

SPANISH SPACE DESIGN COMPETITION

2024/2025



Welcome to the SPSDC!



The final frontier

Space exploration is one of the greatest challenges facing humankind. Luckily for us, we've got great people tackling this task. You will be asked to join this cohort of scientists, engineers and entrepreneurs, as part of an established company competing for an industrial contract in space.

Who we are

The Spanish Space Design Competition (SPSDC) is the first edition of a one-of-a-kind competition in Spain, created to inspire students with exciting challenges in engineering and space design. We are part of the Global Space Design Competition Group, an international network that's been organizing these competitions around the world for over 40 years, sparking creativity and curiosity in students who love space.

Even though we're just getting started, the SPSDC already has a growing community of students, staff, alumni, and volunteers who absolutely love these competitions. Our goal is to create an experience that's not only challenging but also unforgettable, while connecting participants to a global network of like-minded talent.

We're excited to bring this adventure to Spain, and we hope it's just the beginning of something that will inspire future generations for years to come.

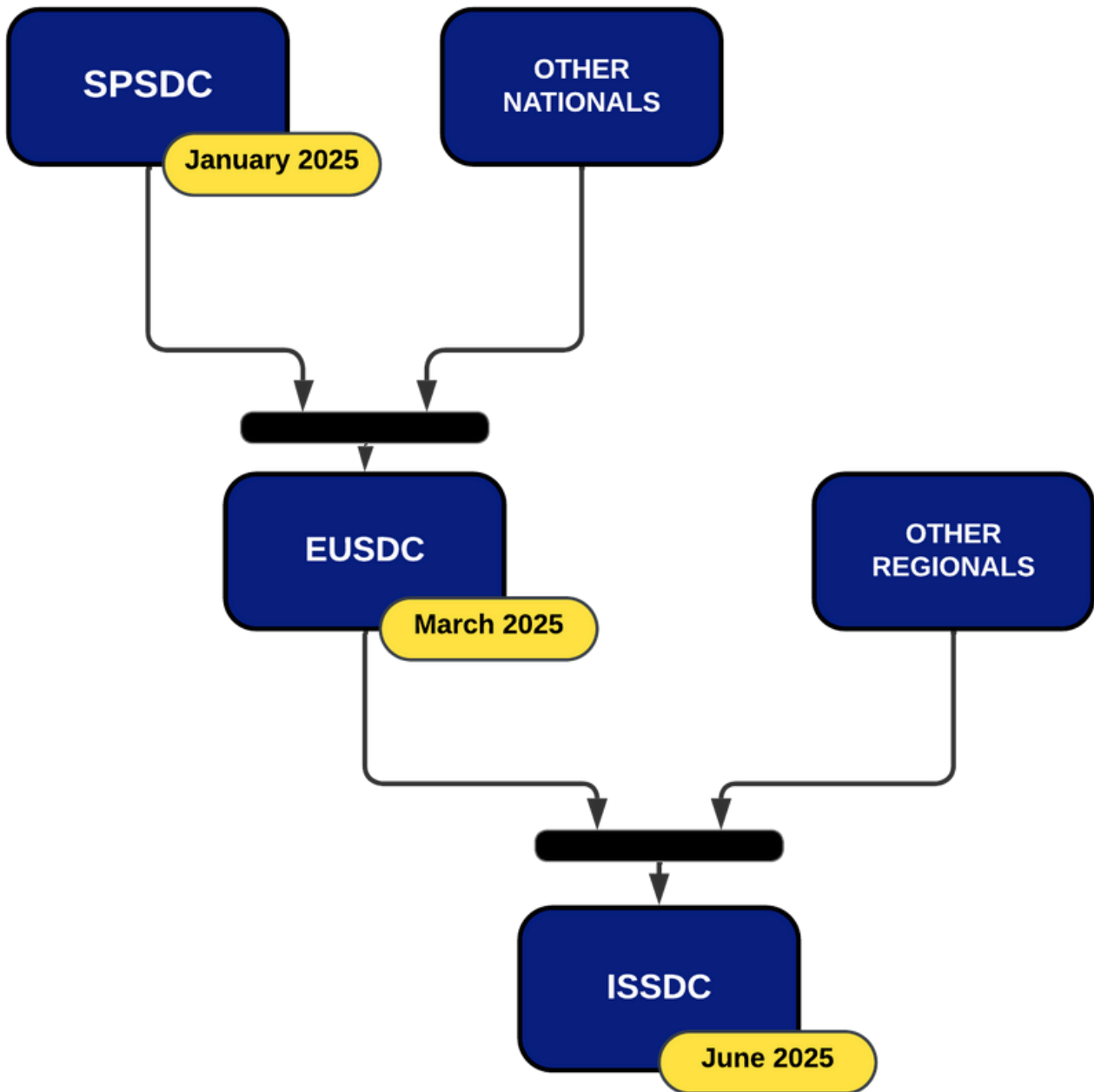
How the competition works

Your company will be given a set of tasks all stated in the Request for Proposal, which will describe all the features and aspects your settlement must have.

As a company, you will have to create a proposal that covers all minimum requirements of the RfP and then present it to a jury that will choose the best one and proclaim that one as the winning team.

As a fictional enterprise you will have to divide your company into different departments (structural, operations, human factors, mission, marketing) to address every point of the RfP in a more efficient way; as well as elect your leaders (president, vp of engineering and vp of marketing) so to have a common

SDC competition overview



Useful links

- SPSDC website: <https://www.spsdc.spsin.org/index.html>
- ISSDC website: <https://spaceset.org/>
- Space Science Education Foundation website: <https://ssef.org.uk/>
- SPSIN webpage: <https://www.spsin.org/>
- EUSDC webpage: <https://eusdc.org/>

How do the heats work?



Technical requirements

For in person heats you will be given information on what is required, and the location of the event prior to the competition. For the Digital format, participants will require a couple of important tools before they can join the competition.

Participants will need:

- A computer with internet access.
- Microsoft teams (either through website version or downloaded app).

Digital heats use Microsoft Teams.

Microsoft teams will be used throughout the day of the digital format competitions. We will be running our Foundation Society presentations on Teams, as well as technical briefings. We will also set up dedicated channels for teams to contact our technical advisors for design help. You will be sent a Teams log in link prior to the event.

Teams will be the headquarters of each company. Each company will be allocated a set of channels which allows them to communicate with their teammates. Each department will be provided with their own dedicated channel. Furthermore SPSDC staff will be contactable via Teams, and technical advisors will visit each company's Teams channels to provide what help they can.

Presentation tools for all heats.

We recommend that all companies resolve which presentation software suite they will be using early on. We recommend Google Sheets due to the ease of collaboration that it offers. Whichever software tools you decide on, the presentation must be exported in the format requested in the technical presentation, usually a PDF.

Communication at digital heats.

We kindly request that all competition-relevant information be exchanged over Microsoft Teams. We ask this to ensure that we are able to perform our safeguarding roles, we can't help with things we don't know about.

How to read an RFP



What is an RFP?

A request for proposal (RFP) is a document that is provided by your fictional client. This document will describe in detail, the requirements that the designs have to meet to impress judges. It will be a mix of technical specifications as well as open-ended requirements that challenge companies to innovate.

When will we be given the RFP?

The RFP is usually handed out after the technical talks and company elections, i.e just before companies set to work developing their designs. The participants will be introduced to the challenge in a general sense during the introductory presentation. The RFP exists to provide accurate specifications enabling companies to do calculations and designs that satisfy the customer.

How do we interpret an RFP point?

RFPs are notorious for their technical language: This mirrors what you will see in industry. Engineers do love their complicated terminology, so let's look at an RFP point from a previous settlement, and break down what it actually says.

The RFP point number helps you identify this requirement, feel free to include this on the slide deck to identify a particular requirement.

The judges are within the rights to question your reason; so make sure your team is well versed with their arguments.

When you are given a list of things, remember that the judges are expecting that each of these things are addressed with the same level of detail.

2.3 Show interior volumes. Specify their dimensions, pressures, and gravity levels. Interior volumes must ensure residents' safety from solar radiation: residents' personal exposure to cosmic-rays must be kept down to ALARP levels. Additionally, for internal features that support (handle) the structural loads of Dias, show the features' locations and designs.

Minimum requirement: Diagrams of the locations of internal volumes, internal structures for load-bearing and radiation protection.

Remember, the judges will need to see this to give and credit for this RFP point. Make sure you label the diagram in your presentation appropriately

How your company works

Companies

Whatever role you are playing in your simulated company, make your voice heard, take initiative and drive conversations forward, but also listen to others.

It's easy to think of companies as a unified force, at-tempting to capture more and more of the market but in engineering, companies are usually just huge collections of many opinions. engineering. These voices, when collaborating, forge technologies and machines that revolutionise the world.

Who will be in my company?

In the Spanish Space Design Competition you will be in a company with around 40 other students from different schools all over Madrid.

On the other hand, in the European Space Design Competition you might be included in a company with people from all over Europe (Italy, Portugal, Romania...); completing all together a team of around 45 people.

Leadership elections

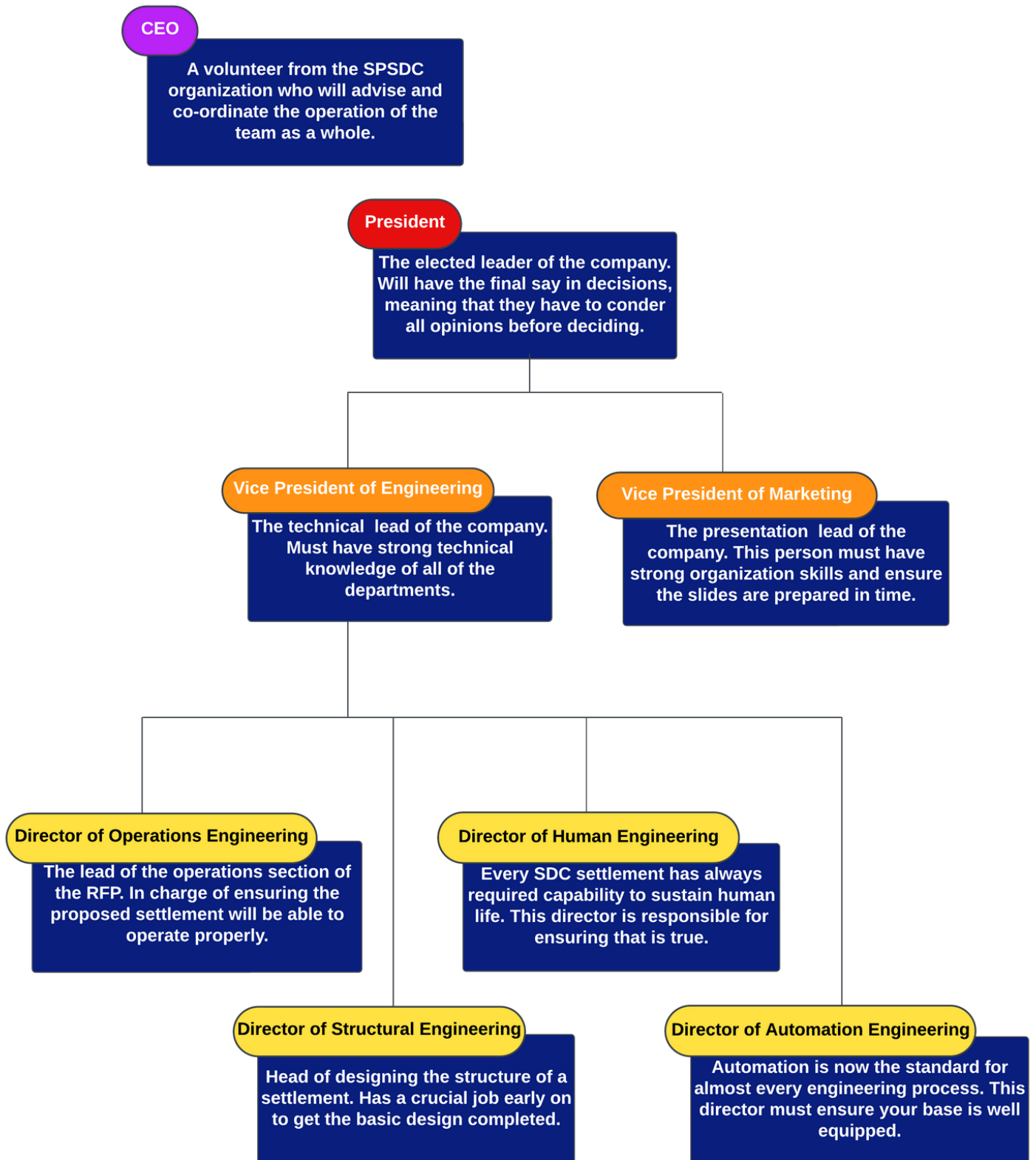
At the beginning of the competition, right after the introductory presentation you will be assigned your company and meet in your company HQ. You can look ahead in this booklet to learn more about the companies.

Each company will be assigned a CEO. CEO's experienced volunteers who will guide your team throughout the competition. This CEO will be there in an advisory capacity and won't directly be contributing to the proposal. Use them as your engineering consultants.

The CEO's will hold elections for a variety of leadership roles (please see the chart on the next page). Each position is normally hotly contested, so each candidate will be asked to give a short speech outlining their suitability for that post. The CEO's will conduct a vote, and the winner will take up the elected position. You are welcome to campaign for more than one position if you don't get your first choice.

When voting, the temptation is just to vote for your friends, but remember that to win you need as strong a leadership team as possible. It's not unheard of for a single departmental head to effectively drive innovations that win the competition. So each elected position is crucial to your teams efforts. Vote wisely

Organization chart



Structural Engineering



Structural Engineering

The structural team will define the settlement design that all other departments rely on. This team will create drawings and external views of the settlement.

Join this department if you enjoy working with mechanical systems, material science, physics and problem solving.

Key Skills

- Mathematics
- Materials knowledge
- Drawing or CAD
- Creative thinking

Key Responsibilities

- Design the overall structure of the settlement
- Provide other departments with dimensions for designs
- Select the core materials required to build settlement
- Assist other teams with locating and fitting their parts

Strategy

At the beginning of any space design competition, the structural engineering division have the crucial task of laying out a basic design. Many companies have had their entire proposals derailed by a structural team who didn't lay out their vision clearly or flexibly enough.

This department must be the golden source of knowledge on the physics of the settlement (e.g. artificial gravity, available volume etc.). Furthermore, ensure that a subteam of this department is working on materials early on. Knowing early, what material you're making your base from, assists in defining the construction process come crunch time.



Operations Engineering

The Operations Engineering group have the daunting task of working out how the base will function on a day-to-day basis.

Join this department if you enjoy managing multifaceted workflows and coordinating the operation of multiple systems with some optimization.

Key Skills

- Logistics
- Practical thinking
- Time management
- Strategising

Key Responsibilities

- Define the systems in place to ensure comfortable life for residents
- Ensure emergency procedures in place for evacuation
- Ensure the settlement is able to achieve it's purpose

Strategy

Operations Engineering has got its own section in the RFP, however members of this department will often find themselves working to facilitate other departments' RFP points. This department will see the most benefit from a Systems Engineer role.

If you're working in this department, make sure you account for all the latest changes across all other departments. Operations has to integrate the design as a whole, making sure that everyone's hard work meshes into an operable settlement.



Human Engineering

The most important part of any settlement, is the people on it. Their safety comes before any stated commercial goals.

The Human Engineering group has to ensure that each and every person who will live on this base is in a comfortable environment.

Key Skills

- Biology
- Design
- Maths
- Psychology

Key Responsibilities

- Ensure that all life support systems are robust
- Design systems and procedures for emergencies
- Provide for the social needs of inhabitants
- Ensure that the health of inhabitants is maintained

Strategy

The Human Engineering team will likely start working on their sections in parallel with Structural Engineering. This can cause conflicts later on when human requirements are not possible due to the structure designed; for example Human might require 24 million cubic feet of air, which might not fit in the structure designed.

It is therefore imperative that the Human group communicate with other departments to ensure that their requirements aren't impeded by work others are doing. This is especially important with respect to life support. Furthermore, the Human engineering slides will be the most visual of your presentations, make sure it's delivery sells the design



Automation Engineering

In a world dominated by technology and automation, the role of this department cannot be overstated.

Join the automation group to work on applying computers and robotics to enable capabilities and accelerate processes for your space settlement.

Key Skills

- Computer science
- Mathematics
- Engineering
- Physics

Key Responsibilities

- Must design and describe the robotic systems on base
- Define the computing architecture for the base
- Innovate to create a communications architecture
- Provide contingencies for emergency situations

Strategy

The Automation department will play a huge role in any successful proposal. The speed, efficiency and accuracy that computers provide are essential to space exploration. Automation engineers must work with other departments to ensure that their needs are met by the automation department's designs.

Automation should also take a practical approach to designing the computer architecture of the settlement, ensuring no single point of failure and defending against cyber-attacks. They will strongly liaise with Operations on this point.

Impactful presentations



What is expected from a presentation

It is a common misconception at SDC's competitions that a proposal is judged solely on the technical achievement of the companies. As an industry, persuasively-explained presentations are equally as important as your designs.

The judges expect you to faithfully represent your company's values, through professional presentations and like to see practiced speeches by the presenters. Remember, while this is a technical competition, the Foundation Society is going to be hiring a company for a multi-trillion dollar enterprise. Therefore, we are looking for a business to partner with, as well as a strong technical group.

Remember the vision

One of the most common mistakes made by companies is forgetting what they are pitching to the clients. These are megaprojects, requiring the co-operation of many many thousands of individuals to make possible. The Foundation Society is willing to invest huge sums of money based on the quality of your design.

To convince the judges, you need to ensure that your presentation is engaging and of high quality. The judges don't want too many flashy animations, but, they'd appreciate a couple of impressive visual artefacts. Furthermore, a plain white slide with some vaguely formatted text is not as helpful as one with at least a basic template, however, ensure that aesthetics does not distract from content.

What can you do to impress the judges?

Firstly, colour is a huge part of visual presentation. The Vice President of Marketing has plenty of time early in the competition before slides start rolling in, to start working on the presentation.

They must ensure to pick a colour scheme and unified set of fonts for the presentation. After that, make sure to proof-read: Not just for spelling errors but for more fundamental errors as well, like the price being orders of magnitude less than you meant it to be.

Impactful presentations



Examples of good presentation slides

RFP point it is addressing Title/Purpose of the slide Name of the company

2.2 **Overview of Dias** Few information in the slide and always relevant

DaVinci MECCANICA

Dias is a space settlement at **0,25 AU** from the Sun at **45° inclination**. Its structure is divided into **large inhabited and pressurized rings** and **smaller rings** dedicated to **uninhabited** management and control. The huge **solar pavilion** facing the Sun collects the **energy** which is then conducted through the **central cylinder** serving the **laser**.

3D Designs complementing the information Credits of the designs and program used Pablo Gutierrez with Blender 3

Measurements/Dimensions nº of the slide

Name of the company Department to which it corresponds 3D Designs complementing the information

EAI HUMAN FACTORS AND SAFETY RFP point it is addressing **RFP 4.3**

Design by Radu Andreea

The residents will have a watch that will not only monitor their health but also provide:

- Exercise feedback (they can ride bicycles on pedestrian way)
- Vital signs monitoring
- Indicates health issues
- On settlement location monitoring (for security)
- Announcements, today's meal propositions, extra activities to go to and upcoming events will be transferred via watch. Their employee pass will also be on it (to access their laboratories in which they work)
- Each user will have a personal profile only available to them. Thought that they unlock their houses.
- Special individuals working in security & ambulance will have special access in case of an emergency. They will need to specify the emergency and the time they have entered the residing area.

(not to scale)

Train line: 5654.9m; $a_c \approx 8,824m/s^2$ (people or cargo)
60 elevators (separated by $6^\circ \approx 100m$)

Done by Cátia S. in Paint from from Pablo Gutiérrez design

Done by Tiago Bastos in Blender Elevator dimensions

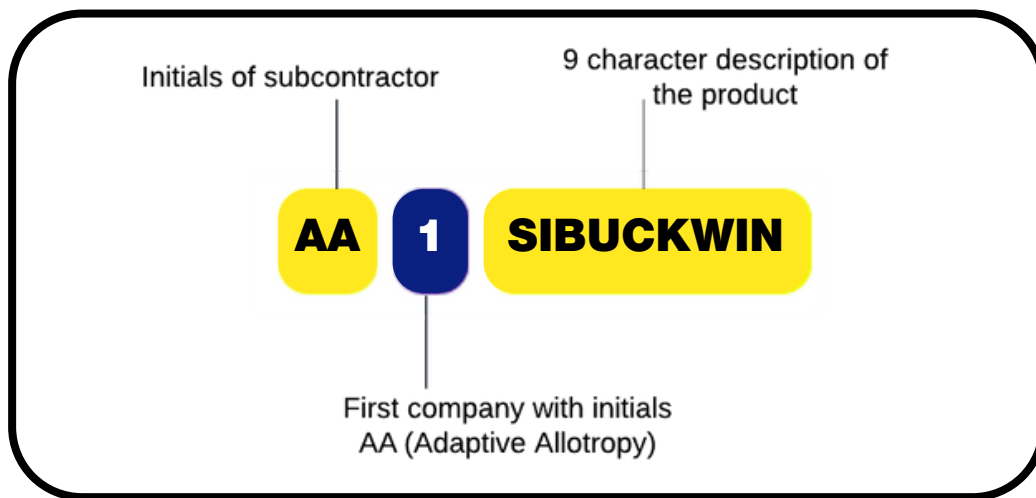
Information shown in bullet points and in a visual way Credits of the designs and program used 25

nº of the slide

Subcontractors

Over the next couple of pages you will be presented with entries of subcontractors. Each subcontractor will provide a description of their services, and conditions for their use but we urge you to look for our most up to date information on the website.

Most subcontractors will require designs to be submitted to them (and therefore included in the final presentation) before they can manufacture the designs. Each subcontractor will also provide a price list, and for each service there will be a product identifier e.g. AA1SIBUCKWIN. This product identifier can be broken down:



To ensure that we understand which exact product you are ordering from a subcontractor, please ensure to include the product identifier on the slide, as well as the cost per unit and number of units ordered. This is not required for products offered by any of the prime contractors.

Adaptive Allotropy

Supplies windows made from silicon bucky-structures materials for use on space settlements. Windows can be ordered in any shape. With proper sealing, standard, 12 mm thick windows with rectangular side length or diameter no greater than 0.91 m can retain up to a 1.01 bar pressure difference across them. The allowable safe span doubles if the thickness of the window is doubled, while the allowable pressure difference squares with the increase in thickness (e.g. doubling the thickness allows for four times the pressure difference). This is quantified with the equation $\sigma_{max} = (\Delta P L^2) / (2 t^2)$ where ΔP is the pressure difference in Pa, L is the span in m, t is the thickness in m, and σ_{max} is the maximum allowable tensile stress in the material, 290.1 MPa. If never exposed to direct sunlight, windows provide adequate radiation and thermal insulation, they are, however, prone to brittle failure. Prices listed below do not include shipping costs from Bellevistat.

Item Code	Description	Unit	Cost(\$)/unit
AA1SIBUCKW00	1-10 m3 of SiBuck Windows	m3	1000
AA1SIBUCKW10	10-100 m3 of SiBuck Windows	m3	900
AA1SIBUCKW25	100-1000 m3 of SiBuck Windows	m3	750
AA1SIBUCKW30	1000 - 10,000 m3 of SiBuck Windows	m3	700
AA1SIBUCKW35	> 10,000 m3 of SiBuck Windows	m3	600

Advanced Materials Group

Are the industry leaders in the supply of specialist plastics, composites, and aerogels. AdMaG produces unformed bulk material to customers or their own specifications. Their own products include a transparent PMMA equivalent (density= 1190kgm^{-3}) with a working temperature up to 675 K (this can be used in windows by applying the formula from Adaptive Allotropy with a σ_{max} of 70 MPa), and a space rated carbon-nanotube-mesh reinforced polycarbonate with a maximum temperature of 500 K and a yield strength of 130 MPa (density= 1240kgm^{-3}). AdMaG sells silica, carbon, and alumina aerogels, produced on-site with specialist equipment. The transport of the equipment and raw stock is included in the price of the material, but a minimum order size of 30 kg is in place. AdMaG processes their plastics, composites, and aerogels at Liberty, a Martian Mining Settlement, and Ariel respectively.

Item Code	Description	Unit	Cost(\$)/unit
AM1PMMMAEQV	Transparent PMMA Equiv	kg	1,60
AM1CARNAPOLC	Carbon-nanotube Polycarbonate	kg	0,85
AM1SICAALAEQ	Silica/Carbon/Alumina Aerogel	kg	2000
AM1CUSTOMMIX	Custom Material Mix	kg	750

Blown Away

Specialises in making inflatable buildings to customer specifications, to enable quick construction of new communities. Although these structures are not intended for permanent or indefinite use, they provide shelter for residents to start new economic activities, until more durable solutions can be established. They are manufactured at Belvestat for the customer's collection. The shelters provide no protection against radiation but are 90% thermally insulative.

Item Code	Description	Unit	Cost(\$)/unit
BA1CSINFLBUG	Custom Inflatable Building	m3	1000

Crucible

A British company which operates an automated manufacturing facility on a ferro-nickel asteroid (6178) 1986 DA. The company produces triangular trusses (usually in a Warren girder) and sheets to customer-specified dimensions, at a rate of 2,500 kg of beam per hour. Some limited assembly of products is permitted in the vicinity of this operation (space rented on the asteroid's surface or within 10 km at a rate of \$500 per day). However, customers are required to organise transportation themselves, with the most common destinations being the orbits of Belvestat and Aresam, having delta-Vs of 1.20 kms-1 and 1.14kms-1 respectively. Crucible charges \$0.20 per kilogram of formed metal or \$0.10 per kg of metal provided as 5 mm diameter spheres. The metals offered are: iron (steel), nickel, chromium, cobalt, copper, lead, molybdenum, manganese, magnesium, silver, zinc, zirconium, and alloys of any of these metals (surcharge of \$0.10 per kg). Available unformed only at a higher price of \$1.20 per kg are bismuth, calcium, gold, iridium, osmium, palladium, platinum, rhenium, rhodium, ruthenium, tantalum, tungsten. Crucible will pay clients \$0.05 per kg to rid them of slag, consisting of 98% fused silicon dioxide by mass, and 2% trace metal oxides.

Item Code	Description	Unit	Cost(\$)/unit
CR1FORMMETNA	Formed Metal - Non Alloyed	kg	0,2
CR1FORMMETAL	Formed Metal - Alloyed	kg	0,3
CR1UNFOMETNA	Unformed Metal - Non Alloyed	kg	0,1
CR1UNFOMETAL	Unformed Metal - Alloyed	kg	0,2
CR1RAREMETUF	Rare-Earth Metal Unformed	kg	1,2
CR1SLGPURSIT	Slag buy back, 98% SIO2	kg	-0,05

Digg

Adapted designs of excavation equipment used on Earth for use in low-g environments. It has created mining equipment, trench diggers, backhoes, dirt-movers, graders, drills and tunnelers and will create new machines on request. Some types of applications require more than one design solution depending on whether local conditions enable bracing the equipment to compensate for lack of gravity. Contracts have call out and services costs in order to place equipment at location and to perform the required task.

Item Code	Description	Unit	Cost(\$)/unit
DG1EXCAVMATR	Excavation of material	m3	10000

Lightworks

Provides soletta and lunette illumination for lunar and terrestrial surface locations. The huge orbiting structures reflect sunlight during the night. Six lunettas (each 1 km²) enable solar power plants to operate all night. The devices consist of sodium-coated fabric made from lunar materials stretched over lightweight composite structures and are constructed in 4,000 km lunar orbits.

Item Code	Description	Unit	Cost(\$)/unit
LW1LUNETTASG	Lunetta	Single unit	120,000,000

Out of the Woods

Is a small organisation that operates one of only a handful of off-world tree farms. They are based at Balderol and produce their wood as a by product from their main task of CO₂ removal. Their founder repeatedly stresses the virtues of design involving wood, particularly the calming and homely feel it creates. They sell a huge variety of wood from Oak to Purple Heart cut into regular sizes for an average of \$500 per cubic metre. However, their manufacturing capacity is limited to 8 tonnes of exports a year.

Item Code	Description	Unit	Cost(\$)/unit
OW1WOODSINGL	Wood	m3	500

Progressive Plumbing

Has developed peristaltic sewerage systems that are less prone to jamming, do not require high pressure to operate, and operate in zero-g conditions. The sewers have a power drain of 1W per kg to be moved per second. The waste maxes out at a speed of 1 ms⁻¹ in the 0.5 m diameter pipes. Silicone spheres with the same outer diameter as the pipe are used to provide a surface for the electro-hydraulic bladders to press against to move the waste stream. Provision must be made for these spheres at intersections or terminuses with processing equipment. The spheres must move through a loop or have separate systems in place for moving them back through the system and must be cleaned after 96 hours in operation for hygiene purposes. The peristaltic effect may operate in both directions along the pipe. The probability of a single failure in a system of length x metres is $x \cdot 0.0001$ and hence multiple failures are distributed Poissonially. The system will be guaranteed for 5 years after the completion of installation. The pipe weighs 1.5 kg per metre while each sphere weighs 11.3 kg and both are produced in Nebraska.

Item Code	Description	Unit	Cost(\$)/unit
CR1FORMMETNA	Peristaltic Sewage System	m	50

Sealant Advancements

Makes paint and coatings from near-Earth asteroid mined materials that provide air-tight surfaces on rock, SuperAdobe and other porous surfaces. Application is done with standard paintbrushes or aerosols and the surface requires 30 Earth days to dry before being capable of retaining air. These are produced at Bellevistat where the company holds a stock of 50,000 litres priced at \$55 per litre. To be effective the paint requires a coating thickness of 0.5 mm and it has a density of 2,000 kg/m³.

Item Code	Description	Unit	Cost(\$)/unit
SA1SEALPAINT	Air tight paint	liter	55

Tubular Technologies

Based on Alexandriat, is the most prolific producer of carbon nanotubes for industrial and scientific uses, for both space and dirtside customers. The company has succeeded in making nanotube cross-linked strings up to 2 km long, although most applications are in the one to ten foot range. Nanotubes add strength to conventional materials; primary customers are manufacturers of construction elements (e.g. for buildings and bridges) and components for machinery, vehicles and tools.

Item Code	Description	Unit	Cost(\$)/unit
TT1NANOTUBES	Nanotube	m	1

Electrical and Robotic Subcontractors



Baena Robotics

Offers purpose-built robots for home and office use only. Currently available functions for robots are cleaning household surfaces, washing dishes, doing laundry, moving furniture and fetching household items for their owners. The company offers to build robots to customer specification, \$10,000 deposit per custom specification. Built on Alexandriat.

Item Code	Description	Unit	Cost(\$)/unit
BR1CUSTROBOT	Custom Design Robot	piece	700

Electro Protect

Build components for circuitry that can withstand space environments and shielding or protective boxes for components and circuits that cannot be built to withstand local environments. ElectroProtect stock components run at the same price as the unprotected variants while custom hardware runs at approximately twice the price as unprotected equipment. ElectroProtect charges a yearly membership fee of \$400,000 for access to its services and shipping is not included from its Bellevistat manufacturing facility.

Item Code	Description	Unit	Cost(\$)/unit
EP1PROTEPCB	Protected PCBs	Yearly	400,000

Fusion Founders

Serendipitously happened upon an apparently ideal combination of conditions and equipment to produce practical fusion power in 2032. Although it can assemble large municipal power plants at customer-specified sites, its most popular product is a self contained unit that can be shipped in a modified version of a C-18 transport aircraft, and installed by local labour with supervision of a company engineer. The unit, weighing 90.8 tonnes, includes a 5.2 metre diameter sphere, its 24.4 metre long turbine 'barn' and support 'shed'. The system is shipped pre assembled and generates a heat output of 30 MW. The plant operates at an efficiency of 70% of the Carnot efficiency. The maximum temperature of the effective hot reservoir is 1,300K. The cost of such a unit excluding heat dissipation systems is \$60,000,000. The reactor must be shut down every 1,200 hours for maintenance of the containment chamber (requires plating replacement every other maintenance period on average) and to refurbish the cermet turbine blades. The reactor containment requires a constant power input of 5 MW while running and 6MW during the 1 hour start-up period. Fusion Founders require a full schematic and report of cooling measures before agreeing to install, for legal liability reasons.

Item Code	Description	Unit	Cost(\$)/unit
FF1POTFUSION	Portable Fusion Plant	Plant	60,000,000

Electrical and Robotic Subcontractors



Nano Solutions

Was established at Alexandriat to commercialise production and marketing of nanobots after techniques were developed to grow them in zero-g and vacuum. The company is constantly innovating new nanobot applications, and accepts challenges to design for custom uses. Programmed nanobots sell by the ounce at roughly 10 times the cost of platinum, when delivered they resemble a fine powder the customer applies as a thin layer to the working surface. Service life is one to five Earth years, depending on operating environment and application. The company reprograms nanobots for new tasks (compatible with their original application) for a modest fee.

Item Code	Description	Unit	Cost(\$)/unit
NS1PROGNANOB	Programmed Nanobots	kg	300,000

Personal PCBs

Market themselves as the solar system's finest custom manufacturer for electronics. They operate a small fabrication plant at Bellevistat and manufacture pretty much any electronic device using a large variety of consumer and professional chips based on RISC-V instruction set, and their open source derivatives. Using material gained from asteroid mining, their electronics have prices comparable to custom electronics found on earth. All their electronics have a 4 year warranty (dependant on proof of shielding and good power regulation) and are shock and acceleration resistant.

Item Code	Description	Unit	Cost(\$)/unit
PC1GENCOMPST	General Compute Stack	10 ⁹ Inst/s	0,01
PC1CUSTASICD	Custom ASIC Device	10 ⁹ Inst/s	0,05

Electrical and Robotic Subcontractors



Chem Sense

Supplies atmospheric and water supply monitoring equipment that reliably and accurately detects chemical concentration changes. These sensors provide a serial data output and list all elements detected and their relative proportions. They provide two variants for their systems: passive and XRF. The passive systems draw 0.5 W per sensor and output data in a constant stream with detection lower bound equivalent to 1,000 ppm and an accuracy of ± 100 ppm for a cost of \$100 per sensor. The XRF system draws 2,000 W during its triggered 10 second run time on a discrete sample of substance. This provides a detection lower bound of 50 ppb with an accuracy of ± 10 ppb, however the sample is irradiated and made hazardous. This system costs \$20,000 per unit and must be triggered to operate when a sample is in place. The XRF system may be used on matter in any form while the passive sensor may only be used on fluid material and has a temperature range of 223-573K. The passive sensor is vulnerable to radiation and amounts in excess of 50,000 Becquerels may cause inaccurate results from sensors.

Item Code	Description	Unit	Cost(\$)/unit
CS1XRFMINSYS	XRF Main System	Single	20,000
CS1PASSENSOR	Passive Sensor	Single	100

Vaporly

Ships nitrogen, oxygen, and clean water from its facilities. Liquid nitrogen and water are shipped in sealed CASSSCs from their production facilities at Alaskol and Argonom. Liquid nitrogen is priced at \$0.15 per litre, liquid oxygen at \$1.5 per litre, while the flagship product, water, is priced \$5 per litre. Stuff of life market their water as; "Never having been touched by human pollution, free from additives and contamination".

Item Code	Description	Unit	Cost(\$)/unit
SL1LIQUIDN2X	Liquid Nitrogen	Litre	0,15
SL1LIQUIDO2X	Liquid Oxygen	Litre	1,5
SL1LIQUIH2O2X	Liquid Water	Litre	5

Lossless Airlocks

Has developed and sells airlocks and hatches that operate with almost no loss of atmosphere to space on opening. LA offers systems in several designs and sizes. These comprise their cylindrical airlocks, which come in various sizes for different purposes, and their hatches, which provide interfaces between already pressurised volumes. The airlocks available are for a single occupant, up to three occupants, up to ten occupants, and one capable of passing a single CASSSC. The hole for the airlock in a pressurised hull will induce a region where the local stress in the material is three times higher than the unaltered hull. LA produces a specialist component to allow docking with front of a pressurised CASSSC.

Item Code	Description	Unit	Cost(\$)/unit
LA1AIRLOCK15	Ø1.5 m by 2.2 m Airlock	Single unit	6,000
LA1AIRLOCK30	Ø3 m by 3.2 m Airlock	Single unit	20,000
LA1AIRLOCK45	Ø4.5 m by 5 m Airlock	Single unit	60,000
LA1AIRLOCK75	Ø7.5 m by 11.5 m Airlock	Single unit	160,000

WasteSide

Offers a final disposal service for irreducible waste products out of internal reprocessing systems. This includes dealing with hazardous waste such as spent nuclear fission fuel. Ultimate disposal involves questionable ethical decisions in the name of capitalism; these involve burying waste on areas of moons currently devoid of human habitation, or using reentry conditions to sublimate or autoclave certain materials. Toss it To Me charge by the mass of the material to be disposed of, charging \$5,000 per kg, requiring the waste to be delivered to their facilities in lunar orbit. Due to the high demand for their services, they limit the use of their services for a single client to 2,000 kg a year.

Item Code	Description	Unit	Cost(\$)/unit
TM1WASTEDISP	Waste Disposal	kg	5000

3D Logistics

Is a multinational corporation that leads in additive manufacturing technologies, with their main off-world production facility based out of Alexandriat. The company provides both printed components and complete 3D printing systems for purchase. They are able to produce metal, plastic and ceramic components with an accuracy of 30 microns up to 8 x 4 x 4 metres in sizes with their in-house proprietary systems, while systems on sale are capable of 40 micron accuracy within a volume of 5 x 2.5 x 2.5 metres (\$750,000). Their mobile printer designs can achieve 3,000 micron accuracies laying at 0.5 litres per second in an unlimited volume of simple metals and plastics with a power requirement of 60 kW for \$500,000. The high precision systems consume 50 kW to lay 0.5 litres of material per 20 seconds. This material is laid across the entire surface before laser sintering.

Item Code	Description	Unit	Cost(\$)/unit
3L1MOBILEPRT	Mobile 3D Printer	Single unit	500,000
3L1STATPRINT	Immobile 3D Printer	Single unit	750,000
3L1PLASTICPR	In-House Plastic Prints	Litre	2
3L1METALPRIN	In-House Metal Prints	Litre	8
3L1CERAMICPR	In-House Ceramic Prints	Litre	16

Life Support Subcontractors



Hard Roll

Accepts ores from off world mining operations, refines the metals and produces rolled sheets, extruded beams and custom shaped parts manufactured by cutting or turning processes. Hard Roll is capable of a throughput of 2,000 kg of product per hour, charging \$0.15 per kg of ore given and processed through them. They have processing facilities on Earth, Bellevistat, and Alaskol. They will not pay for shipping of products or stock for customers.

Item Code	Description	Unit	Cost(\$)/unit
HR10REPROCES	Processing of Ore	kg	0,15

Large Print

Buy in and adapt second-hand 3D logistics mobile printing robots to give the capability for 3D printing of large parts on the Lunar environment. Their mobile printer designs can achieve 10,000 micron accuracies in an unlimited volume in superadobe laying material at a rate of 1 litre per second. Each unit costs \$450,000 and is supplied from Alaskol.

Item Code	Description	Unit	Cost(\$)/unit
LP1MOBILEPRT	Mobile 3D Printer	Single unit	450,000

Medical and Nutrition

Subcontractors



Aesculpien Ventures

Is a medical organization who manufacture medical supplies and equipment for use in cislunar space. From their home at Liberty they are at the cutting edge of medicine, being able to construct advanced artificial organs for use in humans. Their main business is managing a series of hospitals and hospices in LEO, but they sell 3D printers that can manufacture artificial organs for use in settlements for \$50,000,000 each. They also act as the main manufacturer and supplier for all settlements in cislunar space and beyond for more mundane medical and pharmaceutical supplies.

Item Code	Description	Unit	Cost(\$)/unit
AV1ORGAN3DPR	Organ 3D Printer	Single unit	50,000,000

CRISPR Cod

Sell, despite their name, a large variety of genetically modified fish. Based at Liberty, their fish are genetically modified to be able to survive and thrive in all gravitational environments up to 1g. At a competitive average of \$500 per 1kg of eggs (~3,000 eggs), presuming safe transportation, the fish are guaranteed to provide greater yields of produce with greater resistance to parasites and diseases. In efforts to curb the potency of the release of any genetically modified organisms into the greater environment, each fish has had its reproductivity slightly diminished, meaning that a colony of fish will decrease slightly with each generation requiring a regular top up of eggs.

Item Code	Description	Unit	Cost(\$)/unit
CC1FISHEGGSX	Fish eggs	kg	500

Svalbard Seeds

Have expanded their mission to catalogue and store the genetic information of all plants to providing them also. They are currently based at Argonom and have completed a seed vault not too far away. They sell all seeds and cuttings at cost, at 100 seeds per dollar, with the hope to spread natural plants to all corners of the solar system.

Item Code	Description	Unit	Cost(\$)/unit
SS1GENERSEED	Seeds - Generic	Seed	0,01

Medical and Nutrition Subcontractors



Garden-A-Go-Go

Manufactures potable hydroponic and aeroponic ecosystems at Alexandriat for sustaining long duration spaceship crews. The modules attach to the exterior of a ship, over an airlock that would normally go to vacuum. New inter-orbit spacecraft are designed with appropriate interfaces as standard. Sizes are available for crews of five (\$3,000,000), eight (\$4,000,000), and twelve (\$5,000,000) while special orders are reactively fulfilled (min 1000 person). Use of a Garden-A-Go-Go system requires that two crewmembers be trained to work the farm for one hour per day on average. These deliver grains, vegetables, fruit, meat and eggs. The systems require bi-annual maintenance to replenish water and nutrients, introduce non-inbred animals, and replace plant species that have died off.

Item Code	Description	Unit	Cost(\$)/unit
LA1AIRLOCK15	5 person Hydro/Aero-ponic unit	Single unit	3,000,000
LA1AIRLOCK30	8 person Hydro/Aero-ponic unit	Single unit	4,000,000
LA1AIRLOCK45	12 person Hydro/Aero-ponic unit	Single unit	60,000
LA1AIRLOCK75	Special order unit (min 1000)	Per person	100,000

Synthetic Seeds

Are based in Lunar orbit and have used their extreme remoteness to render any restrictions on genetically modified organisms redundant. As such they manufacture genetically modified plants with efficiencies that are getting close to the theoretical maximum of 11%. Combined with other variables, in ideal scenarios, this leads to a doubling of growth rates, a doubling of yields, a lesser need for resources, and complete immunity to any known parasite or disease. All of this with enhanced reproductivity has meant that on Foundation Society settlements, areas dedicated to farming these seeds require full automation, with separate atmosphere processing and additional measures to ensure that no seeds are released into the greater environment. They are famed for their web portal, offering consumers the ability to customise the taste of the produce grown, along with almost all aspects of each plant's genetics. Prices are on average \$1 per seed, with other offerings such as infertile trees saplings that can mature in as little as 5 years priced at \$100 dollars per sapling.

Item Code	Description	Unit	Cost(\$)/unit
SS2GENERSEED	Seeds - Generic	Seed	1
SS2INFERTREE	Infertile Tree Sapling	Sapling	100

Custom Cargo Accommodations (CCA)

Produces Cargo Accommodation Standard Space Shipping Containers (CASSSCs), compatible with standard interfaces on all launch vehicles and interorbital spacecraft currently in use. In efforts to standardise and reduce free waste in space, the Foundation Society has stated that, after 2038, all extraterrestrial cargo must be transported in CASSSCs. CASSSCs are 9 metres long with square 4.5 metre cross-sections and weigh 2 metric tonnes each when empty. Generic CASSSCs are aluminium, fully enclosed and vented to permit pressure equalisation, however special CASSSCs can be whatever customers choose within standard size and interface constraints, including pressurised, open framework or made of composite materials. CASSSCs are now offered across cislunar space with distribution facilities at all major Foundation Society settlements.

Item Code	Description	Unit	Cost(\$)/unit
CC2CASSSCHIR	CASSSC Hire	Single unit	2,000
CC2CASSSCPUR	CASSSC Purchase	Single unit	120,000

Consegna Veloce

Operates interplanetary charter vehicles for either cargo or passenger transportation. Their crewed spacecraft called Caroliners, named after their late founder Carola Genovese, can carry payloads of up to 220,000 kg in up to 10 CASSSCs or 30 passengers, and can travel to and from almost anywhere in orbit within the inner solar system. They charge either \$15.54 $t^{-1}(ms^{-1})^{-1}$ for cargo or \$1,500 per day of travel for passengers. In order to reduce radiation exposure, and to increase shipment times as well, Caroliners are designed to engage longer burns, reducing the transit times between destinations to around half of a typical Hohmann transfer

Item Code	Description	Unit	Cost(\$)/unit
CV1CARGOTRAN	Cargo transport	$t^{-1}(ms^{-1})^{-1}$	15,54
CV1PASSENGER	Passenger transport	Day	1,500

Transportation Subcontractors



Custom Couriers

Manages a large number of offices in all major settlements and transport hubs from where they track and manage the transfer of cargo for their clients. They have negotiated with the Foundation Society an agreement for the tracking of cargo for settlement construction and operations in cislunar space. Custom Couriers charge \$350 per CASSSC for the tracking of the cargo and managing the transfer between carriers at each stage on its journey.

Item Code	Description	Unit	Cost(\$)/unit
CC3CASSSCMAN	CASSSC Journey Management	per CASSSC	350

Dangerous Packages

Is a transportation company that specialises in the controversial movement of hazardous material from one location to another. This includes the nuclear material that is used in nuclear fission power generation. Dangerous Packages emerged as a company as an offshoot from Vulture Aviation, and now acts as an independent firm with regular contracts with almost every major space settlement. Based at Alexandriat, their spacecraft are crewed, and charge \$2,000 a day for the transportation of up to 1,000 kg of hazardous material to anywhere in orbit in the inner solar system. Their company motto is; "If no one else will take it, we will."

Item Code	Description	Unit	Cost(\$)/unit
DP1HAZMATTRA	Transport of Hazardous material	kg	2,000

Interorbital Heavy Payload Carriers (IHPC)

(IHPC) is a Danish company that operates a fleet of gargantuan spacecraft which are the largest in current usage. A single IHPC craft can move up to 1800 fully loaded CASSSCs at once to almost anywhere in the inner solar systems through the use of efficient Hohmann transfers. These massive ships offer some of the lowest cargo fees of any transportation company, coming in at 3.95 \$t⁻¹(ms⁻¹)⁻¹. The customer must make the necessary calculations of Delta V and account for the transport mass when booking cargo space on the ship. Their spacecraft, due to their size, cannot dock with settlements and require specialist portside equipment that is only available at certain spaceports (Columbiat, Aresam, and Astoria) or require tugs to collect delivered CASSSCs from free space.

Item Code	Description	Unit	Cost(\$)/unit
IH1CARGOTRAN	Cargo Transportation	t ⁻¹ (ms ⁻¹) ⁻¹	3,95

Space Trans

Started as a business plan written for a college class project by an ambitious self-styled entrepreneur who idolised the founder of Federal Express. The company acquired funding to build vehicles in space that can provide regular but unscheduled transportation services between locations in Earth orbit, including space stations, major commercial sites and future settlements. Nowadays they oversee, from their headquarters at Columbiat, over 50% of trans orbit flights each day in cislunar space. Rates average \$3000 per person and \$60 per kg of cargo, per day of travel. Their vehicles may carry up to 75 CASSSCs with no total mass limit. Ships carrying both CASSSCs and passengers reduce the maximum number of CASSSCs by ten and may replace a CASSSC with capacity for two individuals.

Item Code	Description	Unit	Cost(\$)/unit
ST1HUMANTRAN	Human Transport	Person/day	3,000
ST1CARGOTRAN	Cargo Transport	kg/day	60

Miscellaneous Subcontractors



Extereme Survival Technologies (EST)

Build spacesuits, and pressurised fabric furniture and impact protection systems (e.g. airbags and restraints) from its Alaskol facility. Its series of custom inflatable products are not rated for extravehicular use but cost only \$6,000 dollars per m3. EST's most popular products are its spacesuits however, with the most popular model being a hard shell suit customised for lunar operations but frequently used for other applications. Efficiencies of line production enable \$40,000 unit costs.

Item Code	Description	Unit	Cost(\$)/unit
ES1INFLATUNI	Inflatable products	m3	6,000
ES1HARDSHELL	Hard Shell Space Suit	Single suit	40,000

Litigation Limiters

Is a law firm that created a niche market which virtually eliminates conflict-of-interest suits for its clients, who usually are companies competing for the same contracts but in need of each others products and/or services, and their customers. From their Colombiat headquarters, the company has negotiated such agreements with all of the world's diversified corporations that have significant product lines applicable to space development. Litigation limiters charge a 2% fee on product of service value.

Item Code	Description	Unit	Cost(\$)/unit
LL2CONFRESOL	Conflict of Interest Litigation	\$ project cost	0,02

Magnetic Propulsion Union (MPU)

Was founded by three professors at Princeton who continued work with mass drivers originally started by Gerard O'Neill. The MPU has spiraled out into a large international project, encompassing many universities and voluntary projects. They exist as a large repository of knowledge and idealism; with constantly improving designs, in terms of launch mass, efficiency or reliability. MPU offer to build mass drivers with a muzzle momentum of up 120,000 kgms⁻¹. The price of such a system is based on the length of the mass driver, costing \$50,000,000 per kilometer, and massing in at 98,000,000 kg per kilometre. The mass driver will impart 6000 kgms⁻¹ per kilometer of length. Shipping is not included. The mass driver transfers energy to projectiles with a 60% efficiency.

Item Code	Description	Unit	Cost(\$)/unit
MP1MASSDRIVE	Mass Driver	Kilometer	50,000,000

