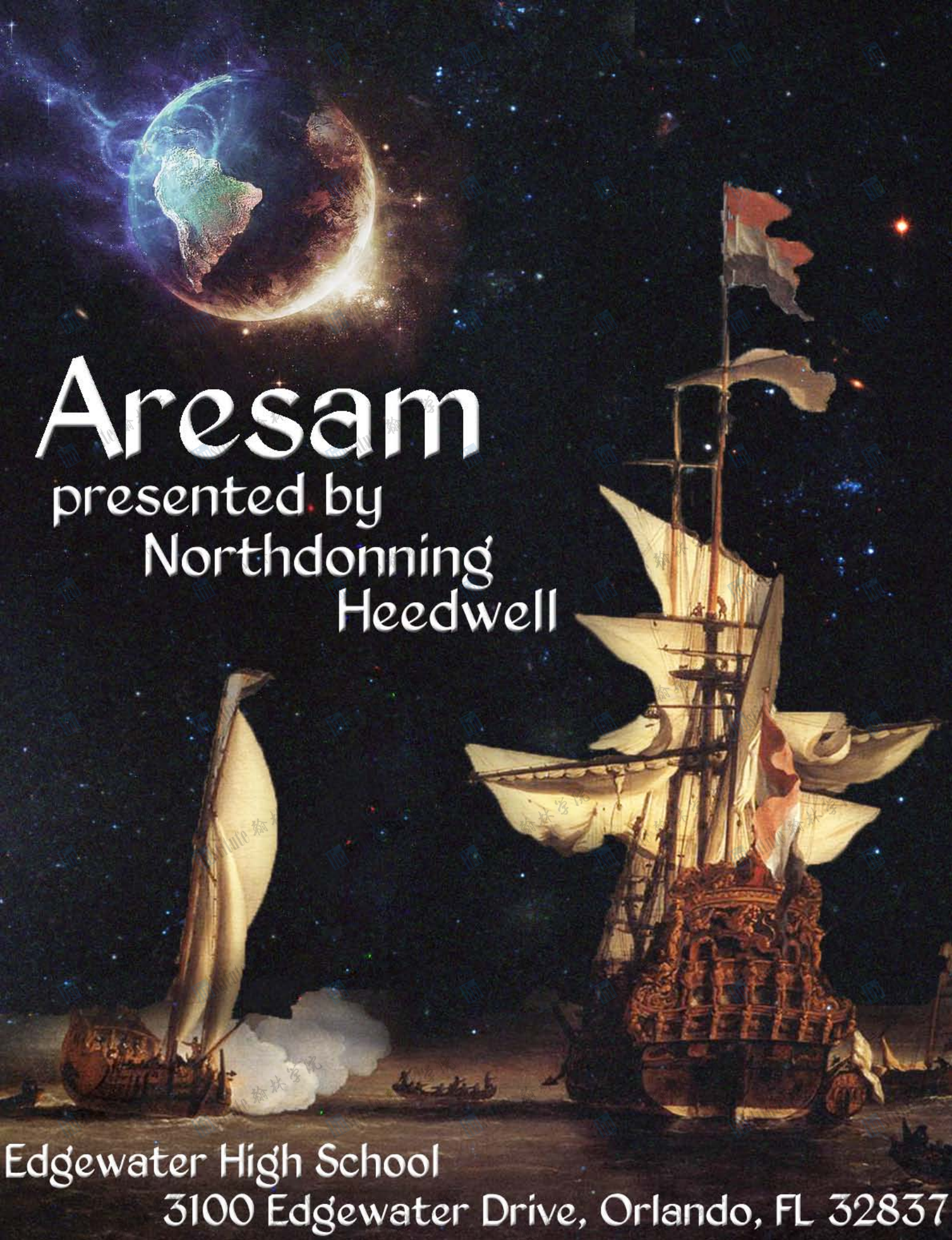
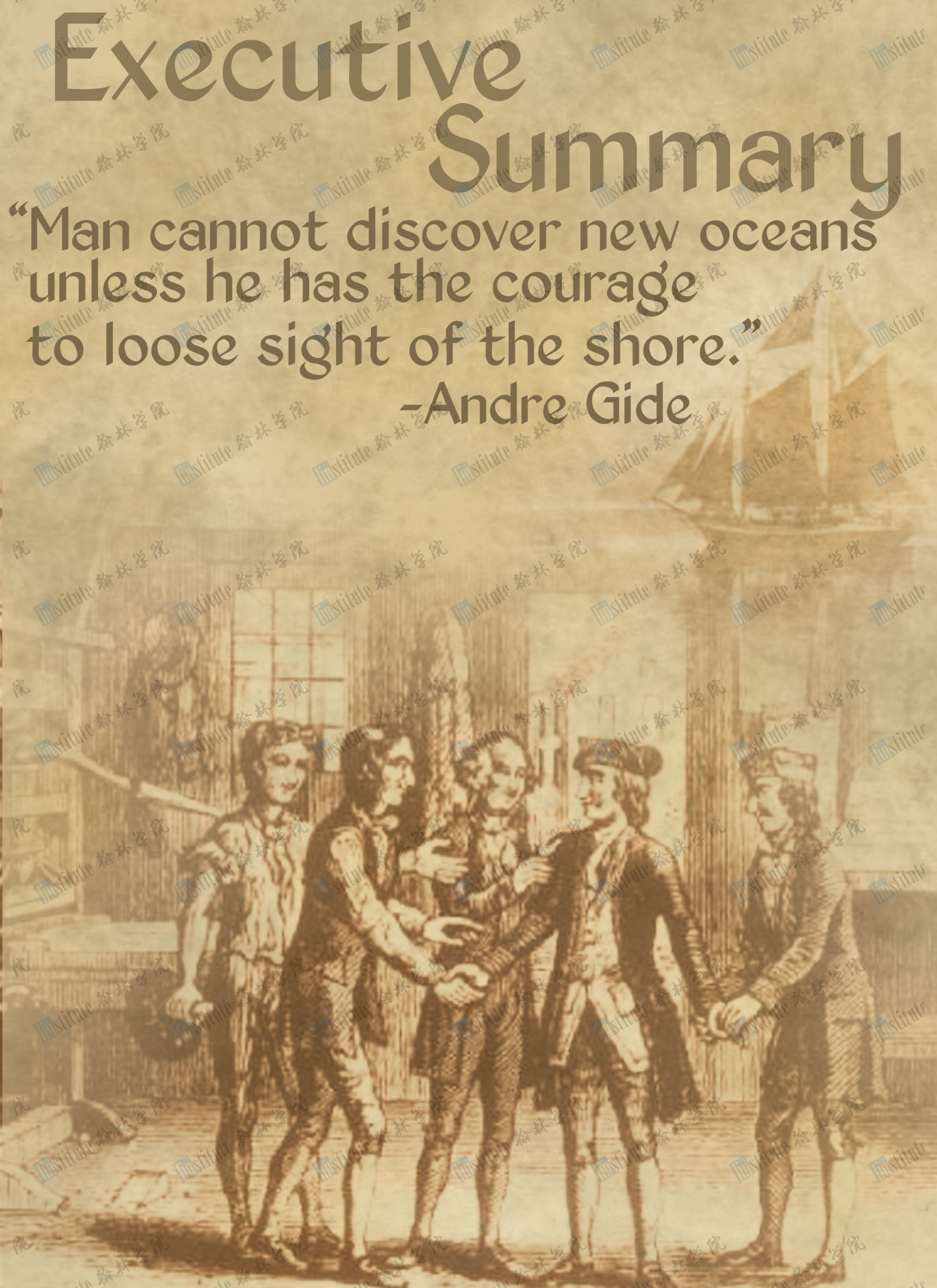

Aresam
presented by
Northdonning
Heedwell
Edgewater High School
3100 Edgewater Drive, Orlando, FL 32837

Table of Contents

Executive Summary

"Man cannot discover new oceans unless he has the courage to loose sight of the shore."

-Andre Gide



1.0 Executive Summary

Aresam, named for the fierce god of War, given the task of linking a new world with ours, will be a major undertaking by the Foundation Society as it attempts to bring humanity to a new frontier. Settlements around Earth and on the Lunar surface are proving successful— and with Columbiat and Balderol soon on the horizon, it is now time to break through previously daunting barriers and move past the Earth-Moon system into uncharted territory. However, as the great explorers of old discovered on their sea-faring adventures, there is a specific set of challenges involved in setting off from the familiar and heading off into the unknown. Aresam will meet the challenges a settlement faces when orbiting a distant planet and function as a vital conduit to the Martian surface.

The copious resources and opportunities presented by Aresam's proximity to Mars and its satellites have not gone unnoticed. Construction of Aresam will begin with the establishment of mining sites on Phobos and Deimos, which will soon begin producing raw material to be processed and used in construction. Once constructed, Aresam's design will focus on efficiency in docking, exports and future expansion. Two large docking facilities will provide ample space for up to ten ships, while the Isabella launch bay will ease the transition between Aresam and the Martian soil. A torus dedicated solely to industry will allow for a working environment with lower gravity and large unpressurized volumes, both of which increase productivity and decrease costs. This separation allows for the development of industrial facilities independent of residential facilities, creating the opportunity for tailored expansion by the Foundation Society as time progresses.

A settlement separated by vast distances from its nearest neighbors must both be self-sufficient and have contingency plans set up to ensure its residents are safe and thrive in their environment. Aresam will be powered by a triple redundant system: two High Temperature Gas-Cooled Reactor Pebble-bed Modules, one actively supplying power, and the other reserved for contingencies, in addition to ElectroSelf units-- self-recharging hydrogen fuel cells. Communications will be provided by Aresam's Plymouth Communications Array, working with a network of satellites to ensure an uninterrupted connection with Martian surface operations, existing settlements, and Earth. Storage facilities allow for a ten month reserve of food and supplies to be kept in case of emergency, which may be routed to surface operations if necessary.

Although Aresam's primary focus lies in the development of Mars, the well-being of its residents will not be overlooked. In fact, far from being forgotten in the whirlwind of progress, residents of Aresam will thrive in an environment with spacious views and culturally diverse, creative communities, crowned by a feeling of belonging to Aresam—mankind's greatest achievement. Snapshots of Earth will be made available to residents through Aresam's biome parks, which feature the flora and climate of four different biomes. The design of Aresam is focused on the wellbeing of its residents— the Coriolis effect will be abated by rotating the station at a low RPM, providing training to incoming residents and transients prior to life on the station, and designing communities in a grid, reducing head-turning.

Automation acts as the functional backbone of Aresam's mission. Beyond relieving residents of tediously mundane tasks, automation on Aresam spearheads the construction of new infrastructure and equipment, driving home Aresam's purpose. The Lattice Barges play the vertebrae to Aresam's backbone, providing a modular platform from which to launch any combination of robotics in a targeted task-force. Residents are fully integrated into Aresam's computer network through a combination of wearable computers embedded in the e-Shirt and retinal display contact lenses.

Aresam will also begin the first expansion of humankind to the Martian surface: The Habilitator of Unsettled Territory will provide not only ample resources for 30 day missions to the surface, but provides for future visitors as well through food growing capabilities and lasting communication with Aresam. Lab equipment will facilitate the surveyal of future sites for Martian expansion.

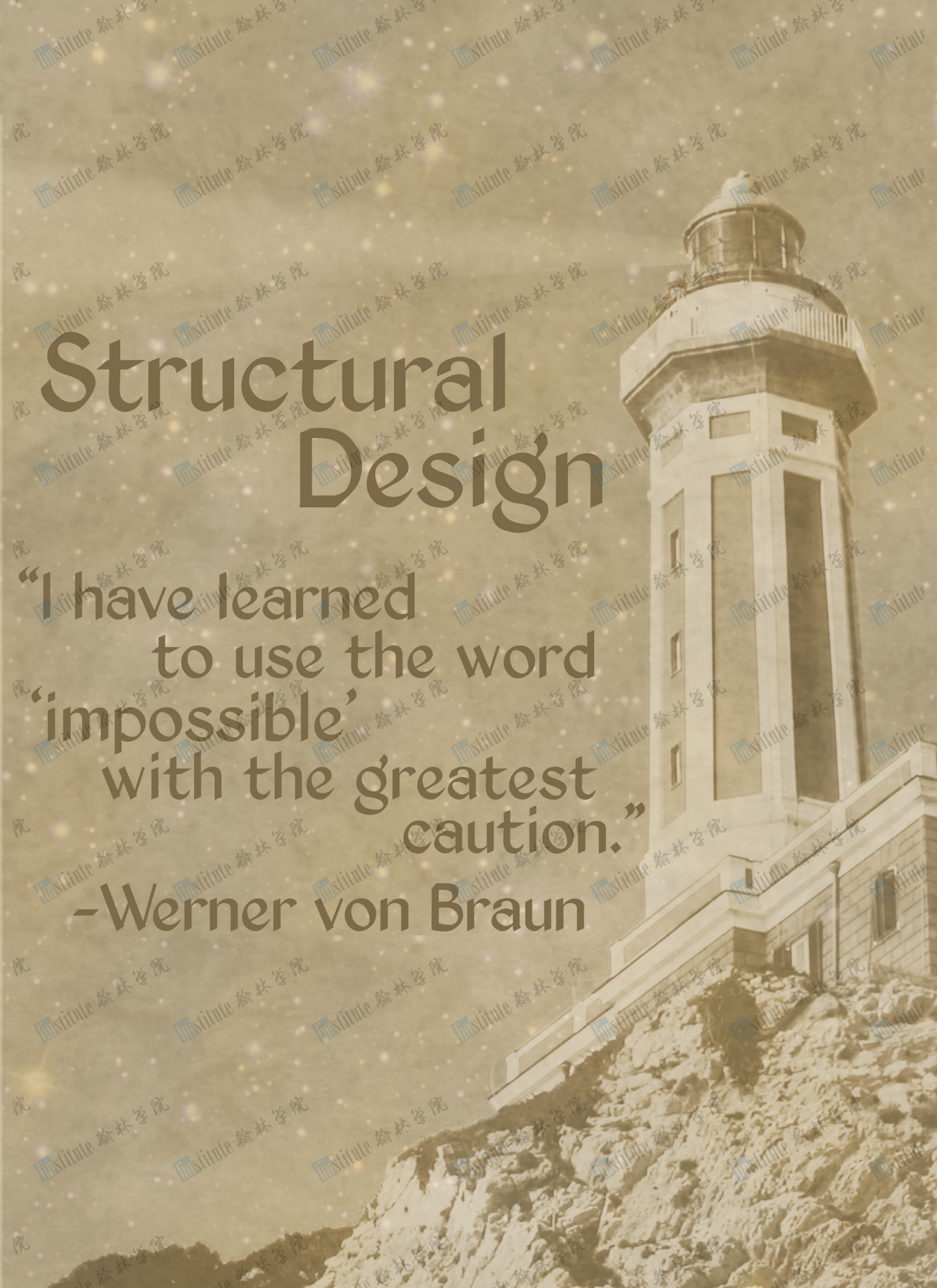
With a new world comes a new bounty of opportunities, and Aresam will be prepared to reap whatever harvest Mars and its satellites have to offer humanity. Aresam's flexible design was conceived with adaptation and future development in mind, thinking forward even now as it stands the next chapter in the human legacy. Aresam will be built in just 13 years, and in an additional 9 years, the Foundation Society will have earned back its investment and have started turning exponential profits.

As we leave the Earth-Moon system, we broaden our horizons and bring infinite opportunity to our fingertips. Northdonning Heedwell with the Foundation Society will link a new Martian world with ours, through Aresam, the greatest feat of mankind.

Structural Design

"I have learned
to use the word
'impossible'
with the greatest
caution."

-Werner von Braun



2.0 Structural Design

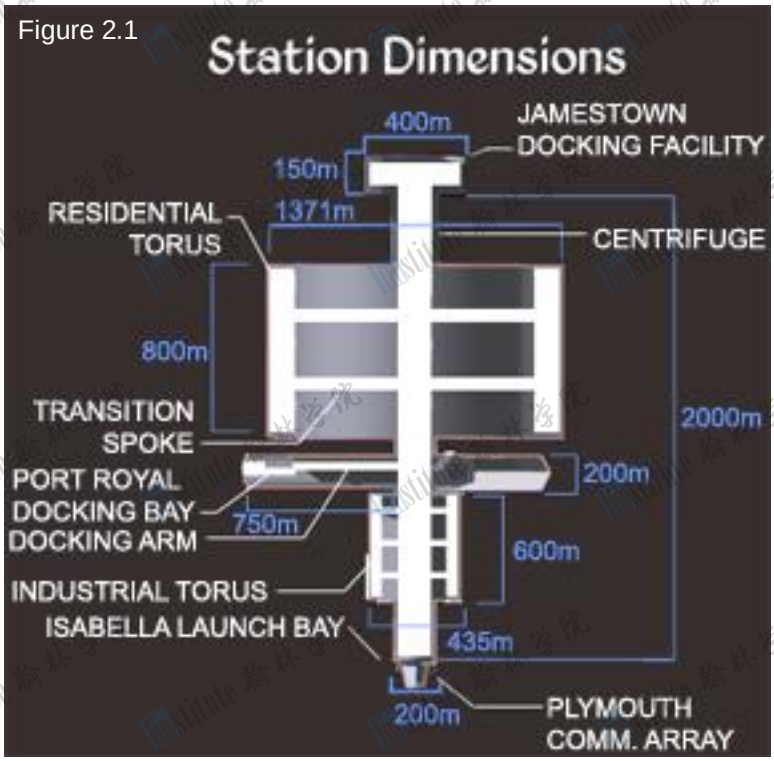
Aresam will function as a link to the Martian surface, providing the industrial and port facilities necessary to ensure the success of human expansion beyond the Earth-Moon system.

2.1 Major Components

Table 2.1

Component	Function
Jamestown Docking Facility	Provides means of docking ships, close proximity to residential torus
Port Royal Docking Facility	Provides additional means of docking ships, close proximity to both tori
Centrifuge	Provide center of rotation for tori, storage, microgravity manufacturing
Residential Torus	Provide for residents' and transients' biological and psychological needs
Plymouth Comm. Array	Relay communications between Mars, Aresam, and Earth.
Industrial Torus	Provide for construction of Mars surface infrastructure.
Isabella Launch Bay	Provide method of launching Mars-bound ships, etc to Mars surface

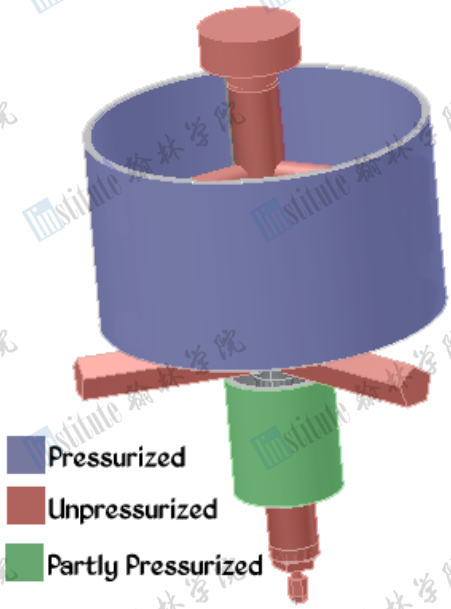
Figure 2.1



2.1.1 Attributes of Volumes

Aresam's residents will occupy the residential torus, located near the Jamestown Docking Station. The Port Royal Docking Bay will be located near the center of the station. The industrial torus will be located below the Port Royal Docking Bay. The Isabella Launch Bay and Plymouth Communications Array will be located on the extremity of the station pointed towards Mars.

Figure 2.2 Volumes by Pressurization



2.1.2 Utilization of Enclosed Volumes

Persons aboard the station will live in the residential torus. The Port Royal Docking Bay and Jamestown docking facility will be used for the docking and accommodation of ships. The industrial torus will be the manufacturing and industrial center of Aresam. The Isabella Launch Bay will be used to deploy materials and personnel to the Martian surface.

2.1.3 Isolation of Volumes

Aresam's residential and industrial tori will have the capability to isolate any two of ten sub-volumes from the rest of each torus. Each isolated volume will be able to function independently from others.

2.1.4 Artificial Gravity

Aresam will use nitrous oxide-hydroxyl-terminated polybutadiene hybrid rockets to initiate the rotation of the station to create artificial gravity. Hybrid rockets will be used because of their higher impulse, ability to be stopped and restarted and their ability to be throttled. The entire complex will spin at 1.142 RPM to achieve Earth-like artificial gravity within the residential torus, allowing for optimal human comfort and ensuring the physical well-being of the residents. This also keeps the industrial torus at 0.317 times Earth gravity, giving machinery an easier work load while allowing for retention of human efficiency. The interior of the centrifuge will be suspended by magnets to provide microgravity.

2.1.5 Radiation and Debris Protection

Aresam's hull will consist of 5 layers of metals, regolith, ceramics, and polyethylene. This variety of materials provides protection from all dangerous elements in space, while utilizing Phobos and Deimos for resources.

Table 2.2 Hull

Material	Purpose	Layer Size
Polyethylene	Radiation Protection	2m
Aluminum	Debris Protection	.75m x 2
Tin	Debris Protection	1m
Boron Carbide	Heavy Kinetic Protection	2m
Lunar Glass	Windows	4m
Regolith	Radiation Protection	5m

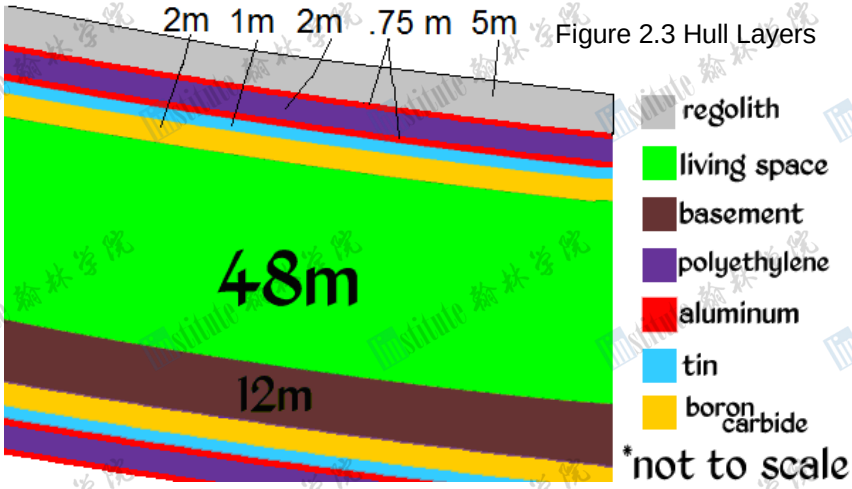
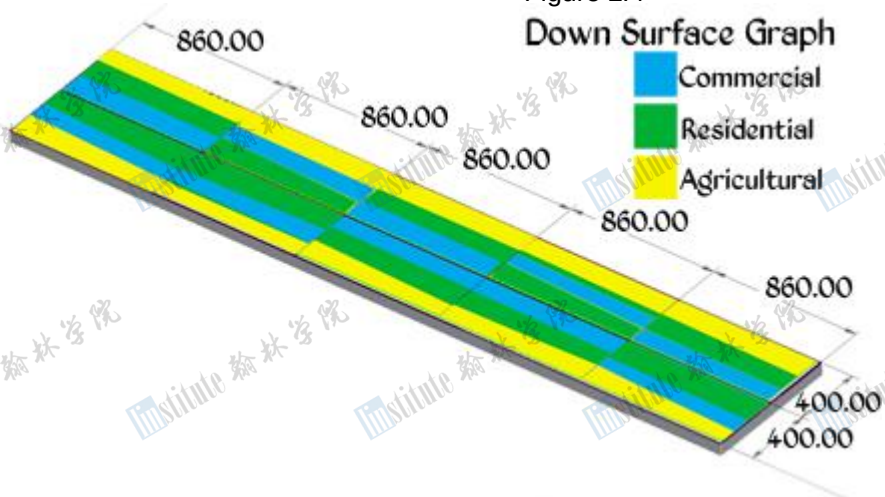


Figure 2.3 Hull Layers

2.2 Allocations and Dimensions

Maintenance areas below the living areas will have a height of 12 meters. The height of the living areas is 48 meters. Living areas will be separated into 10 equal areas as shown in figure 2.4.These sections are divided as needed in case of Hull Breach (see 5.2.3 Safety: Hull Breach).

Figure 2.4



2.2.1 Down Surfaces

The residential torus will be split up into ten equal, self-sustaining partitions of 341553m^2. Each partition can be isolated in the event of contingency (detailed in 2.1.2) and is split up equally among residential, commercial, and agricultural areas.

2.2.2 Surface Area and Vertical Clearances

Table 2.3 Partition Surface Area

Area	Percentage Allocated	Surface Area Allocated
Residential	32%	109297 m^2
Commercial	31%	105881 m^2
Agricultural	37%	125374 m^2

Table 2.4 Down Surfaces and Vertical clearances

Down Surfaces	Vertical clearance	Surface area
Maintenance (basement)	12m	3,447,200 m^2
Living Area	48m*	3,415,536m^2

*This value is the standard for both tori, being living area in the residential torus and manufacturing space in the industrial torus.

2.2.3 Orientation of Down Surfaces

The centripetal force of the torus will orient gravity towards the outer edge of the station.

2.3 Construction

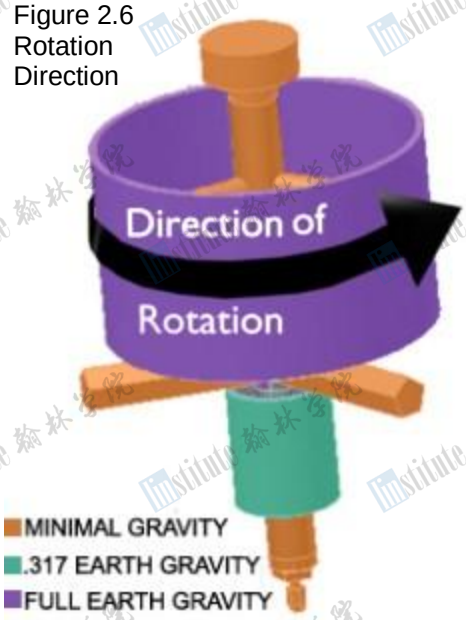
2.3.1 Sequence of construction

Figure 2.5

Table 2.5 Construction Sequence Timeline		
Time	**Step**	**Description**
4 months	Cortez	Mining on Phobos and Deimos begins and construction of Aresam begins with the Port Royal docking bay so resources can easily flow in through the facility for the rest of construction.
12 months	Pizarro	The centrifuge will be built from both sides of the docking bay, creating a base for the rest of the station to be built. Once the centrifuge is complete, new gateways for construction will be opened up.
26 months	Magellan	Construction of the residential torus begins. Spokes will be added to the centrifuge, and the residential torus will be pieced together. Once finished, interior construction will begin.
9 months	de Gama	Industrial torus construction begins. Spokes are added and the industrial torus is assembled. Once assembled, operations within the industrial torus can begin.
1 month	Cabot	The Jamestown docking facility and launch bay will be built simultaneously. Once the Jamestown docking facility is complete, ships can begin docking within the structure. After the launch bay is complete, deployments to the surface will begin.
1 month	Drake	Plymouth Communication Array will follow completion of the launch bay.

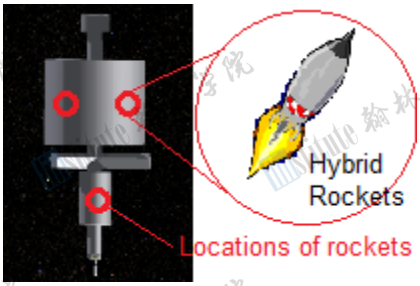
In all construction steps, the Lattice Barge and associated modules will be used to transport, manipulate, place, and affix materials and parts to Aresam.

Figure 2.6 Rotation Direction



2.3.2 Initiation of Rotation

Aresam will use nitrous oxide-hydroxyl-terminated polybutadiene hybrid rockets to initiate the rotation of the station to create artificial gravity. Hybrid rockets will be used because of their higher impulse, ability to be stopped and restarted and their ability to be throttled.

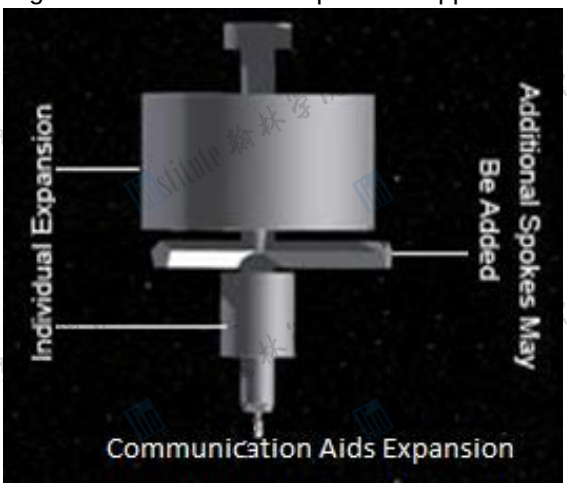


2.3.3 Interior Construction Method

Silicon, Boron and Carbon will be mined from Phobos and Deimos to be used in interior construction. Carbon will be used in the production of steel for buildings as well as with mined Boron to make Boron Carbide, used for constructing bulkheads. Silicon will be mined to create silica concrete-- a stronger, more durable building material for roads, walkways, and buildings.

2.4 Accommodation for Expansion

Figure 2.7 Locations of Expansion Opportunities



2.4.1 Early Exploration

The industrial torus will be the platform for exploration and surface operations on Mars. The industrial torus has a range of capabilities including manufacturing of prefabricated shelters, ore refining and other surface operations support. The Isabella Launch Bay on the planet-oriented end of the centrifuge will serve to transport materials, personnel and prefabricated shelters to the Martian surface. It will serve as an auxiliary docking facility should complications arise to preclude the primary bays from accepting traffic.

2.4.2 Docking for Major Surface Construction

Aresam's main docking facility, Port Royal, is located in the center of the centrifuge in between the residential and industrial tori. The secondary docking facility is the Jamestown Docking Facility, located at the top of the centrifuge. The Docking Facilities will be in microgravity to ensure a safe and easy docking process. Port Royal contains three open bay doors to accommodate for a variety of ship designs. Up to ten ships can be docked within the facility at any given time, with up to three ships docked within the bay at once.

Table 2.6 Docking Facilities

Docking Facility	Total Docking Capacity	Number of Ships Docked at Once
Port Royal Docking Facility	10 Ships	3 Ships
Jamestown Docking Facility	6 Ships	3 Ships
Isabella Launch Bay*	3 Ships	1 Ship

* This facility will only be used in emergency situations for docking purposes

Expansions will be made to the Jamestown Docking Facility and Port Royal Docking Facility to accommodate for more ships as time goes on. More Docking Arms will be added to the Port Royal Docking Facility as the need arises. The Jamestown Docking Facility will incorporate an evolving structural design capable of being adapted to situations and needs over time.

2.4.3 Surface Communications

The Plymouth Communications Array is a structure containing communications transmitters and receivers, located below the Isabella launch bay, facing Mars. It will provide communications between Aresam and all surface structures, and act as a relay between Earth and Aresam.

2.4.4 Industrial Torus

Sitting below the Port Royal Docking Bay the industrial torus serves as the main manufacturing center for the station. From the confines of the industrial torus, ore will be processed, parts machined, equipment, gear, and prefabricated structures assembled, along with materials for further planetary and space exploration. This torus will be separated from the residential torus to reduce stress, noise pollution and the possibility of industrial-related health hazards for residents. The separation will allow for expansion of one torus separate from the other—Aresam may be tailored by the foundation society as time goes on. The proximity of the industrial torus to the Port Royal docking facility and the Isabella Launch Bay decreases cargo transport time and simplifies the process of routing goods to and from Aresam.

Areas above main manufacturing centers will be pressurized for human access. However, most of the industrial torus' volume will be unpressurized to provide a better work environment for robots and to reduce costs.

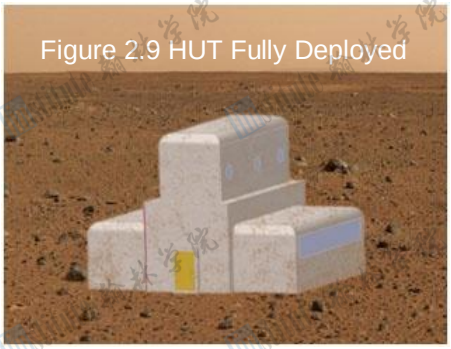


Figure 2.9 HUT Fully Deployed

2.5 Habilitator of Unsettled Territory (HUT)

2.5.1 Structure

The Habilitator of Unsettled Territory (HUT) is comprised of a single structure housed in a standard cargo container. It is made up of four chambers: one main chamber, two chambers that are on either side of the main chamber and one chamber that is on the top of the main chamber. The total volume of the HUT is 392.13m^3.

The HUT walls are composed of a layer of polyethylene for radiation protection, two steel plates and a layer of carbon fiber-reinforced elastomeric isolator in between them for strength and flexibility.

The carbon fiber elstomeric isolator will be used for its light weight, superior dampening qualities and ability to be produced from materials mined from Phobos and Deimos.

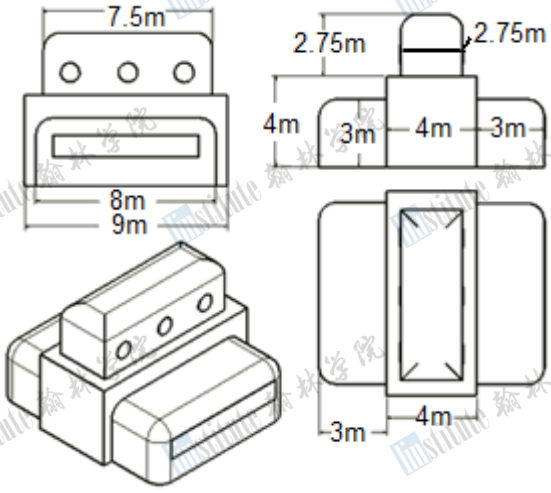


Figure 2.8 HUT Dimensions

2.5.2 HUT Construction Process

The HUT will be constructed inside the industrial torus of Aresam and partially built with materials from Phobos, Deimos, and Mars. Carbon, which is used for steel alloys, can be mined from the moons. Iron is an abundant material found on Mars in the form of Iron(III) Oxide, which can be refined into pure iron.

Materials that cannot be mined from either moon include iron for steel and aluminum. Iron, however, will be mined from Mars and aluminum will be shipped from Earth. After the structure is assembled, it will be stocked with everything necessary for the duration of a venture to Mars. Once completed, it will be transported to the Isabella Launch Bay and await its launch to the Martian surface.

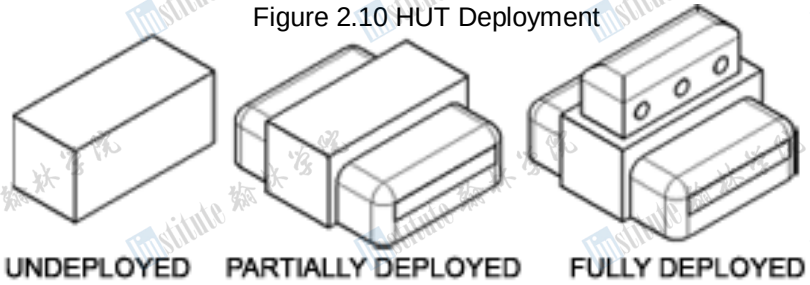
2.5.3 Deployment

The HUT prefabricated shelter will be launched through the Isabella Launch bay in its construction and pre-deployment form. During entry, rockets will assist parachutes in safely decelerating the structure. Before the HUT reaches the surface, a secondary set of rockets will initiate, guiding the HUT to its predetermined destination.

Upon touchdown, two chambers will expand through the sides of the main body.

Once the side chambers are fully deployed, the third chamber will extrude through the top providing a second floor to the shelter.

Figure 2.10 HUT Deployment



Following the full deployment of the structure, telescoping rods will extend from the corners of each chamber, boring into the surface and anchoring the structure.

This entire process will take less than an hour and will not require any effort or labor outside of oversight by humans to complete transformation.

OPERATIONS

"One of the tests of leadership is the ability to recognize a problem before it becomes an emergency."
-Arnold H. Glasow

3.0 Operations and Infrastructure

Operations and infrastructure on Aresam will provide the systems necessary to give a high quality of life to residents and provide for expansion onto the Martian surface.

3.1 Construction Operations

3.1.1 Orbital Location

Figure 3.1 Orbital Location

Aresam will orbit Mars at a height of 19,000 km with an inclination of 1.43 degrees. Both the inclination and height are between those of Phobos and Deimos. This eases transportation between Aresam and the moons, while being closer to Deimos to reduce the effect of tidal forces. This height significantly reduces the fuel needed to send units to Deimos, while not significantly changing it for Phobos missions.

3.1.2 Construction Materials

Table 3.1 Materials

Material	Purpose	Source	Amount
Steel	Construction	Earth/Phobos/Deimos/Bellevistat	50,000,000 m^3
Silicon	Robot Construction	Phobos/Deimos/Earth	5,000,000 m^3
Chromium	Robot Construction	Phobos/Deimos/Earth	10,000,000 m^3
Nickel	Robot Construction	Phobos/Deimos/Earth	10,000,000 m^3
Aluminum	Construction	Phobos/Deimos/Earth	10,000,000 m^3
Polyethylene	Shielding	Bellevistat	4,440,000 m^3
Boron Carbide	Shielding	Earth	6,880,000 m^3
Tin	Shielding	Phobos/Deimos/Bellevistat	1,000,000 m^3
Regolith	Shielding	Phobos/Deimos	1,000,000 m^3

3.1.3 Construction Equipment

Table 3.2 Machinery

Machinery	Purpose	Dimensions (m)
Lattice Barge	Base structure - gathers modules and stores materials	13 x 25 x 49
Indie Thrusters	Alters position of other machines	3 x 3 x 3
Mining Module	Extracts raw materials from surface of moons	5 x 5 x 23
Material Processing Module	Processes raw material into construction grade material	5 x 5 x 23
Welding Module	Welds steel sheets and trusses	5 x 5 x 12
Manipulation Module	Manipulates objects around Barge	5 x 5 x 12
Storage Module	Stores materials ready for assembly	5 x 5 x 23
Power Module	Hydrogen fuel cell	5 x 5 x 12
Prefab Parts Manufacturing Module	Manufacturing facility for most interior building	5 x 5 x 23

Table 3.3 Vehicles

Name	Contractor	Purpose	Size (LxWxH)	Crew	Fleet	Turnaround
Third-Generation Palomino	Northdonning Heedwell	Human transport to and from Aresam	60m x 40m x 15m 35 m. wingspan	5-10	8	30 hours
Lattice Barge (+ Modules)	Northdonning Heedwell	Materials transport to and from Aresam	13m x 25m x 49m	3	6	12 hours
Second-Generation Percherons	Northdonning Heedwell	Supply transport to and from Aresam	60m x 10.7m x 9.1m 28.6512 m. wingspan	5-10	8	2 days

3.2 Infrastructure

3.2.1 Atmosphere

Table 3.4 Atmospheric Composition

Gas	Percentage	Volume
Nitrogen	77	119350000m^3
Oxygen	20	31000000m^3
Water Vapor	2.96	4588000m^3
Carbon Dioxide	0.04	62000m^3

Aresam will have an Earth-like atmosphere consisting primarily of nitrogen and oxygen. Most trace gases will not be present as they are not needed to sustain life. Pressure will be maintained at 101.325 kPa, in a total volume of 155,000,000 m^3. Temperatures will be kept between 20 and 25 degrees Celsius, using heat harvested from the waste and power systems (see 3.2.5). The composition of the atmosphere will be maintained by an automated system, detailed in 5.2.1, which will continuously sample and filter the air.

3.2.2 Food Production

Meat will be produced by *in vitro* growth in factories located in the basement. Muscle fibers are immersed in a solution with stem cells, causing them to grow and multiply. When the muscle fibers are completely grown, they will be injected with collagen via micro-injection needles. The fibers and myoblasts are then combined in a centrifuge, transforming each lump of cells into bundles similar to natural muscles. These bundles are then injected with nutrients as needed, and sent to be processed.

Figure 3.2 Meat Production

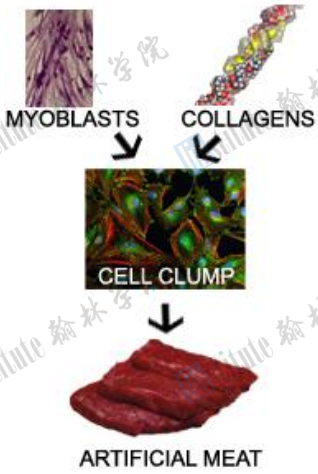


Table 3.5 Crop Production

Food Category	Quantity (kg/year)
Grains	3,100,000
Fruits/Vegetables	2,964,940
Meats	821,920
Legumes	132,000

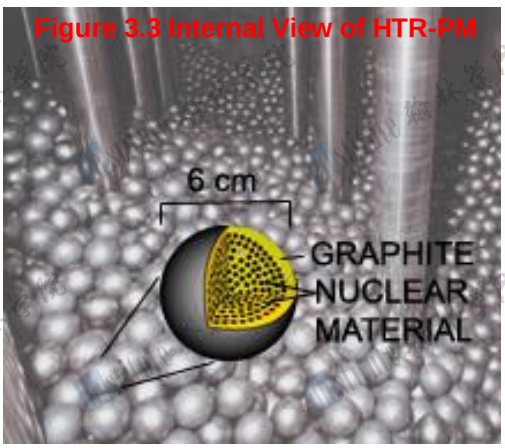
Crop production will be integrated into the landscape of Aresam, where plants are grown aeroponically in parks and gardens, along pathways, the roofs of buildings, and along the main walls of the station, using space efficiently and enhancing the views available to residents. Nebulizers will fog the roots of plants, located in concealed tubes, supplying nutrients and water. Crop harvesting will be handled by the Crop Robot (detailed in 5.2.1), which will monitor the progress and health of crops and meat before harvesting and delivering them to the processing center.

After processing, meats and crops will be vacuum sealed in specially designed containers and stored at low temperatures. Residents may pay to have their food delivered directly to their homes, or purchase food from a neighborhood market. In either case, the food will be transported by the Magnetic Suspension Transport System (MSTS), a system designed to transport consumables throughout Aresam by means of maglev tracks running beneath each of the ten partitions. The transportation module will consist of an air-tight capsule featuring four neodymium magnets placed around it, attached using a non-magnetic high strength polymer. For delivery, the capsule will be placed into a tube lined with electromagnets and, is sent to its destination, guided by scaled down guidance system (detailed in 5.2.1).

3.2.3 Power

Aresam will use the High Temperature Gas-Cooled Reactor Pebble-bed Module (HTR-PM) as the main power source. Uranium-233 fuel, created by bombarding thorium with neutrons, is sealed in graphite pebbles, placed in a simple, shielded container and cooled by helium. It is able to operate at higher temperatures than light water reactors, increasing the amount of electrical energy produced per amount of thermal energy, and has the ability to cool itself via natural circulation without damage to the core in the event of coolant loss, reducing cost. Heat is also harvested to maintain the residential torus internal temperature. Each reactor generates

Figure 3.3 Internal View of HTR-PM



190,000 kWe, fits within a 25m by 7m by 7m space and runs for 40 years when running at 85% fuel capacity. Two reactors will be present on the station, with one providing power needs and the other on standby in the event of contingency. The radioactive waste, uranium-232, is encased in the graphite balls; they are emptied and refilled with fuel as necessary by an automated system. The wastes are stored in lead containers in a location far from human reach, where they will eventually decay into lead. As a secondary power supply, Aresam will use an array of ElectroSelf units, self-recharging hydrogen fuel cells. They both consume and generate water, and will provide immediate back up power in case of reactor failure. Supplies of biogas, created in the waste treatment process, can also be burned for fuel.

In order to efficiently store the electical energy prodcued by (HTR-PM), Aresam uses electrostatic nanocapacitors to store excess energy produced after power usage. These capacitors are made of millions of titanium nitride-aluminum oxide nanostructures, combined in panels, which transport electrons between their large surface areas. The unusual combination of certain natural behaviors of the nanostructure's material allows the capacitor to store and deliver power with their characteristically high power (up to 1 MW/kg) and fast recharge while also having a high energy density (.7 Wh/kg). To send power out from the generator to the various sectors of Aresam, a wired grid system will be used.

Table 3.6 Power Allocation

Use	Allocation
Residential Use	33,000 kWe
Industrial Processes	50,000 kWe
Agricultural Use	80 kWe
Operational Systems	5,000 kWe

3.2.4 Water

Table 3.7 Water Allocation

Uses	Amount
Agricultural	314,250 L
Residential	6,245,930 L
Industrial	1,615,315 L

For water purification on Aresam, a system of filters, reverse osmosis, and UV light treatment will be used. First, water will be run through a combination of sand and sediment filters of sand and sediment to remove solids and pathogens. After passing through the filters, the water will be exposed to UV light to kill all remaining bacteria and improve taste. Finally, the water will undergo reverse osmosis for further purification. Water will then be sent to one of ten reservoirs located in the basement of each partition, holding a total of 8,175,500 L. An automated system (detailed in 5.2.1) will check the purity of this water before it enters the reservoirs, using small robots able to enter and exit the system at will through tubes.

3.2.5 Solid Waste Management

Table 3.8 Waste Produced

Source	Amount (tons/year)
Residential	15,000
Industrial	8,000
Agricultural	1,000

Before treatment, all waste from household and industrial sources is sorted by a system incorporating infrared spectroscopy (I.S. Sorting). Halogen lamps will reflect infrared light off the waste as it passes by a sensor. The sensor will then read the various reflected light wavelengths to discern recyclable from non-recyclable waste. The recyclables will then be separated from the waste by small robots and materials will be re-used.

To treat wastes from household and industries, Aresam will use the Biotechnische Abfallverwertung GmbH (BTA) process, a solid waste treatment process split into two steps. In the initial step, waste will be pulped with wastewater to form a slurry with a solid matter concentration of 10%. In the second step, the slurry undergoes anaerobic treatment in a methane fermentation system resulting in compost and biogas. The compost will be used for fertilizer in biome parks (see 4.1.1), while the biogas is both stored to be used as a backup energy source and sold. The process occurs in a plant with a capacity of 25,000 tons of waste per year.

Figure 3.4 Solid Waste System

3.2.6 Internal Transport

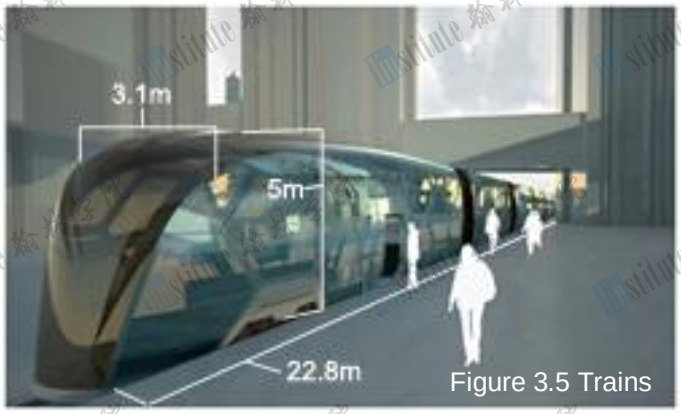


Figure 3.5 Trains

For mass transit in Aresam, electric trains following embedded guide ways will be used. There are 30 train cars, split between 15 trains, and each car has two floors and holds a total of 370 people, with 110 of them sitting down.

For personal internal transportation, bicycles and cars will be used. Bicycles will feature a carbon-fiber frame and sport an integrated digital monitoring system. The system will monitor speed, time, and route information, displaying the data on a thin LCD panel located between the handlebars. The bike will also include a continuously variable transmission (CVT) to allow for seamless shifting of gears when accelerating. Aresam's cars will be battery powered and have a CVT. The cars can be either driven manually or follow a set path chosen by the passengers. When the passengers allow the car to drive itself, they will be prompted to enter a destination into the car's Navigator system (detailed in 5.2.1). The car will then follow the shortest route to that destination after assessing its pre-programmed roadmap of Aresam and traffic conditions. Cars will incorporate a compacting design (as shown in figure 3.7) to maximize storage efficiency.

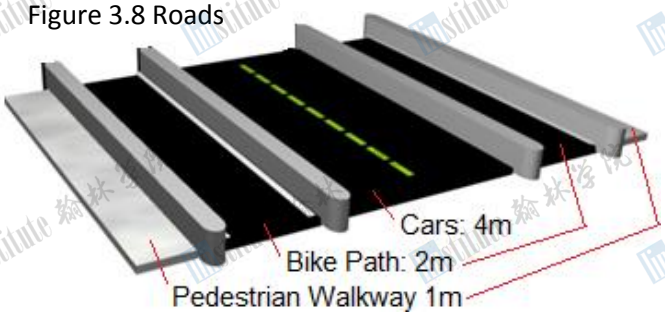
Figure 3.6 Bikes

Figure 3.7 Folding Cars

Table 3.9 Internal Vehicles

Vehicle	Dimensions	Quantity	Population Percentage
Electric Trains	22.8m x 3.1m x 5m	15	50%
Cars	3m x 1.5m x 1.25m	825	15%
Bicycles	185cm x 50cm	7700	35%

Figure 3.8 Roads



3.2.7 Day/Night Cycles

Table 3.10 Day/Night Cycle		
State	**Start**	**End**
Day	7:00 am	6:00 pm
Sunset	6:00 pm	7:00 pm
Night	7:00 pm	6:00 am
Sunrise	6:00 am	7:00 am

Aresam will use white phosphorescent active matrix organic LED panels to simulate a day/night cycle lasting twenty-four hours. OLEDs are produced in large panels, have a long lifespan and are energy efficient, making them optimal for large scale use. The active matrix allows for greater control of the state of individual OLED cells.

3.2.8 Storage Facilities/Contingencies

For food and material storage on Aresam, multiple storage rooms will be used. Each partition of the station will have in its basement a freezer for frozen goods, a chilled chamber to keep foods fresh for sale that day, and a room-temperature room for non-perishable consumables. Aresam's excess food production, 5.25 million kg of crops and protein, will be harvested and stored in the ten temperature and humidity controlled airlock freezers found in the basements beneath each partition for up to 10 months at a time. Additional non-food supplies, such as medicine and metals, will be split among ten dry storage airlock chambers, each capable of holding 500 m^3, with gases and liquids stored in pressurized tanks. Should the need arise, supplies may be diverted to Martian surface operations while production is increased to re-stock stores.

3.2.9 Communication

Table 3.11 Comm. Devices

Category	Number
Plymouth array	1
Mars satellites	3
Mars Orbit Sat.	2
Earth Orbit Sat.	2

Internal communication in Aresam will utilize the system described in 5.3.6. External communication will use radio and laser satellites to requested destinations via external satellites. The Plymouth communications array will be stationed at the bottom of the centrifuge, and will work with three satellites orbiting Mars, two in Mars' orbit, and two in Earth's orbit to ensure constant communications between Aresam, Mars and Earth.

Figure 3.9 Comm. Devices

3.3 Construction Machines/Equipment

Following harvesting, raw material is either processed by a Lattice Barge on site or in the industrial torus.

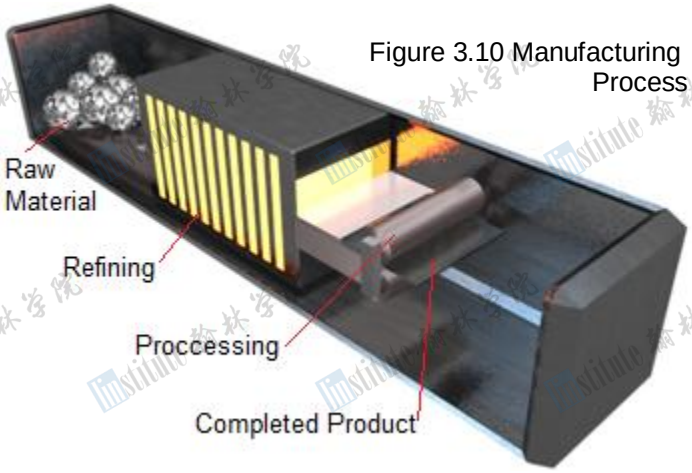


Figure 3.10 Manufacturing Process

3.4 Construction Materials

Mining bases are built on Mars' two moons before the station, allowing harvested materials to be used in station construction. As the mining progresses, miner robots will harvest the materials using an automated system detailed in 5.1.1, place them into pods and shuttle these pods to a Lattice Barge (see 5.1.1).

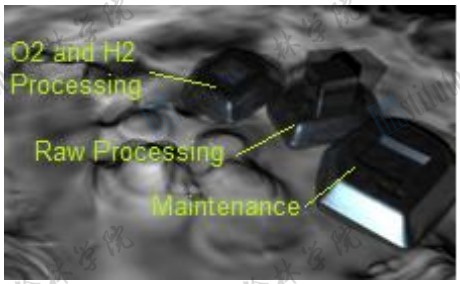


Figure 3.12 Mining Facilities

Figure 3.11 Construction Equipment

3.4.1 Materials Harvesting

Table 3.12 Refining Processes

Material	Refining Process
Silicon	Electrode arc furnace
Iron	Blast furnace
Nickel	Flash smelting
Aluminum	Bayer Process, Hall-Heroult Process
Chromium	Chromium-CO refining
Ice and volatiles	N/A

Prior to mining base establishment, Lattice Barges with mining and materials processing modules extract and refine ores, processing the resulting materials into basic shapes such as sheets (see figure 3.10). After construction of mining bases, the mining process is monitored by the artificial neural network. Each Barge will be filled with pods until full and sent out to the station's location, where it is emptied and sent back. For efficiency, mining bases contain basic refining equipment, while Aresam houses more specialized equipment.

3.5 Pre-Fabricated Base Operations

3.5.1 Power Consumption

Table 3.13 HUT Power Generation and Allocation

Allocation	Amount (kW)	Source
Life Support	65kW	Solar Array/Turbines
Lab	6kW	Solar Array/Turbines
Contingency	15kW	Hydrogen Fuel Cells

The HUT will generate a total of 71 kW using a combination of solar and wind energy. The daily power will be supplied by a 106 m^2 silicon solar mat deployed on both the roof and Martian surface. During sand storms when light reaching the solar panels is inadequate, fifteen horizontally-stored 0.75m diameter wind turbines will fold out from the sides of the building. The turbines, made of boron carbide, will be able to resist erosion from the Martian dust storms due to the durability of material and an automated lubrication system (see 5.2.1). The turbine propellers will be able to retract or lock into place according to the current power needs. Hydrogen fuel cells produced by electrolysis in atmospheric regulation (see 3.5.5) will also available for emergency fuel.

3.5.2 Water

Table 3.14 Water Allocation

Uses	Amount
Agricultural	10 L
Human Needs	400 L
Lab	3 L
Emergency Storage	40 L maximum

The inhabitants of the HUT will have 400 L of water readily available. Additional water, treated with iodine to control microbe growth, will be stored in an another tank in case of emergencies. All waste water will be collected in a filtration tank, where it will be distilled and separated from most of its pollutants. After this process is complete, the water will be sent through an activated carbon bed, to remove any remaining chemicals, and then be sent back to the main water tank.

3.5.3 Solid Waste

Table 3.15 Waste Produced

Source	Amount
Organic	158.7g
Recyclable	1200g
Non-recyclable	400g

Human waste will be heated to 320 degrees Celsius, removing approximately 90% of water and killing all pathogens. Afterwards, the waste will be compressed into pellets and stored. All other organic waste will be composted for food production. Inorganic waste is stored and returned to Aresam for processing when the crew is picked up for their return journey.

3.5.4 Food Supply

Table 3.16 Food Provided

Amount of Food	Allocation
218kg	Initial 4 HUT residents
Varies	Next visitors

An initial supply of 218kg of food stored in reusable containers will be sent down in a 1 cubic meter freezer. Future settlers can contact a HUT via Aresam to have food provisions prepared prior to their arrival. Crops will be planted by the Crop Robot (detailed in 5.2.1) in a hybrid aeroponic/geoponic chamber from stores of seeds and seedlings.

3.5.5 Atmosphere

Table 3.17 Volumes of Air

Gas	Volume (m^3)
Nitrogen (N_2)	265.43
Oxygen (O_2)	68.9
Water vapor (H_2O)	10.2
Carbon Dioxide (CO_2)	.14

The original atmosphere of the HUT arrives in storage tanks, gases being released after full deployment. The atmosphere is maintained by a humidifier/dehumidifier, oxygen production, and carbon dioxide scrubbing. Oxygen will be produced using electrolysis on water in a potassium hydrate solution, resulting in 25L of oxygen per liter of water input. Running the unit for four hours a day produces enough oxygen for all 4 crew members each day. The oxygen will be released into the HUT as needed while the hydrogen will be used as emergency back-up fuel. Carbon dioxide is scrubbed via activated carbon beds, which are recycled by introducing overheated steam into the system, breaking the CO_2 from the filters. CO_2 is released into the Martian atmosphere. Emergency lithium hydroxide canisters, which remove CO_2 will be present in case of scrubber failure.

Human Factors

"Here's something pompous- you take your day and artistically create it, so every moment has an artistic flair."

-William Shatner

4.0 Human Factors

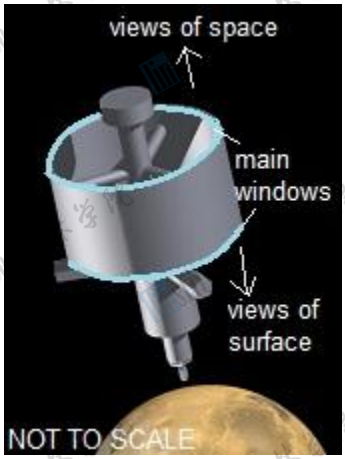


Figure 4.1 Natural Views

4.0.1 Coriolis Countermeasures

In order to acclimate incoming residents and transients to the Coriolis effect, everyone will participate in group training sessions held in a spinning room in the docking area. Training will consist of basic day-to-day activities that will be experienced on the station. Communities will be planned in a grid system, reducing the need to turn heads to navigate.

4.0.2 Natural Views

Windows providing natural views of both space and Mars will span the circumference of the residential torus. The windows will be constructed of lunar glass, two panes of which will encase a layer of ozone capable of blocking harmful solar radiation. Sensors within the panes will monitor ozone levels, detecting and reporting any leaks.

4.1 Aresam Communities

Figure 4.2 Community styles

Aresam's communities will bring together four distinct social backgrounds, creating a richly diversified environment steeped in cultural heritage. The Coastal Territory homes and amenities are designed with the principles of California in mind. Ocean sounds, soft breezes, and open floor plans will replicate the atmosphere of a coastal city. This area will contain more apartments and condominiums for single residents. In addition to holding concerts, shows, and festivals, the territory will also be home to a recreational park containing sand, providing residents with volley ball and "beach" yoga facilities encouraging relaxation and wellness.

Figure 4.3 Canvas Project

The Spanish Quarter is enveloped with life and tightly knit neighborhoods. The gothic architecture, iron fence work, and hanging shrubbery will all evoke a feeling of the old world. Local cafes and recreational parks will cater to the needs of locals, as well as provide gathering spots for families and friends. The Spanish quarter will contain a larger amount of houses designed with families in mind. In true Spanish tradition, locals will be able to experience augmented reality bull runs. The booming Metropolis and upscale buildings of the Midgard District will be modeled after New York's Time Square. Active couples and small families will be able to visit art galleries and museums similar to those found in Earth-based cities like the original Big Apple. Residents will be able to express their creativity through the citywide Canvas Project, which will allow them to paint on public buildings through augmented reality technology. The French Providence will be modeled after the sophisticated culture and intricate architecture of France. Small families and married couples will have gourmet food, parks, and street markets at their fingertips. Gazebos, virtual balloon rides, and a carousel will further add a sense of whimsy and entertainment to the providence.

4.1.1 Facilities for Services

Northdonning Heedwell will meet and exceed the living requirements of its citizens with a wide selection of functional, aesthetically pleasing facilities.


Figure 4.4 Biome Park

Parks and Recreation

To keep its residents in a healthy physiological and psychological state, Aresam will feature an ample amount of physical activities. Aresam's biome parks will act as slices of Earth, sampling themes from its mountains, tundra, forests, and grasslands. Residents visiting the mountain biome will spend time hiking or climbing on rock walls hewn from the Martian crust, while those in the tundra park will find artificial snow and oil-packed polymer "ice" skating rinks. Both the forest and grassland biomes will offer a more relaxed set of activities, such as picnicking and nature walking. Recreational centers throughout Aresam will provide facilities for exercising, each one offering a current pool, weight center, and augmented-reality treadmill area. Current pools will feature a swim-in-place jet system, allowing the swimmer to fully customize the resistance against swim strokes in a smaller space more suited for personal training.

Entertainment

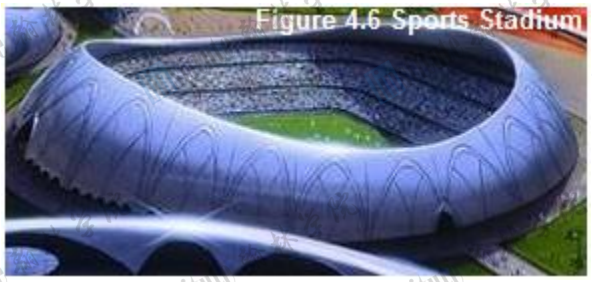


Figure 4.6 Sports Stadium

Each community is home to dozens of entertainment opportunities. Parks provide visits to Earth-like environments, while recreation centers house soccer, basketball, and tennis facilities, exercise equipment and classes, current pools for swimming, 3D mazes, and virtual reality video game tournament rooms. Assembly halls double as theaters for shows and movies, while the streets of Aresam double as theaters for musicians and dancers. The Spanish Quarter will be unique in its virtual reality bull runs, an event that showcases Aresam's cultural embrace.

Housing

Table 4.1

Home Type	Quantity	Square Feet (ft^2)
Midgard Loft	5500	998 ft^2
Spanish Villa	275	1600 ft^2
French Chateau	580	1444 ft^2
Coastal Retreat	6875	1288 ft^2

Each home harmonizes with the municipality it resides in, bringing the culture's architecture and ambiance together. The quantity of each housing unit corresponds to the size, the apartments being abundant and larger villa scarcer.

Health Care

Aresam will have two hospitals in each community. Each medical center will be fully staffed with doctors and medical robots, and are fully equipped to handle any medical emergencies. For minor concerns, automated systems assess the patient's condition through constant body function reading, provided by the e-Shirt (see 5.3.1), and appropriate remedies are prescribed. In emergency situations, e-Shirts will alert an ambulance and the patient will be rushed to a hospital for immediate treatment.

Assembly Halls

Assembly halls will be available in every community, capable of serving as centers for religious practices, meetings, celebrations, and performances.

Education

Residents of Aresam seeking education will be able to learn at their own pace from homes and community centers in virtual classrooms. Online textbooks and resources will be made available to students, along with a staff of tutors.

Community Design Map

Ten partitions are designed in one of four styles, described in 4.1. Each community has slightly varying facilities; however, the general layout remains the same. Areas not yet assigned a function will be available for expansion for commercial or residential use.

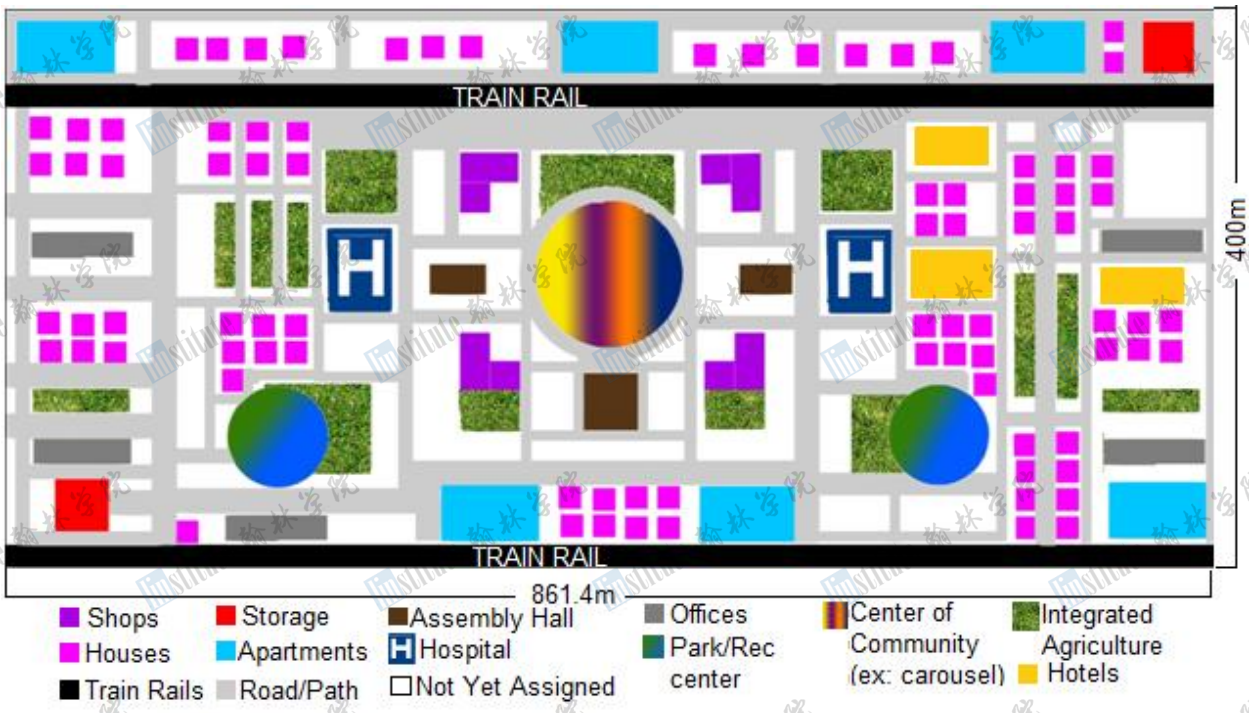


Figure 4.7 Community Design Map

4.1.2 Distribution of Consumables

Table 4.2

Category	Source	Amount Produced
Toiletries/Cosmetics	Aresam	10,731 items
Clothing	Aresam	1,296,650 items
Food	Aresam	13,797,000 kg
Medical Supplies	Aresam	14000,000 products

The Magnetic Suspension Tube System (MSTS) will distribute goods to Aresam's residents (see 5.2.1). The distribution system runs throughout the station, giving residents the option of home delivery or pick-up at set locations

4.1.3 Consideration of Psychological Factors

Many psychological amenities will be incorporated into Aresam's design. Day/night cycles, natural views, and spacious sights that are reminiscent of Earth are some of the ways Aresam will emulate a familiar environment for its residents. Communication to other settlements as well as Earth will promote continue connectivity with the old world. Unhindered views of space will be incorporated into the stations design for colonist to enjoy the stars. OLED lighting will provide illumination akin to a clear blue sky, coupled with the horizon created by the natural curvature of the station and vegetation such as flowers, grass, and trees to make a more Earthly environment. Sounds of wind, birds, and other wild life will contribute to the atmosphere of Aresam. Mimicking Earth's natural cycles will help to advocate productivity, conductivity, and a healthy state of mind.

.

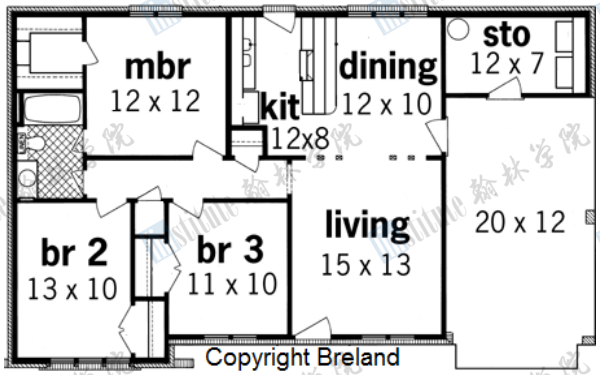
4.2 Residential Design

4.2.1 Interior/Exterior Design

Homes will be divided into four residential areas. The Midgard District will be city-based and contain more apartments and condominiums. The Spanish quarter will contain larger family houses and have a family-centered lifestyle. The French providence will be more sophisticated and contain upscale townhouses. The coastal territory will be more relaxed with open floor plans and incorporate more windows into their design.

4.2.2 Floor Plans [Figure 4.8]

Midgard Loft



Spanish Villa

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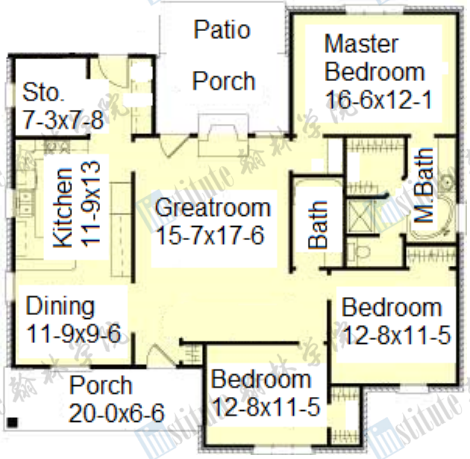
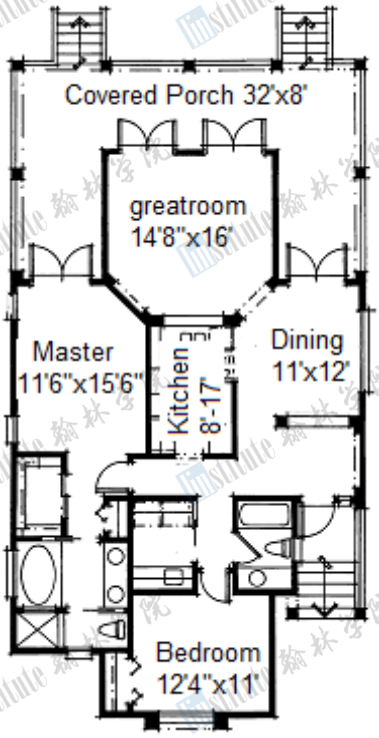




Costal Retreat

French Chateau

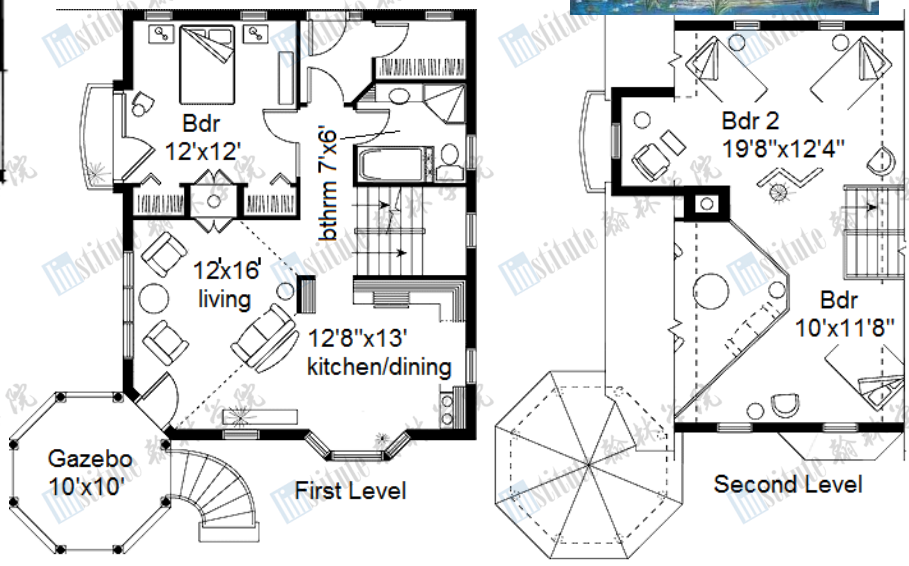


Table 4.3 Furniture Provided

Furniture Type	Quantity
Beds	20,031
Couches	13,230
Bathtub/Shower	16,025
Toilet	16,025
Sink	16,025

4.2.3 Customizability

Architecture

The houses and amenities in the Coastal Territory will be designed with pastel-colored stucco wall panels. These houses have open floor plans and incorporate more windows into their architecture. The Spanish quarter is a tight knit community with wide cobble stone streets leading around the quarter. There will be minute Gothic details on houses and churches with warm color pallets and iron fence work. In the French Providence, muted color palettes and intricate architecture reflect the sophistication and refinement of French culture. Street markets allow neighbors to interact regularly, as well as for residents to sell their home produced goods and services. The Midgard District will incorporate towering structures into its design, playing along with the city motif.

Figure 4.9 Custom bath/shower

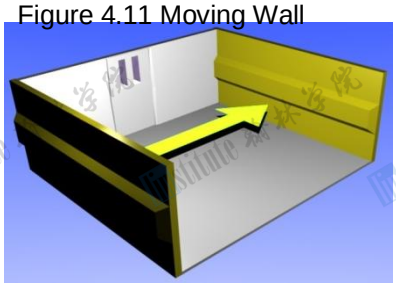
Furniture

Aresam will give its citizens the freedom to customize their living quarters according to preference. Lavatories will be furnished with a tub mounted on a swivel, able to play dual roles as bath and shower. The dining room table is a multipurpose table containing a mini-dish washer, toaster, microwave, refrigerator, and coffee maker in the pull-out center (detailed in 5.3.4). The tabletop functions as a display enabling residents to view recipes or read the news. Residents will be able to store items in stackable bins, providing a means for organization and conserving space.

Figure 4.10 Custom Couch

Room Design

Figure 4.11 Moving Wall



There are different options and styles available to cater to the people's varying tastes and preferences. Each home will be equip with multiple functions dedicated to full customization; this will ensure maximum comfort within the home of each resident. Each room will have a wall panel that allows the owner to customize their living space as well as moving wall units to accommodate the size of the home. The owner will be able to use their HUD to display what the furniture will look like and the location in their homes. Citizens will have total control over the layout of their homes. Northdonning Heedwell appreciates colonist's individual needs and wants each occupant to be at ease in a place of their own design.

4.3 Designs of Systems

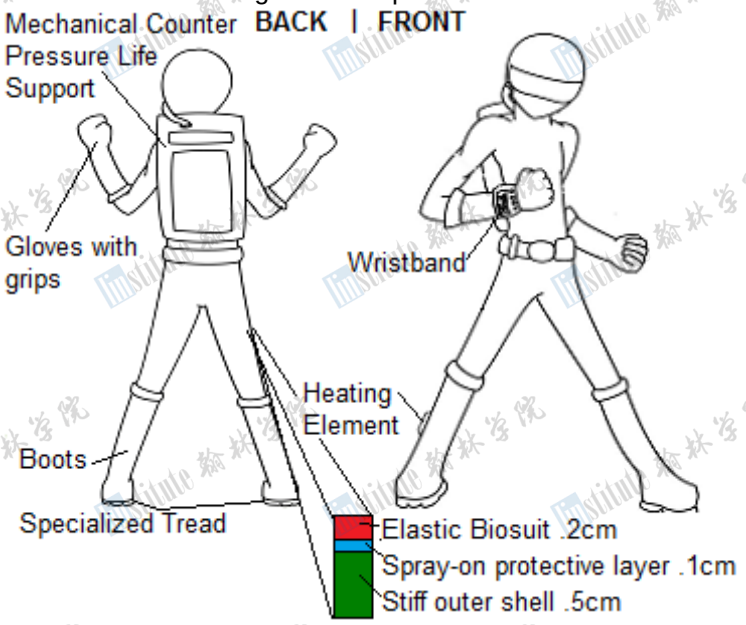
4.3.1 Spacesuit Design

Northdonning Heedwell has designed a custom-fit spacesuit for its residents and transients. The spacesuit will use mechanical counter pressure and Shape Memory Polymer (SMP) fibers capable of being easily thermally repaired. The suit will have a belt clipped at the waist customized for the wearer, and a pack of essential tools. High traction boots will contain a heat conductor to fix any small damages in the suit during prolonged extravehicular activities. An embedded computer in the suit's wristband will signal the wearer of any small rips or tears, allowing repairs to be made.

4.3.2 Donning/Doffing/storing

In order to ensure the safest and cleanest donning and doffing process, spacesuits will never fully enter the colony. Colonists will don and doff their suits in prep rooms where the suits will be stored. The wearer will step into the suit, composed of an elastic bio-suit layer. The suit will then be zipped from behind. The "spray on" second layer, is applied next, protecting the suit from planetary dust. The hard torso shell and portable life support system are then donned along with the helmet and tool belt. Before doffing, colonists must first be purged of all planetary residues. This task will be handled by a vacuum coupled with computer sensors. Colonists will then reverse the donning process, from which the outer shell and bio-suit will be sent to a cleaning facility and then later stored.

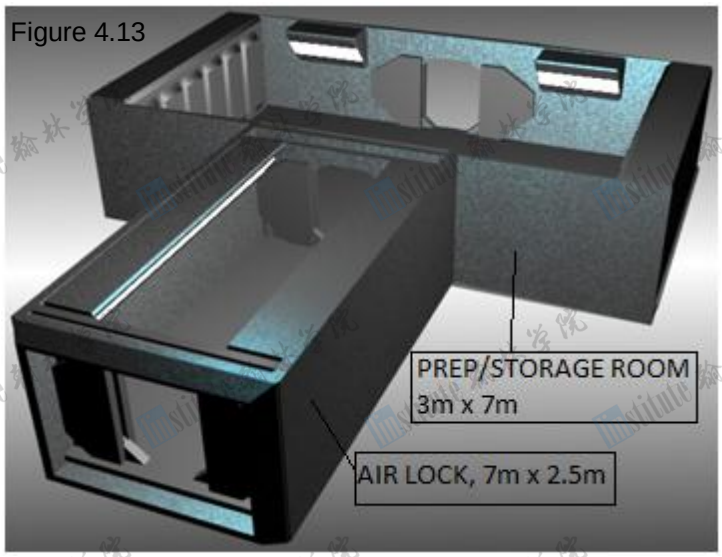
Figure 4.12 Spacesuit



4.3.3 Airlock Design

The airlock consists of three chambers: a prep room, the airlock itself, and a storage facility. The prep room's primary use is for pre-release preparation (i.e. changing into space suits); within the prep room wall storage units will store and keep suits uncontaminated. To prevent air loss, a specialized computerized sequence within the doors will be used to maximize efficiency and safety. Minimizing air loss takes the highest precedence, and computer sequencing will ensure maximum air retention. The air lock components are designed to work with maximum energy efficiency; helping to circulate power to other systems. Control panels within every air lock room will prevent the doors being opened while the airlock is in use. Air lock pass code recognition ensures maximum security; preventing accidental door releases and closing.

Figure 4.13



4.3.4 Devices And Vehicles

Bicycles will have on-board computers that will show directions to the rider's destination. On cars, the computers will monitor speed and destination between objects to direct traffic flow. The car accepts user-input to drive itself to a location, using the aforementioned traffic data to select the path. If the driver does want control, a manual option is available. The car is capable of slowing itself to a stop should it detect an imminent collision.
The health of residents will be monitored through e-Shirts

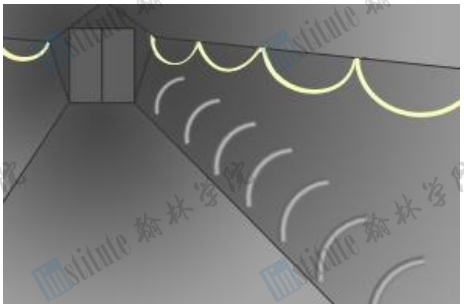


Figure 4.14

(detailed 5.3.1) which monitor blood pressure, temperature, and heart rate. If an emergency arises, an ambulance will be summoned to transport the patient to the nearest hospital, where a staff of physicians will begin administering treatment. Handholds and tethers will be available to colonists in low-g environments such manufacturing oversight areas in the industrial torus, as seen in figure 4.14.

4.4 Anticipated Demographic Changes

Years after Initial Population arrives	Population*	increase(+)
0	20000	N/A
5	20250	50
10	20500	50
15	21750	50
20	21000	50
25	21250	50
30	21500	50

*This number does not include transient population

Aresam will be fully equipped to provide for a fifty person increases yearly for a thirty year time. Positive relations of colonists and careful watch on development will balance and accommodate an ever-increasing community.

4.4.1 Anticipated Trends

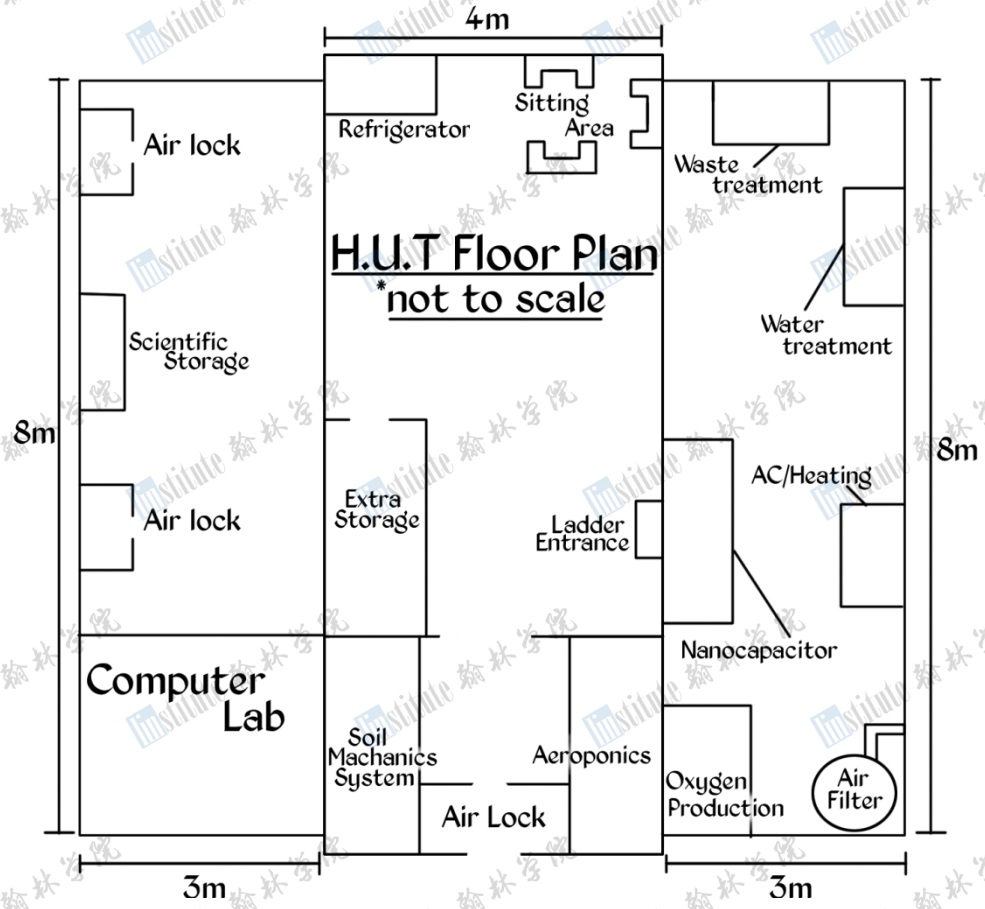
Event	Ratio (per 20,000)
Birth	284
Death	162
Marriages	130
Divorces	68

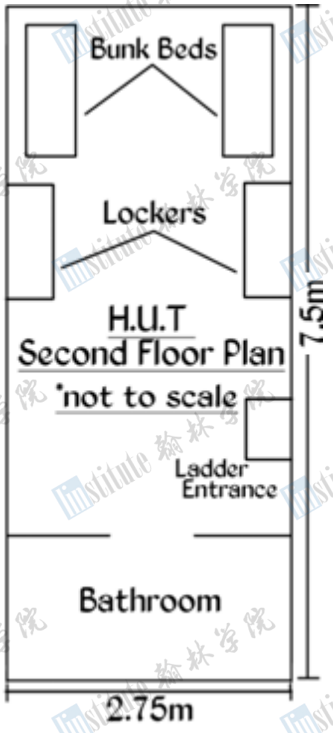
4.4.2 Possible Adaptations in Housing and Communities

Aresam will be fully equipped to provide for station wide growth by utilizing compact building methods as well as rationing the space for development. Through a positive living environment for colonists and meaningful development will balance and accommodate an ever-increasing community. Control will be put into the resident's hands ensuring maximum flexibility, and offer residents multiple options from living spaces to food type. Leaving extraneous room offers flexibility without disturbing current residents from establishing peaceful communities.

4.5 Living Quarters and Amenities for HUT

The HUT is equipped with many windows scattered throughout the bedroom and living room, giving a beautiful view of outside space. HUT residents will be able to enjoy TV with specialized video games with state of the art motion sensitive remotes; allowing the HUT residents "get away" from the stressful life lived in outer space. Food provided for initial HUT residents will be frozen, premade crop based meals ready for reheating and consumption for the first 30 days. HUT users will input their daily activities and their meal plans will be selected for them based on their daily caloric needs. This ensures that food supplies will meet the varying needs of HUT scientist's day-to-day life and prevents waste. HUT scientists will also have access to their own personal lab, which can be sealed and quarantined.


4m
Air lock
Refrigerator
Sitting Area
Waste treatment
H.U.T Floor Plan
*not to scale
Water treatment
Scientific Storage
8m
Air lock
Extra Storage
Ladder Entrance
AC/Heating
8m
Nanocapacitor
Computer Lab
Soil Machanics System
Aeroponics
Oxygen Production
Air Filter
Air Lock
3m
3m


Bunk Beds
Lockers
H.U.T
Second Floor Plan
*not to scale
7.5m
Ladder Entrance
Bathroom
2.75m

Automation

"Genius is the very eye of intellect and the wing of thought; it is always in advance of its time, and is the pioneer for the generation which it proceeds."

-William Gilmore Simms

5.0 Automation

Aresam will provide its residents with cutting edge automation. This high technology will bring to our residents an unsurpassed piece of mind and comfort as well as a simplified lifestyle.

5.1 Construction Automation

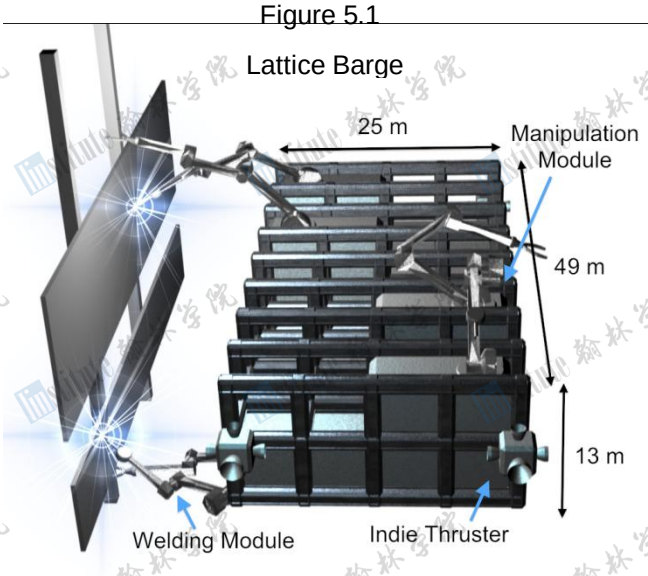
Robot	Tasks Performed	Dimensions (m) w x h x d	Units
Lattice Barge	Base structure used to congregate construction modules and store materials.	13 x 25 x 49	50
Indie Thrusters	Attaches to different modules and Barges to change and maintain their position.	3 x 3 x 3	150
Mining Module	Used for initial extraction of raw materials from surface of moons.	5 x 5 x 23	60
Material Processing Module	Processes raw material into construction grade components.	5 x 5 x 23	30
Welding Module	Uses electron beam welding to attach metal sheets, trusses, and all structural units.	5 x 5 x 12	40
Manipulation Module	Advanced six-axis articulated arm used to manipulate objects around Barge.	5 x 5 x 12	100
Storage Module	Large holding area for all ready to assemble materials.	5 x 5 x 23	100
Power Module	Module with hydrogen fuel cell to provide power to electric grid within Barge.	5 x 5 x 12	55
Dust Mitigation Robot	Independent robot used to remove excess dust from essential parts using alternating electrostatic sweeper.	4 x 4 x 4	25
Prefab Parts Manufacturing Module	Manufacturing facility used for interior phase to create all interior parts of settlement.	5 x 5 x 23	60
Finale Robot	Monotonous robot used for final finishing and interior maintenance.	.8 x 1.5 x 1.5	300

5.1.1 Delivery of Materials

The Lattice Barges will be assembled from triangular trusses at Bellevistat and first loaded with Mining, Processing and Power Modules. The first Barges will be used for material mining and will be sent as early as possible on the first Cycler Spacecraft. The Barges used will be slightly structurally modified for landing on surfaces of moons and simple surface mobility. The Mining Modules will provide most of the raw materials for construction, oxygen, and hydrogen for fuel. The later batch of Barges sent on the second Cycler Spacecraft will be solely utilized for the automated construction of the settlement. The Cycler Spacecrafts will then be used to transport materials, robots, and tools that cannot be provided by mining and construction Barges.

Figure 5.1

Lattice Barge



5.1.2 Exterior Construction

All Barges, Modules, and Thrusters will be part

of an early stage artificial neural network using low-latency networking. Each individual entity will be equipped with high accuracy star tracking systems and use advanced location algorithms for smooth operation. The Indie Thrusters are independent propulsion systems that will be used for reaction control and short distance propulsion. The Indie Thrusters will attach using a standard latching system. All entities of the construction fleet will work in unison thanks to the neural network, which will oversee and ensure the use of the most efficient module configurations for material processing, manipulation, and assembly. The construction process will start with mining of raw materials and initial processing in the Barges on the moons. The Indie Thrusters will move storage modules with raw materials from mining Barges to the construction Barges. The construction Barges will prepare materials for assembly with dedicated Material Processing Modules. Manipulation Modules will ensure the Barge's flexibility to maneuver any number of parts while the Welding Module fuses parts together.

5.1.3 Interior Finishing

Upon exterior structure completion, the Prefab Parts Manufacturing Modules will be delivered from Bellevistat to the construction Barges. These high tech Modules consist of specialized manufacturing chains within that will manufacture 1onsite all the prefab parts necessary for interior facilities. Such prefabricated parts are the skeletal structures of houses and the All-In-Walls. The All-In-Wall concept consists of creating modular wall segments that fasten easily and provide all necessary utilities necessary within the house. These All-In-Walls will make up all the walls in the settlement and provide power, water, HVAC, networking, ambient lighting, and time-of-flight laser 3D scanners (used for interface see 5.3.1). The Barges will assemble the interior structures by moving on the inside of the torus structure using Manipulation Modules for gripping. The Barges will use a different module configuration for completing internal structures, working their way up from the basement to the tallest building. The Barge will use the strategy of building its way up so that it can add all necessary finishings before completing a level and building the next one. The Barges will be disassembled while most modules will be repurposed for other tasks such as maintenance. When artificial gravity is initialized the final preparations such as furniture placement and quality checking will be carried out by the Finale Robot, which will continue being used for interior maintenance after the settlement is completed.

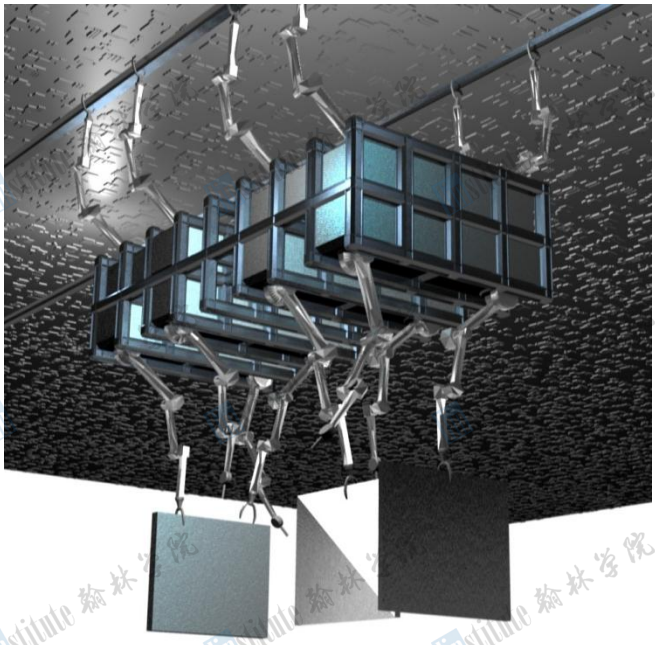


Figure 5.2 Interior finishing Barge

5.2 Automated Operations

5.2.1 Automated Utilities

System	Method
Power	A system with double redundancy will ensure safe operation of the reactor by monitoring and correcting operations of the reactor. It will ensure safe storage of the graphite and uranium pebbles through a fully automated robotic storage system. The power grid will be monitored by a group of vital servers to ensure all power needs are met and efficiency is at its highest.
Water	Each All-In-Wall contains water pressure, quality, and leak sensors in order to maintain water safety and detect leaks. In case of a leak or contamination each All-In-Wall contains two valves on either end to shut off water flow. Contaminants will be neutralized by sending chemical reactants through the system and by purging the plumbing. Releasing rubber "platelets" of various sizes that will seal any leaks will repair

	leaks. Water reclamation will be monitored and optimized by critical servers.
Food	Meat will be grown in an automated in vitro system that will ensure healthy growth and consistent texture. Crops will be automatically misted with necessary nutrients and pollinated by RoboPollinators (robotic bees). A Crop Robot will use various sensors to monitor crop growth, guarantee quality, and harvest at the optimal time. Food will be packaged in a processing center where a partial amount will be sent to the basement and stored for contingency.
Food Preparation	Food can be automatically prepared and for meals within the kitchen facility. The cooking system consists of an assembly line set of robots specialized in different preparation techniques.
Atmosphere	Air quality will be monitored by the RoboPollinators placed throughout the station. CO_2 scrubbers and gas reserves will be used to regulate atmospheric pressure and concentrations.
Lighting	OLED lights are very reliable, in case of failure they will be replaced by Wall-A-B Robots
Delivery of Consumables	The Magnetic Suspension Tube System will deliver consumables and relatively small objects nearly instantly to a resident's house. The delivery processing center will sort and prepare orders quickly, sending them through the series of tubes.
Cargo	Transportation system similar to the Magnetic Suspension Tube System, but larger scale, will be used to transport cargo in the industrial areas and docking facilities.
Waste Disposal	Disposed waste will be sent through basement to the recycling facility where the automated waste disposal system will process all waste.
Transportation	Guidance system controlled by a main server will ensure a collision free operation of all transportation on the station.

5.2.2 Maintenance and Repairs

Automated System	Location	Tasks Performed	Innovations	Dimensions (m) w x h x d
Internus Robot	Internal Structural	Perform repairs to the internal structure of the station, such as buildings and transportation networks	Equipped with high strength sealants and polymers for temporary repairs before major repairs can be made equipped with welder and modular manipulation arms.	2 x 2 x 3
Externus Robot	External Structural	Perform repairs to the station hull structure can also repair docked ships	Repurposed construction Barge with Indie Thrusters magnetically attached to the outer surface. Can quickly move to required location.	13 x 25 x 49
Wall-A-B Robot	All-In-Walls & Computer Systems	Accesses computer systems & networks, perform minor repairs	Micro-size, spider-like limbs, foldable, easy access to systems within walls and computer servers work in groups different types equipped with different tools	.01x .01x .01
Finale Robot	Residential Interior	Retrieves and replaces objects in a house or building, ex. Furniture, fixtures, appliances	Repurposed from interior finishing phase adaptability to any object, can be requested for use anytime by residents.	.8 x 1.5 x 1.5

5.2.3 Safety

Emergency	Contingency Plan Response
Fire	Suppression systems will be concealed in the upper section of all the All-In-Walls in the station. Sensors will indicate the source and type of fire. The sensors will signal what type of suppressant, where, and how much. Personnel in the affected areas will be informed of the necessary evacuation.
Solar Flares	During solar flares all unshielded electronics will be temporarily shut down. Polyethylene will be incorporated into the structure of Aresam for general protection. Personnel not in the station will be signaled to return to the station ASAP.
Pandemic Diseases	Quarantine zones will be set up for the afflicted areas. The quarantine will last until all the patients are cured or a vaccine is developed. Only authorized personnel will have access to enter and leave quarantined area. The air supply to the quarantined zones will be separated from the main supply, in case of air-borne pathogens.
Violence	In case of violent outbreaks, there will be high intensity strobe weapons installed throughout the station. These can temporarily immobilize the target by dazing and disorienting them, allowing for proper response against the offender.
Airlock Failure	Only one lock can be opened at a time, therefore if one lock happens to fail the other two will be closed, which ensures no decompression will happen. If a lock does fail, the situation will be assessed by station officers that will decide either to bring people back in through the interior lock or perform a rescue from the exterior.
Hull Breach	In the event of a hull breach, Externus Robots will be sent to evaluate and repair damages. All residents will be notified to evacuate the area as quickly as possible in order for the affected partition to be sealed off. The total time for evacuation would be around 30 minutes to ensure all resident can leave the area. This amount of time would lead to only 2% loss of atmosphere.

Personnel will be notified immediately as soon as any contingency or emergency takes place. High ranking personnel will have the authority to override contingency plans as they see fit. Critical system data will be accessable to stations engineers only which will be able to use this information to take any action that may have been unforseen by contengency plans. The data will be displayed in a comprehensive chart through an augmented reality interface (see 5.3.1) and control will be base on commands. Identification for all purposes will follow the levels described in the following chart. Identification methods

Table 5.1 Identification methods

Level	Area Type	Persons Qualified	Methods for Authorization
1	Public	Residents Transients	ID Chip on e-Shirt Face Recognition
2	Business/Office	Working staff Personel	Fingerprint Scan Palm Geometry
3	Industrial Area	Management Servicemen	Iris Scan
4	Entire Station All System Areas	Station Officers	Behavior Tracking DNA

An important part of the station's safety is redundant systems which Northdonning Heedwell takes very seriously. Life-support critical server nodes, two located in each partition of the tori for redundancy, can all operate independently of each other. General purpose servers will be gathered in numerous datacenters. Each partition will house three data centers, including one solely for backup. These datacenters will be located in the basement of all partions and backed up data will always be located in a different area of the station. Each datacenter will be made up of approximatly 100 servers each for a total of 3,000 servers on Aresam.

5.3 Residential Automation

5.3.1 Computing

The residential computing experience will make use of a natural user interface and powerful social networking. The personal computing device will consist of the e-Shirt, a light undershirt worn under people's daily clothes, working side by side with retinal display contact lenses (or eyeglasses). The user interface is based on augmented reality, which enables unparalleled flexibility and integration. To promote social interaction, social networking is incorporated throughout the OS. The e-Shirt interacts with other devices throughout the station to enable the user to use any input or output methods, the best example being the e-Shirt connecting to the time-of-flight laser 3D scanners built into the All-in-Walls in order to map the 3D environment for augmented reality. The e-Shirt is powered by the thermal energy given off by the body and piezoelectric energy from the movement of the user. The e-Shirt uses nano-electronics embedded in the fibers as well as flexible organic flash memory in order to function and store data. The e-Shirt will incorporate numerous sensors such as electromyography for muscle computer interfaces, and will also collect information regarding health data. The retinal display contact lenses will be the main data display for people, it will overlay all necessary data and user interface, while also being totally unobtrusive when wished for. The lenses use nanophotonics as well as microelectromechanical systems to manipulate and display light on the retina. The contact lenses will also have photo sensors to enable the user to record images and videos in 3D based on their own perspective. Most of a user's data will be stored on their e-Shirt, while all of their data will be stored in a datacenter available from anywhere. In the workplace, to improve productivity, an immersive interface enables workers to concentrate on the task at hand while social networking allows for greater communication among coworkers; all while distractions will be reduced as set by requirements of the employer.

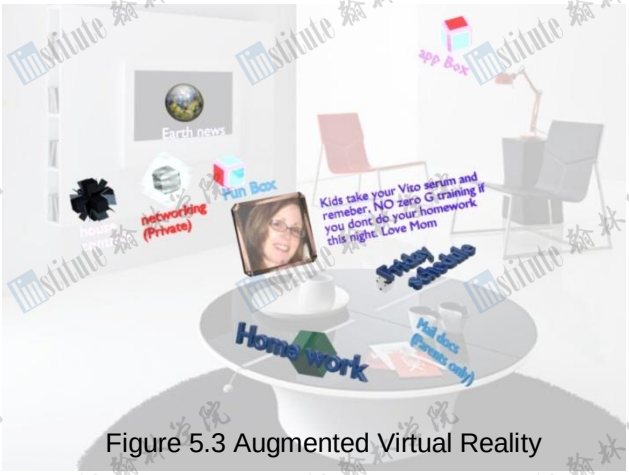
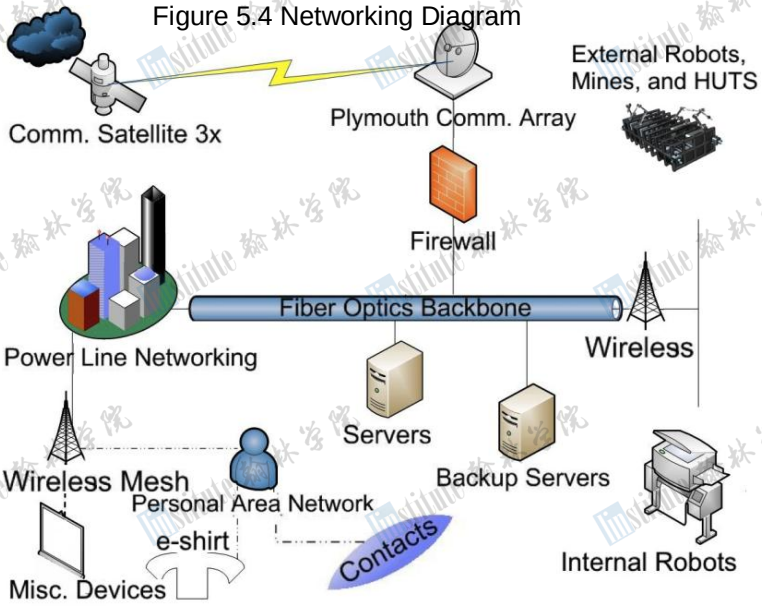


Figure 5.3 Augmented Virtual Reality

Figure 5.4 Networking Diagram



5.3.2 Networking

Networking within the station will consist of a fiber optics backbone, connecting all ten server nodes in the basement of each partition. The remainder of the wired communications is carried out through power line networking through the All-In-Walls. Routers are evenly spaced to create a meshed wireless network, connecting all the devices within the station. Devices on a person are connected via a high-bandwidth personal area network, enabling devices in the vicinity of that person to connect directly with the e-Shirt. Bandwidth requirements within the station for individual users will be near a terabit per second because of the use of high resolution 3D interface data, multimedia, and instant access to all personal data stored in datacenter. The initial total storage capacity of Aresam's datacenters will be roughly one Exabyte. Bandwidth from Earth to Mars will be limited to a couple terabits per second based of environmental factors such as distance from Earth and latency.

5.3.3 Automated Tasks Within the Community & Residences

Name	Location	Purpose	Dimensions (m) w x h x d	Units
Beautification Robot	Public areas	Beautification and trash removal, basic landscaping	.5 x 1 x .5	500
Crop Robot	Crop beds	Cultivate crops grown in the landscape of Aresam	.5 x 2 x 1	2000
RoboPollinators	Air	Pollinate plants and monitor air quality	.05x.05x.025	2000
Medicare System	Hospitals	Small Hospitals for Health care	N/A	20
Laundry System	Raised floor of each residence	Washes dirty clothes, dries them, and folds them	Variable with floor plan	13230
Bathroom System	Bathrooms	To provide for a clean modular experience to residents.	Variable with floor plan	20000
Assistor	Within raised floor of all residences	All purpose system consisting of tracks under raised floor and robot with snake-arms able to organize household mess	Variable with floor plan	13230
otoTable	Home	Serve food, clean dishes,	5 x 1 x 5	13230
Sweep Robot	All residences	Cleans all surfaces with room temperature plasma and climbs surfaces with magnets.	.3 x .1 x .1	20000

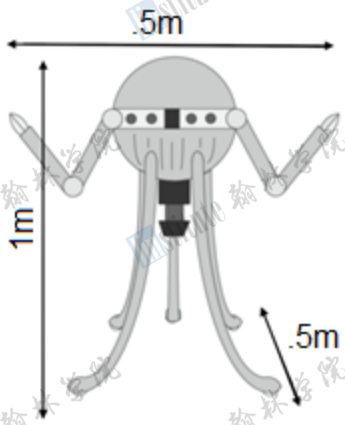


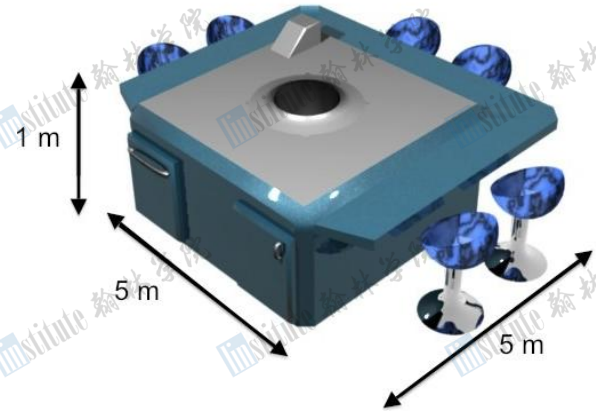
Figure 5.5 Beautification Robot

Residences on Aresam will all have floors raised 75cm on each level which will house many of the automated systems within the house. The most inovative use of the raised floor is the Assistor system which will act like one's personal butler. This system will use its snake arm for task such as placing clean clothes in the closet, organizing objects, and transporting objects.

The bathroom will be have a modular design where different appliances will be at the user's disposal only when necessary. For example, the bathtub rotates into a shower, and the toilet is hidden in the floor until needed. Old fashion hand washing will be replaced with a room temperature plasma sanitizer. All the surfaces in the bathrooms will will be aquafobic with a titanium dioxide layer for self-cleaning. The toilet will not require wearing any contact lenses but instead will rely on self-cleaning touch screen interfaces for user input. The toilet will clean its self when empty by using room temprature plasma.

In the kitchen, prepared food or ingredients will be delivered from the food storage and preparation area through the magnetic suspension tube system to the otoTable in the kitchen. This table is meant to reinvent the notion of a kitchen. It integrates all appliances and storage within one central hub. It has a dish washer, concealed stove-top, refrigeration system, and beverage preparation system, with many of these systems within the raised floor around the otoTable. It will contain all the functionality of a regular kitchen in a fraction of the space. The otoTable top functions as a touch screen, displaying any data from the

Figure 5.6 otoTable



user's e-Shirt. The otoTable will serve prepared foods on plates by elevating them and pushing them out of its center aperture. The table has a manual mode where the stove top is revealed with conventional cooking utensils, allowing residents to dabble in a little culinary exploration.

5.3.4 Privacy

Private data will always require authentication before access and will use identification methods as detailed in 5.3.2. Networking will use the proven quantum encryption technique. While all data stored on servers and devices will use encryption that adapts to computing capabilities and will grow ever more complex as computers become more powerful.

5.4 Internet Access

5.4.1 Internet Access Methods

Communications or data transfers between the sation and Earth will be managed by a delay-tolerant network (DTN). Information through Northdonning Hedwell's DTN protocol is bundled in packets that can be stored and forwarded at the various points where the data will be routed. This allows for easy data transfers even if certain bundles are delayed and helps ensure that no data will be lost or corrupted. The DTN protocol can work with both IP and non-IP based networks.

5.4.2 Methods of Creating the Appearance of Instant Access

In order to give people on Aresam the illusion of instant access to the internet from Earth, the station will make heavy use of a caching system encompassing a front-end server farm on Earth and a back-end datacenter on the station. This caching system will be applied for the most popular and important websites. The front-end servers on Earth will use a web spider to visit all pages wanted and will transmit all the data and updates when they are made available to the back-end caching servers on Mars. The compressed data will be contained in this cache and be ready for instant access by Aresam residents. The same process will be applied with data on Aresam that needs to be access from Earth, except the back-end and front-end of the system is reversed. If data that is not cached is requested, the user will have to wait but in the mean time the system will suggest related cache pages that may be of interest.

5.4.3 Messages Identifying Delays

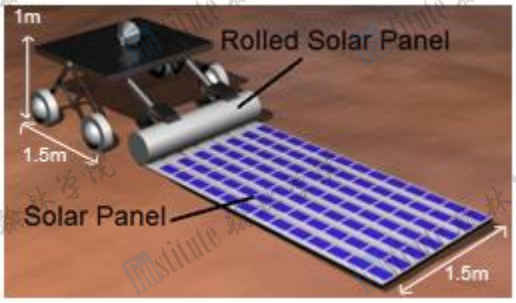
Situation	**Dialog Message (X represents variable of time delay)**
Message received Earth	Earth message just delivered with X minutes of delay.
Message sent to Earth	Earth message sent. Estimated time of arrival X
Browsing cached website	Currently viewing cached webpage. Last updated X minutes ago.
Requesting uncached website	Currently fetching uncached webpage. This may take a long time, you may want to consider the following cached websites.

Figure 5.7 Delay Message

5.5 Off-Site Automation

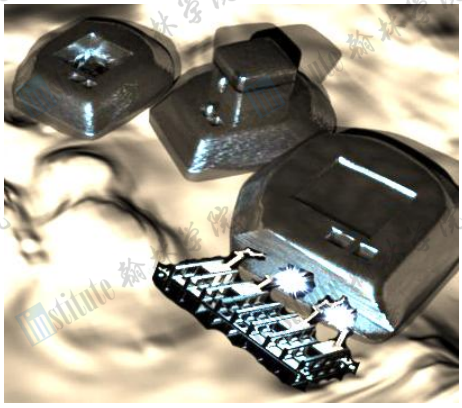
5.5.1 HUT

Figure 5.8 HUT Solar Panels Set-Up



The automated systems aboard the HUT are essential to simplifying humanity's mission by speeding up deployment and managing life support. After landing, the automated systems within the HUT will expand the chambers and begin laying solar panels, constructing a power-generating array. In order to keep the solar panels free of dust, they will be coated with an electrostatic coating wich will cycle electrostatic pulses. All of the life support systems will be monitored by automated systems that will ensure the survival of researchers and the success of missions. To help with the explorer's endeavors, an autonoumous vehicle can be brought on the mission to further explore the surroundings.

5.5.2 Materials Extraction

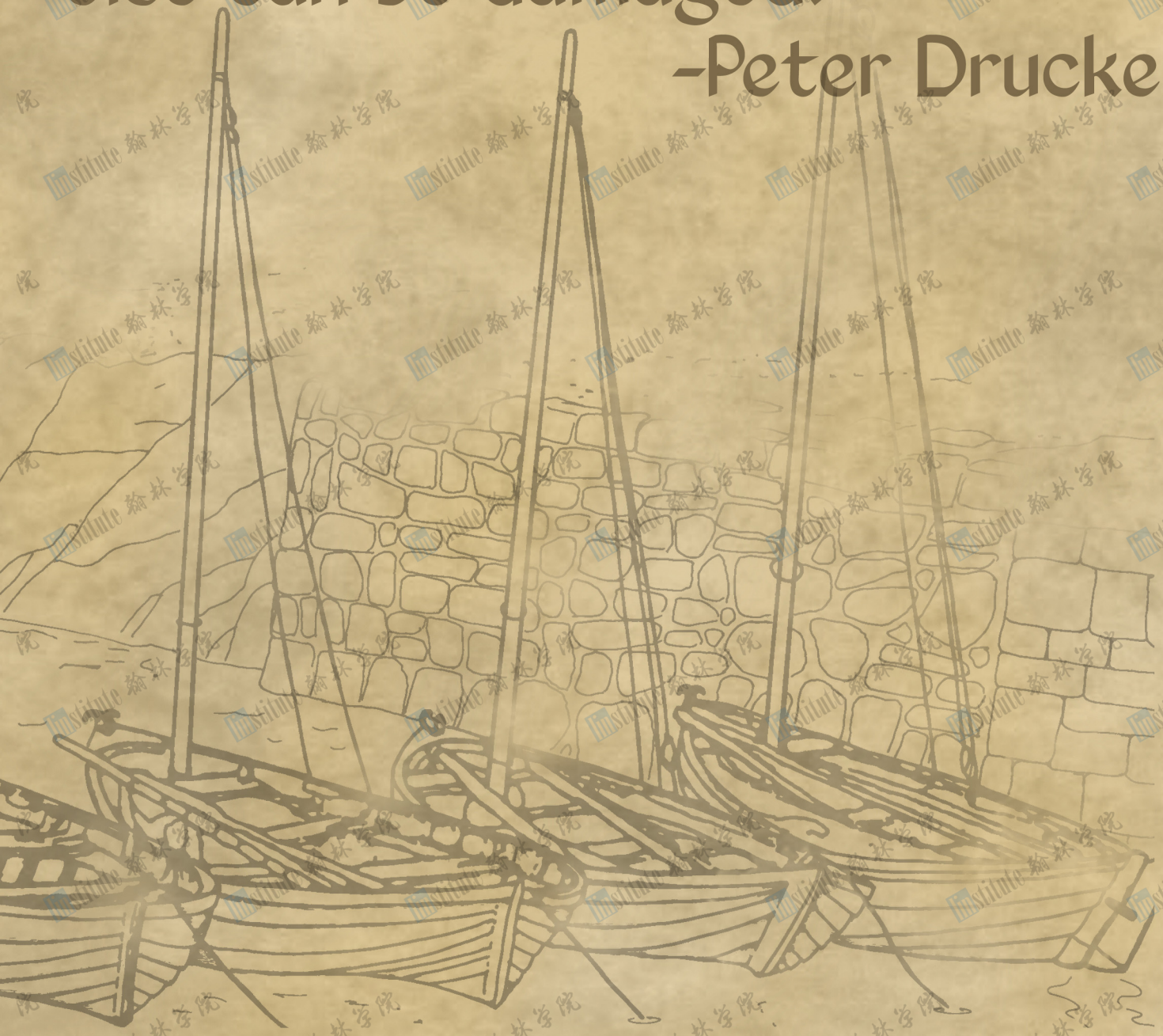


Mining will begin with the Raw Processing Modules on the Barges, followed by the establishment of Mining Posts. A fully automated Mining Post will process and refine raw materials at a rate and quality greater than that of the Raw Processing Modules. The Mining Post will make fuel for the hydrogen fuel cells on the Barges by processing hydrogen and oxygen and be used to maintain and modify the mining Barges that will continue to strip the surfaces of Phobos and Deimos.

Schedule and Cost

"Time is the scarcest resource and unless it is managed, nothing else can be damaged."

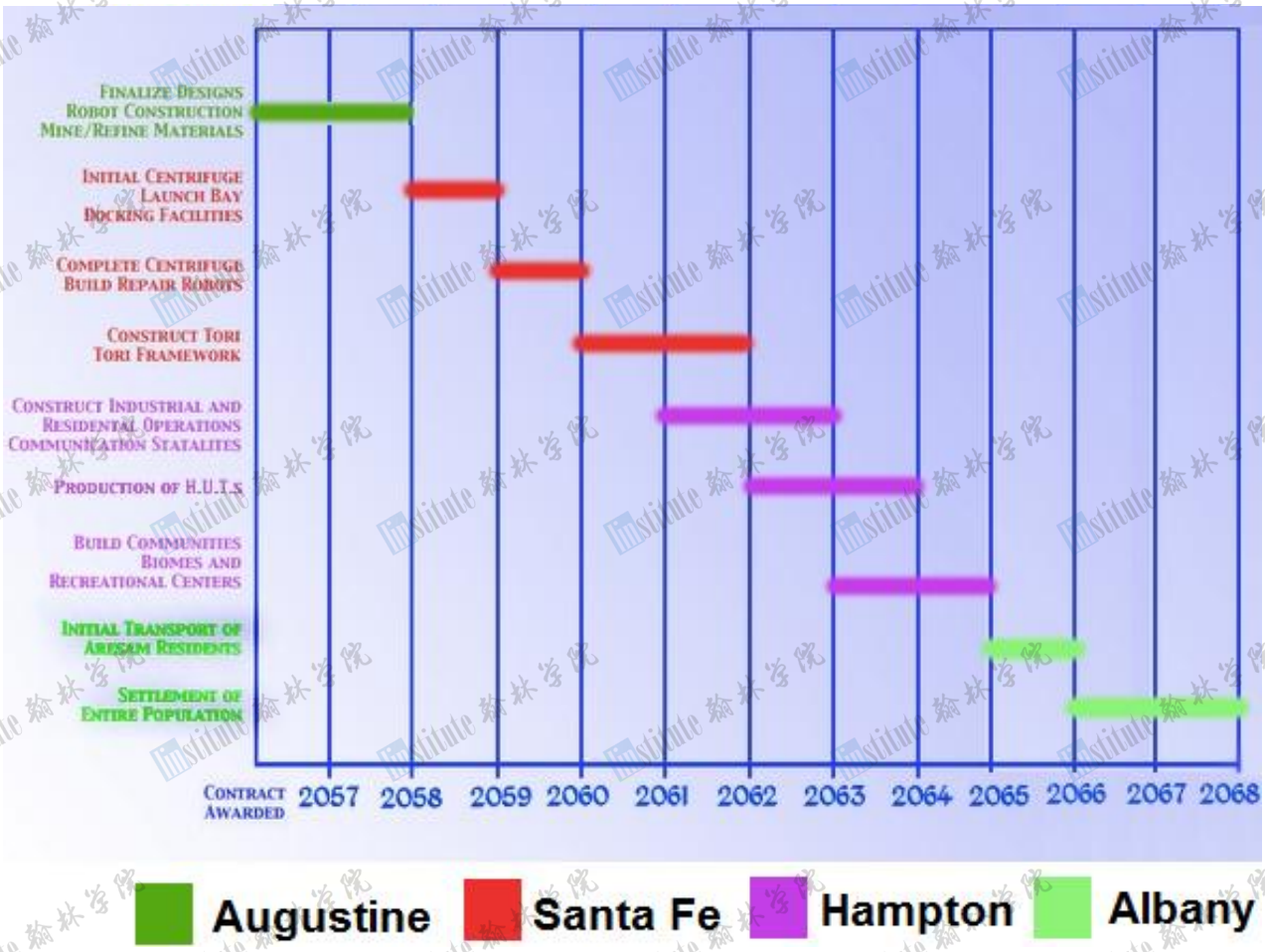
-Peter Drucker



6.0 Schedule and Cost

Aresam will be constructed over the course of thirteen years, starting with the awarding of the contract in May of 2055. Construction will be divided into four phases: Williamsburg, Washington, Philadelphia, and Augustine, concluding with the declaration of fully operational status in May, 2068. The total cost of construction for Aresam will be $310,884,250,387.45.

6.1 Schedule



6.2 Cost

Structures			
Material	Volume m^3	Cost per m^3	Cost
Steel	53,760,000	$534.48	$28,733,644,800.00
Boron Carbide	6,880,000	$1,739.56	$11,968,172,800.00
Polyethylene	4,440,000	$522.12	$2,318,212,800.00
Silicon	5,000,000	$2,633.08	$13,164,500,000.00
Lead	10,320,000	$2,574.18	$26,565,537,600.00
Aluminum	10,000,000	$1,934.78	$19,347,800,000.00
Alumina	2,238,400	$2,440.23	$5,462,210,832.00
Chromium	10,000,000	$5,442.83	$54,428,300,000.00
Nickel	10,000,000	$4,295.58	$42,955,840,000.00
Regolith	1,000,000	$3,222.28	$3,222,280,000.00
Tin	1,000,000	$143.99	$143,990,000.00
Lunar Glass	412,800	$18.75	$7,739,669.80
Structures Total	**115,051,200 m^3**	**N/A**	**$208,318,228,501.80**

Operations			
Point	Cost	Point	Cost
Material Quantities 3.1	Included into 6.1 Structures	Waste Management 3.2	$27,940,289.00
Power 3.2	$370,443,693.36	Water Management 3.2	$121,799,855.39
Food Production 3.2	$184,721,654.30	Communication 3.2	$416,250,000.00
Weather and Day/Night Cycle 3.2	$25,488,699,881.94	Harvesting Mars 3.4	$307,872,950.00
Internal Transportation 3.2	$100,139,511.36	HUT Operations 3.5	$161,410,800.00

Operations		
Operations Total		**$27,179,278,635.35**

Human Factors			
Point	Cost	Point	Cost
Consumer Needs 4.1	$8,306,271,445.00	Parks and Recreation 4.1	$6,974,021,650.00
Education 4.1	$3,493,243,151.00	Housing 4.1-2	$793,826,608.80
Entertainment 4.1	$13,456,216,210.00	External Safety Equipment 4.3	$952,824,000.00
Medical 4.1	$8,755,560,000.00	**Human Factors Total**	**$42,731,963,064.80**

Automation			
Point	Cost	Point	Cost
Construction 5.1	$215,000,000.00	Community 5.3	$7,611,615,140.10
Upkeep 5.2	$29,234,151.90	Communication 5.4	$3,254,991,866.70
Emergency 5.2	$16,374,072,248.40	HUT 5.5	$3,410,723.39
Operations Robots 5.2	$2,123,101,917.78	Mining/Refining/Processing 5.5	$3,043,454,137.23
Automation Total			**$32,654,880,185.50**

Total Cost of Aresam	**$310,884,250,387.45**

6.2.1 Cost of Construction

Year	Price Billed	Year (continued)	Price Billed (continued)
2055	$51,750,217.00	2066	$22,633,902,082.09
2056	$57,865,317.00	2067	$20,540,695,041.77
2057	$50,750,138.00	2068	$11,540,855,123.09
2058	$2,784,152,591.42	2069	$11,590,934,123.10
2059	$11,187,965,114.10	2070	$21,100,889,998.27
2060	$11,590,904,123.11	2071	$1,604,044,263.87
2061	$30,840,814,092.43	2072	$30,540,620,113.31
2062	$14,451,013,120.65	2073	$25,840,480,208.23
2063	$23,540,505,072.43	2074	$7,550,910,675.84
2064	$22,540,695,042.77	2075	$8,572,210,705.84
2065	$21,545,815,080.77		

6.2.2 Employees and Cost per Phase

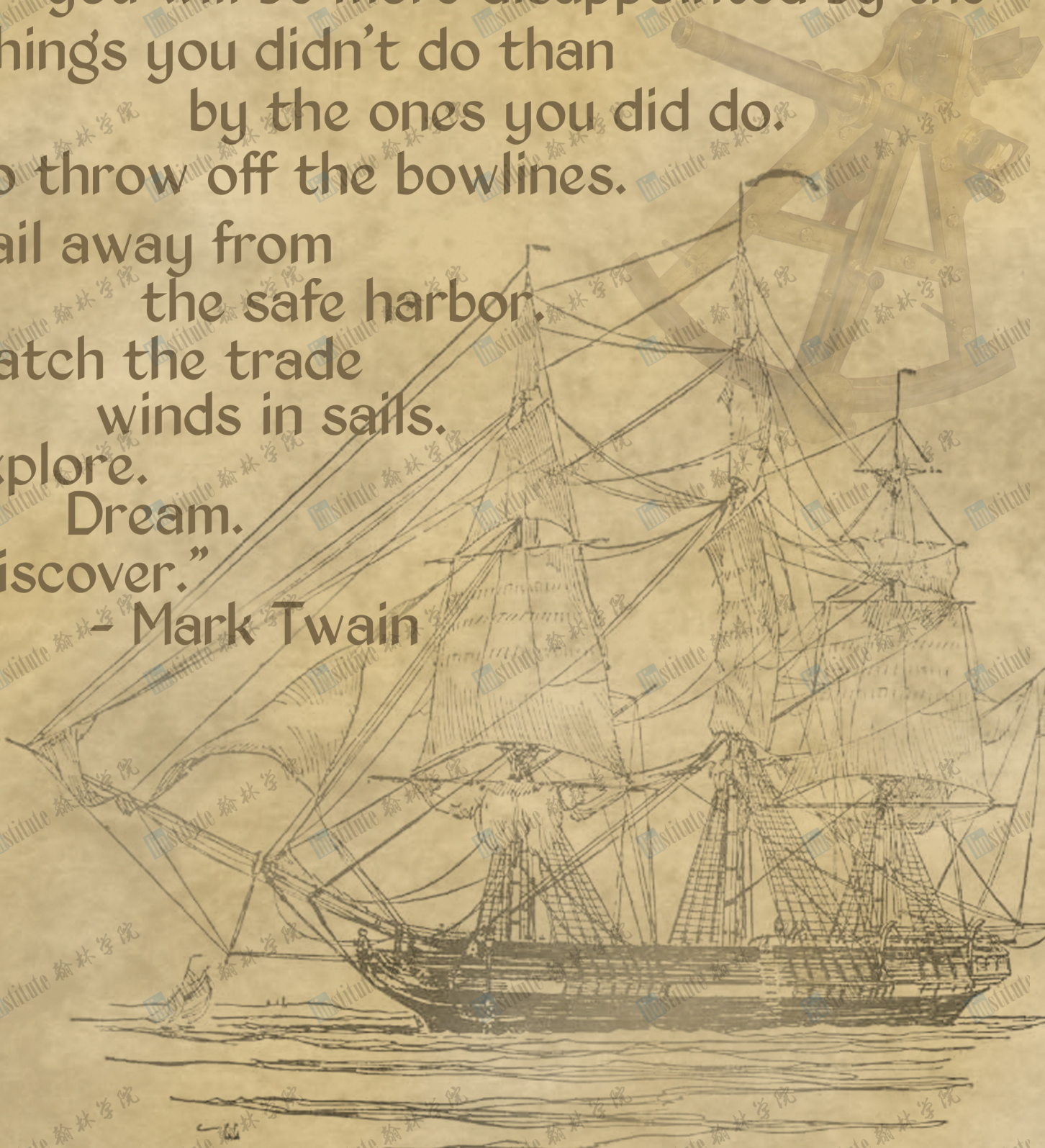
Phase	Number of Employees	Cost
Williamsburg	50	$40,430,460,462.20
Washington	400	$208,307,828,501.80
Philadelphia	200	$61,025,306,900.15
Augustine	175	$1,120,654,523.30
Total	825	**$310,884,250,387.45**

6.2.3 Justification of Costs

Following the construction of Aresam, initial investments will immediately begin returning in the form of revenue. The Foundation Society will begin making an average $35 billion per year in sales and leases, a sum that is expected to continue growing as additional infrastructure and settlements are developed. This massive income will be supplemented by new technologies produced from breakthroughs in research facilities, Aresam's refueling and restocking services, and additional commercial and industrial venues. The Foundation Society is expected to receive a full return on investment within 9 years of station completion.

Business Development

"Twenty years from now,
you will be more disappointed by the
things you didn't do than
by the ones you did do.
So throw off the bowlines.
Sail away from
the safe harbor.
Catch the trade
winds in sails.
Explore.
Dream.
Discover."
- Mark Twain



7.0 Business Development

Northdonning Heedwell is looking forward to Aresam being the most profitable station for the Foundation Society, while sporting a cutting edge design. As humanity's furthest settlement, Aresam will act as a portal to the new world, treating Mars as the gateway to further colonization. Manufacturing is one of the key features of Aresam. The station will be capable of long-term growth and self-sufficiency. The bulk of Aresam's profit will come from the manufacturing of spacecraft, the use of transportation nodes and ports, and developments in science and research. The economic prosperity of Aresam will give the Foundation Society an annual profit of $35,000,000. The initial investment is negligible compared to the proposed income for years to come, while recouping costs in up to 9 years.

7.1 Commercial and Industrial Venture

Aresam is expected to be the next frontier for expansion to the Martian surface and beyond. Northdonning Heedwell is maintaining its commercial and industrial productivity with massive amounts of economic sufficiency. Commercially, our main ventures are utilizing our ability to be the gateway to planetary colonization. Aresam will be serving as a terminal between the Martian surface, orbit, and other established colonies. This pivotal location as the forerunner in Martian colonization will ensure Aresam holds an iron grasp over fueling services, generating additional profit for the Foundation Society. The HUT prefabricated shelter will offer astounding possibilities to researchers of all kinds, and Earth-based companies will be eager to purchase slots for their researchers to begin experimentation. Real estate on the Martian surface will also be sold. The Foundation Society will benefit largely from Aresam's superior ability to produce and export valuable technologies from our industrial production facilities.

7.1.1 Accommodation of Business

The structural configuration of Aresam enables development of our core facility to proceed to move the capitol of space to Aresam in a short time. As time goes on, Northdonning Heedwell will start to colonize from the HUT shelters Aresam has set up around Mars. When colonization begins, Aresam will be able to utilize Mars real estate as a massive source of income. Northdonning Heedwell plans to rent out its 300 HUT shelters to the scientific community, generating a stable income that will speed the return on the Foundation Society's investment. In addition, Aresam will be able to attract researchers to apply the gathered results and trends from the health care system anonymously monitoring all residents in Aresam. Ultimately, the greatest source of profit will come from Aresam being used as a gateway to future settlements, acting as a necessary stepping stone for any future ventures. Aresam will function as the first stop along the path to further settlements, planning to offer refueling, restocking, and repairing services to passersby.

7.1.2 Transportation Nodes and Ports

The Port Royal docking facility will be located on the centrifuge. From here, incoming ships will be able to dock and conduct business. The port will be capable of handling multiple researchers coming in and spacecrafts trying to refuel or proceed to Mars and beyond. This is an essential business venture for many reasons. It will handle all the cargo, incoming spacecraft, repairs, medical, and quarantine services. Northdonning Heedwell is set on our supreme design, able to accommodate development for additional business types, embracing a modular business structure.

7.1.3 Docking, Warehousing, and Cargo Handling

Incoming spaceships will dock into a zero-g launch bay in the centrifuge. Contents of the ships will be transferred to a warehouse facility in the industrial torus. The cargo will be taken off the ships by the Barges, equipped with manipulation modules. The storage module will take the cargo from the launch bay to the warehousing facility and back. Aresam's cargo will be easily accessible as it will be used for Mars surface development and mining missions planned for Mars, Phobos, and Deimos.

7.1.4 Terminal Facilities for Passenger Transit from Mars

Once passengers exit their ship they head to the first air lock. In the all the air lock chambers will be an Electro Interstitial Scan, to check on the medical condition of all transients into and out of Aresam. This also ensures maximum security from biological hazards. Once, past the air lock passengers are in the terminal facility where they will next go through security to check for identification fraud and make sure there are no weapons brought onto Aresam. Continuing on, transients will be given their living address and their e-shirt. Having an e-shirt is necessary for monitoring the constant levels of humans, locations, and it is their computer interface. After that, humans will exit the terminal facility on an elevator going up to the residential torus.

7.1.5 Refueling and Provisioning Services for Visiting Ships

The docking structure will accommodate visiting ships with fuel. The Barge hand will extract all of the imports from the incoming ships and take it to the warehousing facility in the industrial torus. In the warehousing facility, material imports will be integrated into Aresam's systems by incorporating new resources with our industrial product manufacturing. The containers will then be utilized by having storage module put commercially viable Earth products in it. These containers will then be sent back to the visiting ship to go back to Earth for profit.

7.1.6 Base and Repair Depot

Aresam will be a base and repair depot for a fleet of repair vehicles. Multiple docking facilities and storage room in the centrifuge allows for ships to be repaired, restocked, and sent back to the surface of Mars with minimal impact on industrial or residential sectors of Aresam. Refueling will occur in the docking facilities along with other ships, while repair will be done in the centrifuge, or parts to be repaired will be sent to the industrial torus.

7.1.7 Vehicles on Martian Surface including dust mitigation

The accumulation of dust from Mars surface and landing vehicles is being conducted by multiple sources. The Dust Mitigation Robot (detailed in 5.1) will clean all of the interior and exterior surfaces of the incoming vehicles. The incoming vehicles with accumulated dust will dock on an external dock on the outskirts of the launch bay to guarantee the dust has minimal contact with Aresam's infrastructure and other ships/machines/anything it can harm. Additionally, spacesuits won't ever enter the interior of Aresam. With the donning, doffing, and storing process detailed in 4.3.2.

7.1.8 Medical and Quarantine Services

Aresam will host phenomenal quarantine services and medical services to monitor all of the material that goes through the HUT and the launch bay. Electro Interstitial Scan will test incoming transients for medical problems and contamination, determining if a quarantine is necessary. This scanner works by measuring the electro-physiological properties of twenty-two different volumes within the body. When hazardous material is about to infiltrate our system, sensors will detect the harmful specimens and contain it and anything else affected in the air lock chamber. Instantaneously releasing cold plasma into the chamber disinfecting all of its contents.

7.1.9 Manufacturing Center for Elements of Infrastructure

Aresam will mine heavily and bring in raw materials for mass production in the industrial torus. Our goal is to be the key manufacturer of spacecraft, robots, machinery and more. The industrial torus will be producing a substantial amount of cash flow through the Aresam station. It is key that Northdonning Heedwell's Aresam be possible to provide for all of the industrial needs of other Foundation Society settlements.

7.1.10 Products of Manufacturing

A bulk of Aresam's economic sufficiency is going to come from the sales of products of its industrial torus. Northdonning Heedwell will be manufacturing surface vehicles for the Martian surface. These vehicles will go along with the HUT shelters to enable further research opportunities in a larger radius around the HUT. Also, Northdonning Heedwell will be manufacturing machinery and robots for use on the station and for future sales to Earth and other Foundation Society settlements.

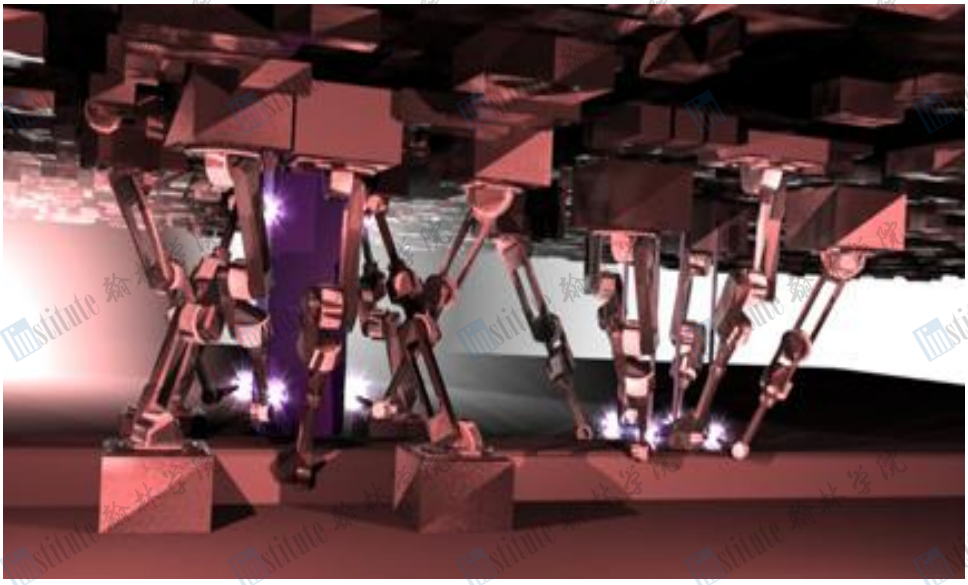
7.1.11 Sources of Materials

Surface vehicles are going to be constructed in the industrial torus. They utilize silicon and steel as they are prominent resources near Aresam. Silicon is mined from Phobos and Deimos, making it very cost efficient to use to build within our industrial bay for transportation costs. Steel is gathered at our mining basing on the moons of Mars. Aresam's machinery will be made of silicon, titanium, and steel. The aluminum is from the moon of Mars. The titanium is from Earth. The steel is from the mining base. Robots will be constructed of 3 basic resources from the moons of Mars. Silicon, chromium and nickel provide the most efficient and innovative robots for the marketing of Aresam. Aresam's prefabricated transportable bases (HUT) will be constructed of three materials. The exterior walls of the HUT will be made of two layers of steel from Phobos and Deimos. Between the steel is a layer of elastomeric isolators providing enforcement. The elastomeric isolators are mined from Phobos and Deimos. This construction allows maximum ability for safety and support while utilizing all mined materials. The HUT windows will be formed by alumina glass also from the moons of Mars.

7.1.12 Manufacturing Process in Aresam

State	Rotating	Non-rotating
Pressurized	Aluminum (Bayer + Hall-Heroult processes) Iron (Blast furnace) Nickel (Flash smelting) Silicon (Electrode arc furnace)	Chromium (Cr-CO process)
Non-pressurized	No Manufacturing in Non-Pressurized	No Manufacturing in Non-Rotating

7.1.13 Production Line



7.1.14 Transportation of Vehicles and Robots

Transportation between Aresam and the Martian surface is carried out by Second-Generation Percherons contracted by Northdonning Heedwell. With its configuration flexibility, Aresam will enforce its likelihood of capturing a contract for further space exploration and settlement. These also are the same ships that can be exporting our profitable vehicle and robotics technology to other settlements contracted by the Foundation Society to enhance their capabilities and further endeavors.

7.1.15 Transportation of Food and Commodities

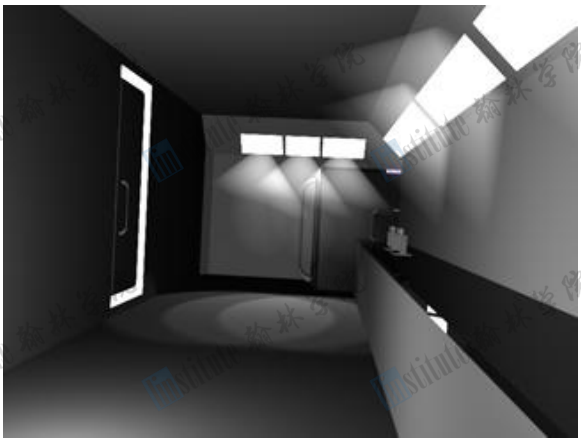
Second-Generation Percherons contracted by Northdonning Heedwell will execute the shipment of food and commodities from Aresam to the Martian Surface. The immense cargo load delivery provides provisions for essential HUT development and ongoing research. Aresam's fleet will guarantee the continued exchange of goods between fledgling settlements and itself.

7.1.16 Martian Resource Research Center

Aresam is going to facilitate massive amounts of research for the development of Martian resources. Between the HUT and the main station, Northdonning Heedwell is focusing on getting the Foundation Society the largest profit possible. Aresam is going have extensive research done on the HUT pertaining to the health care system. Researchers will be able to conduct studies for the benefit of space settlements and Earth.

7.1.17 Testing Laboratories for Material Collected on Mars

Material mined from the Martian surface will be tested in the HUT. Computers will process the mined resources to ensure commercial and economic efficiency and to log all incoming material to the HUT. Experiments will also be conducted to test the potential uses for expansion and economic sufficiency. On the HUT researchers will be proficient enough to provide credible data on which elements have been mined from Aresam. Eventually, Earth-based businesses will be able to contract HUT researchers to work on the Martian surface.



7.1.18 Commercial Potential Products

The potential for Aresam products to make a revolutionary splash in the market is beginning to rise. Northdonning Heeedwell is analyzing Aresam and planning out to profit on all aspects of life. The HUT is going to be one of our main sources of income. To begin with, the HUT will be able to be rented out for future research and developmental research. Companies that cannot afford to send some of their researchers can commission Northdonning Heedwell's researchers to experiment on specimens of their choosing. Another source of income for Aresam will be produced through the industrial torus. Money will be accumulated when Aresam exports goods to other stations and back to Earth. Also, Aresam is going to be able to sell real estate on Mars for future development. Aresam will market its surface vehicles, robots, and machinery that were made in the industrial torus.

7.1.19 Commercial Standards

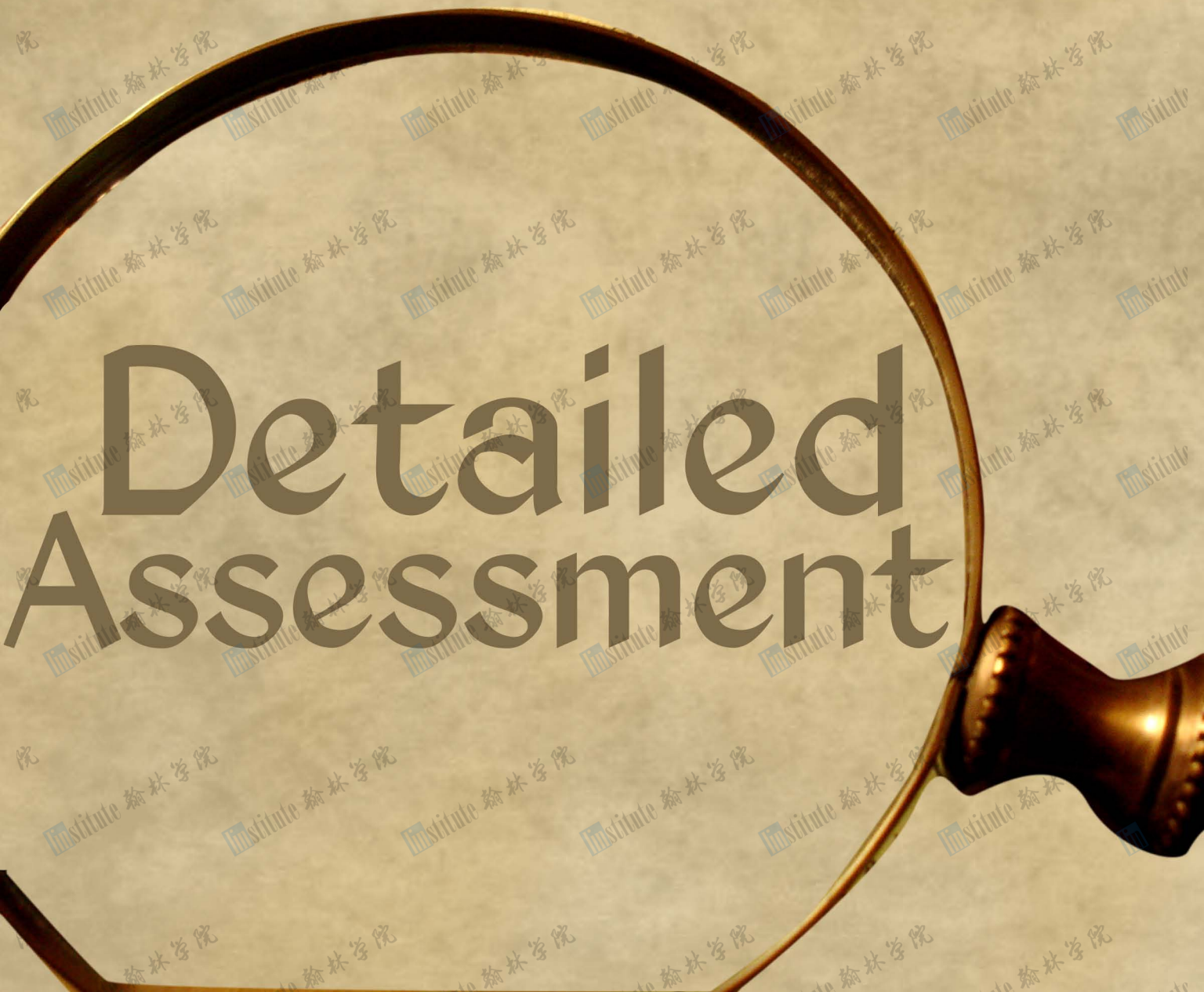
The ability for mass production and manufacturing of essential needs for space settlements clearly defines the worthiness of building products out of Mars elements for Aresam use. Northdonning Heedwell is going to utilize the practical uses of mining and refining from resources in Aresam's surroundings. By doing this, Aresam can profit by selling back some of the manufactured products. Aresam can choose to sell ore that it has mined or it has the option to sell the final product refined from the raw material. By producing its own products, Aresam need not worry about the transportation costs associated with sending materials from Earth.

7.1.20 Quarantine methods

The HUT will have to be prepared to deal with possible contingencies that come with searching for new land. The researchers are going to be prepared with the ability to use a dual air lock system on all entrances and exits to the HUT. When researchers walk past the first airlock, humans will be scanned by an Electro Interstitial Scan. This will alert the researcher of any problems, the room will be disinfected with cold plasma that is released through slits in the ceiling of the air lock chamber. If life is found on Mars, a separate single air-locked lab will be utilized. The single air-locked lab will have a bio filter, to maintain its cleanliness and independence from the rest of the HUT. This will provide the capability to researchers of protecting themselves from hazardous material, and the inverse as well.

"We stand today on the edge of
a new frontier...
a frontier of unknown opportunities
and perils-
a frontier of unfulfilled hopes
and threats."

-John F. Kennedy



Detailed Assessment

APPENDIX A. **Detailed Assessment**

The industrial torus is a defining element of Aresam. The torus spins in unison with the station, its reduced size causing a general outward force of 0.317 times Earth gravity. This lower force acts as a boon to manufacturing, especially when combined with the torus' use of vacuums to enhance production efficiency. Additionally, the placement of the torus near the Isabella launch bay allows for the uninterrupted exchange of materials and fabrications, resulting in optimum productivity for developing infrastructure.

The lower gravity of the torus gives all equipment and robotic machinery a lesser workload, causing them to work faster and with less physical stress. Aerogels, used for the maintenance, manufacturing, and repair of machinery and protective hulls, are structured differently when created in lower gravities. The differences in structure have proven to be beneficial to all applications of the aerogels. Silicon crystals, used in the manufacturing of computer circuitry grow differently in low gravity environments. The crystals are grown with fewer impurities, producing a significantly greater yield with additional benefits towards machine manufacturing, including fewer faults during assembly.

When working in a vacuum, several advantages in productivity become apparent. Mirrors and lenses emerging from a flame can form, fire polished, directly from the melt without any interference from an atmosphere. Lack of an atmosphere also prevents corrosion and oxidation, meaning materials and parts can be stored for long periods of time without risk of contamination.

By separating the pounding hammer of industry from the tranquil lives of its residents, Aresam eliminates the noise pollution factor from its residential facilities. This convenience is not the only benefit gleamed from the gap, as the likelihood of human lives being threatened is greatly reduced. Were an accident to happen within the industrial torus, it would be contained and completely discrete from the dwelling of Aresam's inhabitants.

It is a priority of Northdonning Heedwell to place safety first in Aresam's design, and this compartmentalization of its busiest areas is but the first of many steps towards meeting that goal.

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"Imagination will often carry us
to worlds that never were.
But without it, we go nowhere."
-Carl Sagan

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Compliance Matrix

"Man must rise above the Earth- to the top of the atmosphere and beyond- for only thus will he fully understand the world in which he lives."

-Socrates

APPENDIX C. Compliance Matrix

1.0 Executive Summary	Aresam, the next great human achievement, functions as an essential link between Earth and Mars, opening a new world to those willing and able to go	PAGE 5
2.0 Structural Design	Aresam's design allows it to hold up to 22,000 occupants safely while functioning as a link between Earth and Mars	6
2.1 Major Components	Aresam will provide for its residents and the expansion to the Martian surface.	6
2.1.1 Attributes of volumes	In case of emergency the torus will separate into ten independent sections that can remain self-sustaining for up to six months.	6
2.1.2 Utilization of Enclosed Volumes	Aresam will have a residential torus and an industrial torus to provide appropriate facilities to residents and industry.	6
2.1.3 Isolation of Volumes	And of ten individual volumes may be separated by bulkheads.	6
2.1.4 Artificial Gravity	Artificial gravity will be created by spinning the residential and industrial tori in opposite directions to create Earth gravity and .6 Earth gravity, respectively.	7
2.1.5 Debris and Radiation Protection	Radiation and debris will be protected by a layer of polyethylene over a layer of lead, with the polyethylene protecting from radiation and the lead from debris.	7
2.2 Allocations and Dimensions	Aresam will make efficient use of down surfaces and vertical spaces.	7
2.2.1 Down Surfaces	The centripetal force of the torus will orient gravity towards the outer edge of the station. Consequently, the surface area of the living area will be 3,415,536m^2 which allows for a basement surface area of 3,447,200 m^2.	7
2.2.2 Surface Area and Vertical Clearances	The total living height of the residential torus will be 60m, with a living space ceiling of 48m and a maintenance "basement" area underneath of 12m. Surface area is divided into ten partitions.1	8
2.2.3 Orientation of Down Surfaces	Artificial gravity is oriented away from the centrifuge.	8
2.3 Construction	Aresam will be efficiently constructed, beginning with docking facilities.	8
2.3.1 Sequence of construction	We will begin with the docking facility, extend the centrifuge to either side, then attach the industrial and residential tori, as well as the comm. array, to either side of the docking facility.	8
2.3.2 Initiation of rotation	We will use eight hybrid chemical rockets to initiate and maintain rotation.	9
2.3.3 interior construction method	Steel will be used for buildings, boron carbide for bulkheads, and silicon for concrete	9
2.4.1 Early exploration	We will utilize the industrial torus and launch bay to explore Mars and process resources gathered on Mars.	9
2.4.2 Major Surface Construction	The docking bay in the center of the station has three doors of varied size which can accommodate up to six ships at a time.	9
2.5.1 HUT Structure	The HUT is deployed in a shipping container sized single structure,	10

7.0 Business Development	Aresam will function as transportation hub, manufacturing center and research laboratory	39