

Computer Games Laboratory - SS 2019

# Team Rocket



beyond reach

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# Project Structure Document

## 1. Formal Game Proposal

### 1.1. Game Description

The game follows the narrative of mankind who leave their dying solar system through the help of artificial intelligence by building a galactic ark.

#### 1.1.1. Storyline

Pressured by vanishing resources and a dying sun, mankind put their fate into the hands of their creation: Masterminds of artificial intelligence, capable of perfect rational decision making. The discovery of a planet with the requirements for life, as well as similar properties to earth sparks the torch of hope. With different ethnological ideas and beliefs concurring between the factions of the homeplanet, a space race begins with the goal to build the first giant vessel for safe passage. Its manufacture will take a lot of resources from multiple planets of the system. Only with the help of their artificial leader, people will be able to complete this journey before it is too late.

#### 1.1.2. Game Idea

The player takes control of one of these leader AIs and tries to lead its group of people to victory, by completing multiple construction steps of the galactic ark. To do so, it will be required to collect enough resources that are scattered on the planets of the system. To harvest these, the player needs to expand its planetary base to provide means of workforce and production. Not only buildings for expansion but also factories, energy sources and housing will require strategic decision making. The base will go through stages of improvement, until it is required to embark on other planets with tougher environmental hazards to gather the required resources.

The player in the role of the AI must plan construction of his bases and maximization of building material, available energy and workforce satisfaction.

Since there are rivaling factions on the home planet, the player will compete against other AI's to be the first one finishing the ark project. Conflict between the fractions is certain, especially towards the endgame, in which later technologies require rarer materials from the edge of the solar system. This conflict might be resolved by fighting forces.

The game features a simulated solar system, with a central sun and planets with different properties. Planets will be connected by a galactic map, which enables the actors to move interplanetary.

At some stages of the game, the AI will be confronted with moral decisions, for instance using part of the population as energy resource to accelerate the expansion. The player is forced to decide as the AI, which is expected to choose the one 'right' decision, since it is rational. These moral dilemmas between technical effectiveness and human ethics will affect the game from there in terms of economic bonuses in contrast to human loyalty.

### 1.1.3. Gameplay

The Game takes place on spheres that represent planets of the solar system. Their surface consist of hexagonal fields, similar to strategic board games. The player is able to move the gameview around these planets in a top-down fashion. The game actors begin with a base on the homeplanet and aim to expand theirs on the hexagonal fields. They place multiple types of buildings with different effects such as mining a resource, or provide housing. Since construction requires building materials and workers, the actors have to wait until they produced enough material to continue. Therefore, optimal base planning is required to expand faster than their rivals. The effectiveness of tiles will be influenced by the adjacent environment they are placed in. Ultimately, it is the goal to succeed building the galactic ark in multiple steps faster then the others by optimizing his resource output.

At some point an actor gathers enough resources required to move ahead. He/She constructs a space port and ship units that travel on the galaxy map in between planets. These resources are spread throughout the solar system and are required to produce better technology, new tiles, improvements and parts for the ark. The ships feature different types for different purposes, for instance constructing a new base on a different planet, establishing trade routes or even combat and protection. These units are independently manageable and require some time to move between the planets.

### 1.1.4. Relation to Course Theme

With artificial intelligence as theme of this project, we decided to develop a game in which the player itself takes the role of an artificial intelligence. As AI is supposed to act rational, a strategy game does fit very well into the theme, since core gameplay requires to optimize the chain of actions to be more efficient than one's opponents.

Because humans steadily approach their end in this solar system, the choice of selecting an AI as their leader is justified. The top down view on a strategy game creates a illusion of almost god-like control over the human population. This fits well to an AI whose decision making is exceeding human comprehension. The usage of hexagonal shaped fields will help us to give the planets an organized and analytic feel to it, even with larger bases.

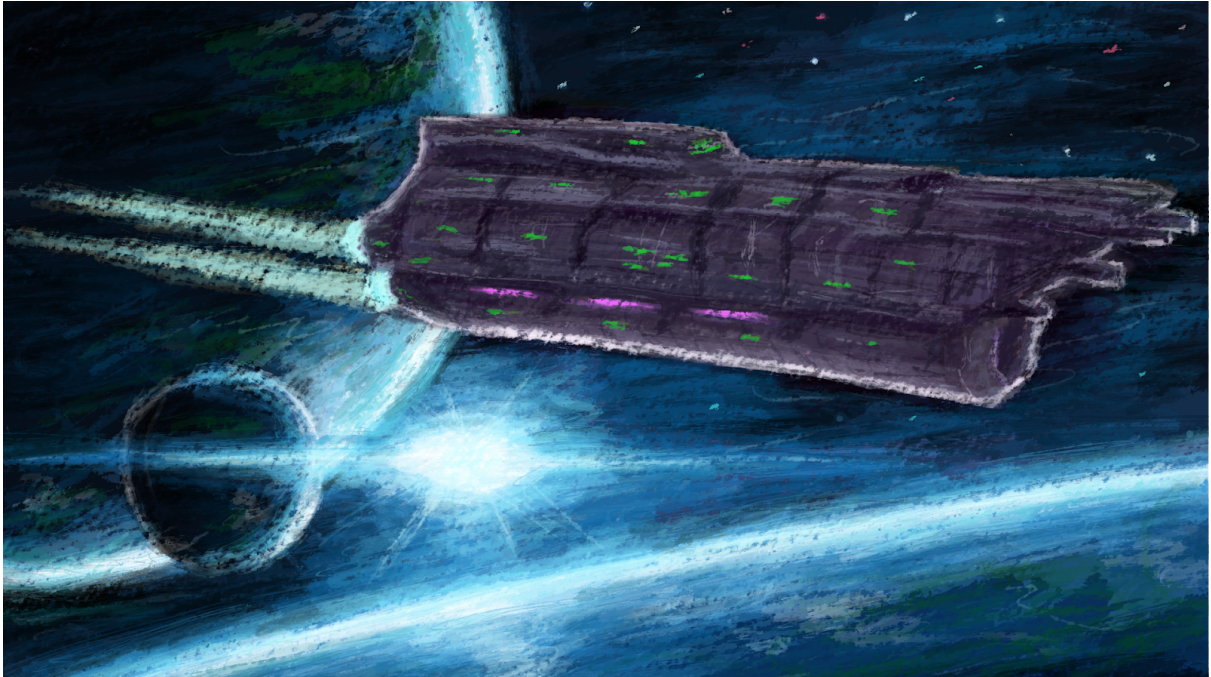
### 1.1.5. Concept Art and Sketches



Concept art for the look and feel of the player's base on the planet's surface. Here the player will construct buildings, such as the base, iron ore mine, steelworks, observatory, hangar, fuel extraction plant, ship building yard, ship hull factory, space station, population modul, food module, unobtainium ore refinery, advanced component factory, weapons factory, weapons alloy production, laser cell production, and the monumental shipyard for the escape vessel. Each planet will grant the player unique challenges and terrains, generated by our planet generator algorithm.



A concept art viewing the planets from the space station, which circles the planet and functions as a docking hub for larger ships. With this, the many resources featured in the game, such as iron ore, steel beam, fuel cell, ship hull plates, population, food, unobtainium ore, advanced component, weapons, weapons alloy, and laser cell, can be shipped between different planets.



This is a concept art of the large vessel for transporting the civilization to the edge of the galaxy. Building this vessel is the ultimate goal of the player and the first one reaching the edge of the galaxy wins the game.





This concept arts depicts a space battle, which is featured in our high targets. If we have enough time, we also want epic space battles between the factions as a feature in our game.



This image was taken from: <https://i.pinimg.com/originals/d1/e1/07/d1e107cdaaad05ecc217a4137ba4a533.png> . This is an idea on how the surface on our planets might look. The only difference is that our planets are round, as seen in the technical achievements.

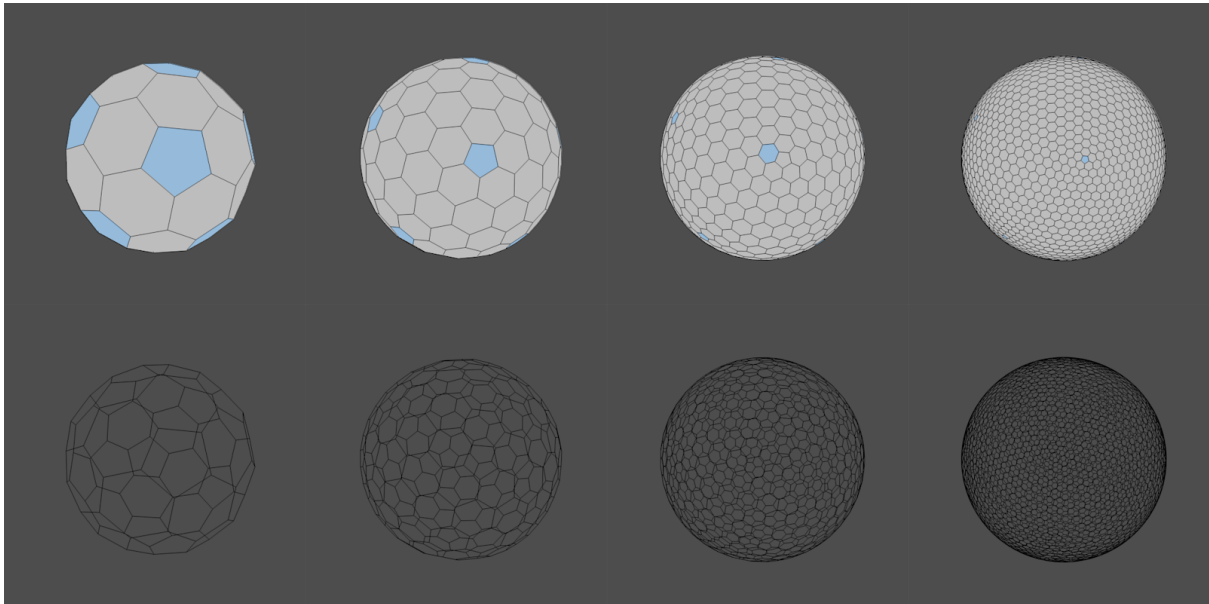


This image was taken from: <https://assetstore.unity.com/packages/3d/environments/sci-fi/polygon-sci-fi-space-pack-138857> . This is a low polygon asset pack in the unity asset store, which we will use for our game. As we have no skilled 3D artists, we choose to use this asset pack, so we can focus on programming tasks.

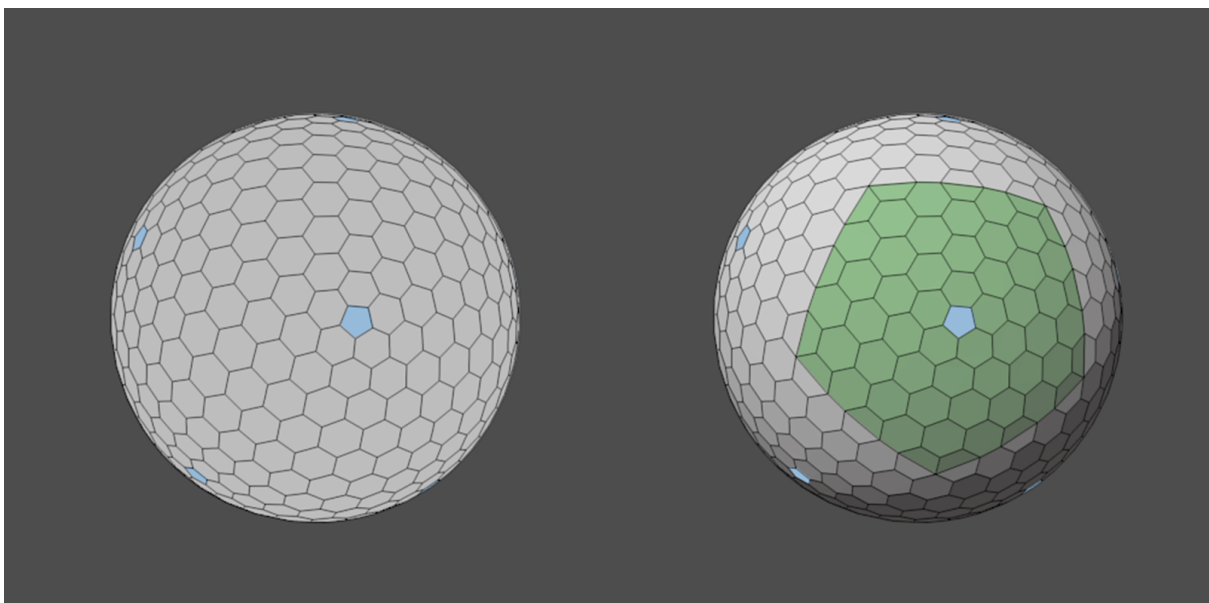
## 1.2. Technical Achievement

### 1.2.1. Generated Solar System

The solar system with its various planets is generated for each game. The planets are based on ico spheres, with their size being adjustable by adding hexagons in between the pentagons.



The planets are divided into sectors with the pentagons in their center. Since there are always 12 pentagons, each planet has 12 sectors with varying size. The sector base will always be based on the pentagon, and each sector can only be controlled by a single player.



Combining this with different atmospheres and biomes on the planets, the planets feature plenty of differences each playthrough.

### 1.2.2. AI Factions

Since the game is a singleplayer game, the two enemy factions are controlled by an advanced AI, capable of controlling all the functions available to the player. The AI has to adjust to the generated planets each playthrough, while still being balanced and its difficulty being comparable each playthrough.

### 1.2.3. Hex Based Building

Around the base building (on the pentagon), the player can build large bases out of single hex tile buildings. Different resources and biomes influence the players decisions and enforce varying playstyles each playthrough. The building serve a wide variety of functions, from resource mining and shipyards to food and science.

## 1.3. “Big Idea” Bullseye

In its core, the game is a multi-planetary strategy game. This allows for a wide variety of gameplay systems based on e.g. resources, habitability and biomes.

This concept is supported by the concept of generated planets. Combining different ground biomes with different atmospheres and planet sizes changes the look of those planets and refreshes the visuals for each playthrough. Random generator parameters adjust the gameplay as well and increase replayability a lot. Adding fog of war style exploration to each round forces the player to adjust his/her strategy each round and come up with new ideas on how to build the spaceship that takes the player’s people out of the solar system.



## 1.4. Development Schedule

### 1.4.1. Plan in Layers

- Functional minimum
  - Basic planet generation -> different sizes but only water
  - Sun in centre and planet rotates around sun
  - Basic camera movement around the planet
  - Resource system -> building resources for buildings (iron ore, steel beam)
  - First buildings -> base, iron ore mine, steelworks, monument shipyard -> build prefabs for models
  - Platform base model for buildings
  - Placing buildings actions
  - AI can place buildings based on blueprint(ish) system
  - Victory achievement process: Ore Mine -> Steelworks -> Shipyard(Monument)
- Low target
  - Generate more than one planet -> add land and atmospheres to planet generation
  - Build small solar system for the planets to move in and to be colonized
  - New buildings -> observatory, hangar, fuel extraction plant, ship building yard, ship hull factory (Power Plant ?) -> build prefabs for models
  - New resources -> fuel cell and ship hull plates (Electricity ?)
  - Ships -> cargo ship and small explorer -> build prefabs for models
  - More complex camera system for different modes between planets and space
  - Ship movement between planets and transfer of resources between planets
  - Discovery mechanic of new planets with the observatory
  - AI can build new buildings and move ships
  - First UIs for ingame tasks
  - First soundtrack songs
  - Victory achievement process: Ore Mine -> Steelworks -> Observatory -> Other planet base(hangar, cargo, explorer ship) -> ship hull factory -> fuel extraction -> Shipyard(Monument)
- Desirable target
  - Workforce system
  - New resources -> population, food, unobtainium ore, advanced component
  - New buildings -> space station, population modul, food module, unobtainium ore Mine unobtainium ore refinery, advanced component factory -> build prefabs for models
  - New Ships -> people carrier, large cargo ship -> build prefabs for models
  - Menus and fancy in-game UI
  - Update AI to new workforce system and new components
  - Effects and and other visual enhancements
  - Soundtrack and effects, voice over

- Victory achievement process: iron ore mine -> Steelworks -> Observatory -> Other planet base(hangar, cargo, explorer ship) -> ship hull factory -> fuel extraction -> another planet base(space station, large cargo ship, people carrier) -> unobtainium ore mine -> advanced component factory -> Shipyard(Monument)
- High target
  - Tutorial for game, explaining all concepts step by step
  - Ability to load and save game
  - Fancy visual effects (clouds around planets)
  - Add different terrain to planet generation (different production speeds for different buildings on certain terrains)
  - Add different tiers of resources, that are better, on other planets (better statistics for buildings etc.)
  - Add different tiers of buildings, if they are constructed with different tier material
  - Combat system
  - New resources -> weapons, weapons alloy, laser cell
  - New buildings -> weapons factory, weapons alloy production, laser cell production -> build prefabs for models
  - New ships -> small cruiser, battleship, large destroyer -> build prefabs for models
  - Add strategic variation to AI
- Extras
  - Add different difficulty settings
  - Add people and robots walking on different planet field
  - Ship upgrades
  - Tech tree
  - 3rd parties (neutral factions)
  - World events such as quests, hazards
  - Monument travel to edge of solar system
  - Different factions
  - Multiplayer
  - Statistics screen
  - Achievements

### 1.4.2. Task List

For the high resolution task list PDF, please see our project Wiki page: <https://wiki.tum.de/display/gameslab2019/Team+Rocket?preview=/234292590/234292893/Project%20Task%20List.pdf>

| PROJECT DETAILS            |                    |            |            |          |                             |           |  | HOURS           |              |
|----------------------------|--------------------|------------|------------|----------|-----------------------------|-----------|--|-----------------|--------------|
| STATUS                     | PRIORITY           | START DATE | END DATE   | DURATION | TASK NAME                   | ASSIGNEE  | DESCRIPTION  | ESTIMATED HOURS | ACTUAL HOURS |
| <b>Game Idea Milestone</b> |                    |            |            |          |                             |           |  |                 |              |
| Complete                   | Functional Minimum | 15/04/2019 | 21/04/2019 | 6        | Project Setup               | Jan       | Set everything up to start the project   | 5               | 4            |
| In Progress                | Functional Minimum | 22/04/2019 | 28/04/2019 | 6        | Report                      | Everyone  | Write the Report for the milestone and upload to the wiki                                    | 10              | 0            |
| In Progress                | Functional Minimum | 22/04/2019 | 28/04/2019 | 6        | Presentation                | Everyone  | Make the Presentation for the milestone and upload to the wiki                               | 1               | 0            |
| In Progress                | Functional Minimum | 15/04/2019 | 28/04/2019 | 13       | Game Concept                | Everyone  | Create the basic game concept  | 10              | 0            |
| In Progress                | Functional Minimum | 15/04/2019 | 28/04/2019 | 13       | Draw Concept Arts           | Everyone  | Draw concepts arts and sketches of the basic mechanics in the game                           | 15              | 0            |
| In Progress                | Functional Minimum | 15/04/2019 | 28/04/2019 | 13       | Game Idea                   | Everyone  | Define the basic game idea   | 10              | 0            |
| In Progress                | Functional Minimum | 15/04/2019 | 28/04/2019 | 13       | Game Design                 | Everyone  | Define the game in more detail   | 20              | 0            |
| In Progress                | Functional Minimum | 22/04/2019 | 28/04/2019 | 6        | Technical Achievements      | Everyone  | Define the technical achievements of the game  | 5               | 0            |
| In Progress                | Functional Minimum | 22/04/2019 | 28/04/2019 | 6        | Development Schedule        | Everyone  | Define the tasks and development schedule for the game                                       | 10              | 0            |
| <b>Prototype Milestone</b> |                    |            |            |          |                             |           |  | <b>162</b>      | <b>0</b>     |
| Not Yet Started            | Functional Minimum | 29/04/2019 | 05/05/2019 | 6        | Critiques                   | Everyone  | Written critiques of all other projects as an email to the supervisors                       | 1               | 0            |
| Not Yet Started            | Functional Minimum | 06/05/2019 | 12/05/2019 | 6        | Report                      | Everyone  | Write the Report for the milestone and upload to the wiki                                    | 10              | 0            |
| Not Yet Started            | Functional Minimum | 06/05/2019 | 12/05/2019 | 6        | Presentation                | Everyone  | Make the Presentation for the milestone and upload to the wiki                               | 1               | 0            |
| Not Yet Started            | Functional Minimum | 06/05/2019 | 12/05/2019 | 6        | Mutual Critiques            | Everyone  | Submit mutual critiques on the wiki (every team member separately)                           | 1               | 0            |
| Not Yet Started            | Functional Minimum | 29/04/2019 | 05/05/2019 | 6        | Paper Prototype Building    | Everyone  | Build the paper prototype of the game  | 20              | 0            |
| Not Yet Started            | Functional Minimum | 29/04/2019 | 05/05/2019 | 6        | Paper Prototype Design      | Everyone  | Design the paper prototype of the game   | 20              | 0            |
| Not Yet Started            | Functional Minimum | 29/04/2019 | 05/05/2019 | 6        | FM Building Stats           | Jan, Maxi | Define the statistics (cost, production etc.) of the bulings in the functional minimum stage | 1               | 0            |
| Not Yet Started            | Functional Minimum | 29/04/2019 | 12/05/2019 | 13       | Loading Data System         | Jan, Maxi | Implement the loading of building and other important data from file                         | 2               | 0            |
| Not Yet Started            | Functional Minimum | 06/05/2019 | 12/05/2019 | 6        | FM Building Models          | Jan, Maxi | Build the preabs for the building models in the functional minimum stage                     | 8               | 0            |
| Not Yet Started            | Functional Minimum | 29/04/2019 | 12/05/2019 | 13       | FM Building Implementation  | Jan, Maxi | Implement the functional minimum buildings into the gameplay                                 | 10              | 0            |
| Not Yet Started            | Functional Minimum | 29/04/2019 | 05/05/2019 | 6        | Unity Setup                 | Alex      | Setup the Unity project with assets and settings needed for our game                         | 2               | 0            |
| Not Yet Started            | Functional Minimum | 29/04/2019 | 05/05/2019 | 6        | Controls Design             | Jan, Maxi | Design the control scheme of the game  | 1               | 0            |
| Not Yet Started            | Functional Minimum | 06/05/2019 | 12/05/2019 | 6        | Playtesting Paper Prototype | Everyone  | Playtest the paper prototype   | 10              | 0            |
| Not Yet Started            | Functional Minimum | 06/05/2019 | 12/05/2019 | 6        | Refining Paper Prototype    | Everyone  | Refine the paper prototype based on the playtesting sessions                                 | 10              | 0            |
| Not Yet Started            | Functional Minimum | 06/05/2019 | 12/05/2019 | 6        | Basic Planet Generation     | Alex      | Build the basic planet generation for our game   | 10              | 0            |

|                 |                    |            |            |    |                              |           |  |    |   |
|-----------------|--------------------|------------|------------|----|------------------------------|-----------|--|----|---|
| Not Yet Started | Functional Minimum | 06/05/2019 | 12/05/2019 | 6  | Lighting and Sun             | Alex      | Build the sun in the middle of the solar system and implement the light emission | 1  | 0 |
| Not Yet Started | Functional Minimum | 06/05/2019 | 12/05/2019 | 6  | Basic Planet Movement        | Jan, Maxi | Implement the planets moving around the sun                                      | 2  | 0 |
| Not Yet Started | Functional Minimum | 29/04/2019 | 05/05/2019 | 6  | Basic Controls               | Jan, Maxi | Implement the basic controls needed on the first planet                          | 4  | 0 |
| Not Yet Started | Functional Minimum | 29/04/2019 | 05/05/2019 | 6  | Tools Setup                  | Alex      | Setup and build all tools needed for the project                                 | 5  | 0 |
| Not Yet Started | Functional Minimum | 06/05/2019 | 12/05/2019 | 6  | Basic Resource System        | Jan, Maxi | Implement the first basic resource system  | 2  | 0 |
| Not Yet Started | Functional Minimum | 29/04/2019 | 05/05/2019 | 6  | Modelling Placeholder Planet | Alex      | Model the placeholder for the planet, so that gameplay programming can begin     | 2  | 0 |
| Not Yet Started | Functional Minimum | 29/04/2019 | 05/05/2019 | 6  | Modelling of Platform        | Alex      | Model the base platform, which will house all buildings in our game              | 4  | 0 |
| Not Yet Started | Functional Minimum | 29/04/2019 | 05/05/2019 | 6  | Building Placement System    | Jan, Maxi | Implement the placement system for the buildings on the planet                   | 10 | 0 |
| Not Yet Started | Functional Minimum | 29/04/2019 | 12/05/2019 | 13 | Basic AI                     | Lukas     | Implement the basic AI of the enemies for the functional minimum stage           | 20 | 0 |
| Not Yet Started | Functional Minimum | 06/05/2019 | 12/05/2019 | 6  | Basic Victory Condition      | Jan, Maxi | Implement the first victory condition in the functional minimum stage            | 5  | 0 |

**Interim Demo Milestone**

|                 |                    |            |            |    |                              |           |   |    |   |
|-----------------|--------------------|------------|------------|----|------------------------------|-----------|---|----|---|
| Not Yet Started | Functional Minimum | 27/05/2019 | 02/06/2019 | 5  | Report                       | Everyone  | Write the Report for the milestone and upload to the wiki   | 10 | 0 |
| Not Yet Started | Functional Minimum | 27/05/2019 | 02/06/2019 | 5  | Presentation                 | Everyone  | Make the Presentation for the milestone and upload to the wiki  | 1  | 0 |
| Not Yet Started | Functional Minimum | 13/05/2019 | 19/05/2019 | 6  | Playtesting FM               | Everyone  | Playtest the functional minimum game from the previous milestone  | 5  | 0 |
| Not Yet Started | Functional Minimum | 13/05/2019 | 19/05/2019 | 6  | Adjust Gameplay              | Jan, Maxi | Adjust the functional minimum gameplay based on the findings in the playtest  | 6  | 0 |
| Not Yet Started | Functional Minimum | 13/05/2019 | 19/05/2019 | 6  | Fine-Tune FM AI              | Lukas     | Fine-tune the AI based on the findings in the playtest  | 6  | 0 |
| Not Yet Started | Functional Minimum | 13/05/2019 | 19/05/2019 | 6  | FM Bug Fixing                | Everyone  | Fix any bugs found during the playtest and polish the gameplay  | 10 | 0 |
| Not Yet Started | Functional Minimum | 13/05/2019 | 19/05/2019 | 6  | Multiple Planet Generation   | Alex      | Implement the generation of multiple planets and polish the current generation process                              | 10 | 0 |
| Not Yet Started | Low Target         | 20/05/2019 | 02/06/2019 | 12 | Add Components to Generation | Alex      | Add new components to the planet generation, such as land masses, atmosphere and animated water                     | 35 | 0 |
| Not Yet Started | Low Target         | 13/05/2019 | 19/05/2019 | 6  | Build Solarsystem            | Jan, Maxi | Build a moving solarsystem out of the planets   | 4  | 0 |
| Not Yet Started | Low Target         | 13/05/2019 | 19/05/2019 | 6  | LT Building Stats            | Jan, Maxi | Define the statistics of the new buildings added in the low target  | 1  | 0 |
| Not Yet Started | Low Target         | 13/05/2019 | 26/05/2019 | 13 | LT Building Models           | Jan, Maxi | Build the prefab models for all the buildings   | 10 | 0 |
| Not Yet Started | Low Target         | 13/05/2019 | 26/05/2019 | 13 | LT Building Implementation   | Jan, Maxi | Implement the low target buildings into the game  | 6  | 0 |
| Not Yet Started | Low Target         | 20/05/2019 | 26/05/2019 | 6  | Add LT Resources             | Jan, Maxi | Add the low target resources into the game  | 3  | 0 |
| Not Yet Started | Low Target         | 20/05/2019 | 26/05/2019 | 6  | LT Ship Stats                | Jan, Maxi | Define the statistics of the ships added in the low target  | 1  | 0 |
| Not Yet Started | Low Target         | 20/05/2019 | 02/06/2019 | 12 | LT Ship Models               | Jan, Maxi | Build the prefabs for the low target ship models  | 4  | 0 |
| Not Yet Started | Low Target         | 20/05/2019 | 02/06/2019 | 12 | LT SHIP Implementation       | Jan, Maxi | Implement the low target ships into the game  | 4  | 0 |
| Not Yet Started | Low Target         | 20/05/2019 | 26/05/2019 | 6  | Advanced Controls            | Jan, Maxi | Implement the advanced controls for the camera, which differentiates between the planet and the general solarsystem | 8  | 0 |

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|                 |            |            |            |    |                          |           |   |    |   |
|-----------------|------------|------------|------------|----|--------------------------|-----------|---|----|---|
| Not Yet Started | Low Target | 20/05/2019 | 26/05/2019 | 6  | Ship Selection System    | Jan, Maxi | Implement the system to select and command ships to new positions   | 10 | 0 |
| Not Yet Started | Low Target | 20/05/2019 | 26/05/2019 | 6  | Ship Pathfinding System  | Jan, Maxi | Implement the pathfinding system for the ships  | 6  | 0 |
| Not Yet Started | Low Target | 27/05/2019 | 02/06/2019 | 5  | Resource Transfer System | Jan, Maxi | Implement the resource transfer system between two planets  | 12 | 0 |
| Not Yet Started | Low Target | 27/05/2019 | 02/06/2019 | 5  | Discovery Mechanic       | Jan, Maxi | Implement the discovery mechanic, to discover new planets with the observatory  | 12 | 0 |
| Not Yet Started | Low Target | 20/05/2019 | 02/06/2019 | 12 | AI Additions for LT      | Lukas     | Adjust and implement the newly added features from the low target to the AI implementation                                | 35 | 0 |
| Not Yet Started | Low Target | 20/05/2019 | 02/06/2019 | 12 | Simple In-Game UI        | Alex      | Design and implement first simple UIs for in-game actions, such as selecting and placing buildings and transferring goods | 10 | 0 |
| Not Yet Started | Low Target | 20/05/2019 | 02/06/2019 | 12 | First Soundtracks        | Maxi      | Create and add first soundtrack samples for the game (background music)   | 5  | 0 |
| Not Yet Started | Low Target | 27/05/2019 | 02/06/2019 | 5  | LT Victory Condition     | Jan, Maxi | Implement the victory conditions for the low target game  | 5  | 0 |

### Alpha Release Milestone

|                 |                    |            |            |    |                               |           |  |    |   |
|-----------------|--------------------|------------|------------|----|-------------------------------|-----------|--|----|---|
| Not Yet Started | Functional Minimum | 17/06/2019 | 23/06/2019 | 6  | Report                        | Everyone  | Write the Report for the milestone and upload to the wiki  | 10 | 0 |
| Not Yet Started | Functional Minimum | 17/06/2019 | 23/06/2019 | 6  | Presentation                  | Everyone  | Make the Presentation for the milestone and upload to the wiki   | 1  | 0 |
| Not Yet Started | Low Target         | 03/06/2019 | 09/06/2019 | 6  | Playtesting LT                | Everyone  | Playtest the low target game from the previous milestone   | 5  | 0 |
| Not Yet Started | Low Target         | 03/06/2019 | 09/06/2019 | 6  | Adjust Gameplay               | Jan, Maxi | Adjust the gameplay based on the findings in the playtest  | 6  | 0 |
| Not Yet Started | Low Target         | 03/06/2019 | 09/06/2019 | 6  | Fine-Tune LT AI               | Lukas     | Fine-tune the AI based on the experience in the playtests  | 10 | 0 |
| Not Yet Started | Low Target         | 03/06/2019 | 09/06/2019 | 6  | LT Bug Fixing                 | Everyone  | Fix bugs encountered during the playtesting  | 10 | 0 |
| Not Yet Started | Low Target         | 03/06/2019 | 09/06/2019 | 6  | Planet Generation Fine-Tuning | Alex      | Fine-tune the generation of the planets based on the playtest  | 6  | 0 |
| Not Yet Started | Desirable Target   | 03/06/2019 | 09/06/2019 | 6  | Workforce System              | Jan, Maxi | Define the workforce system that will be added during the desirable target stage                         | 2  | 0 |
| Not Yet Started | Desirable Target   | 03/06/2019 | 09/06/2019 | 6  | Add DT Resources              | Jan, Maxi | Implement the resources of the desirable target stage, including to fully implement the workforce system | 10 | 0 |
| Not Yet Started | Desirable Target   | 03/06/2019 | 09/06/2019 | 6  | DT Building Stats             | Jan, Maxi | Define the statistics for the desirable target buildings   | 1  | 0 |
| Not Yet Started | Desirable Target   | 03/06/2019 | 16/06/2019 | 13 | DT Building Models            | Jan, Maxi | Build the prefab models for the desirable target buildings   | 10 | 0 |
| Not Yet Started | Desirable Target   | 03/06/2019 | 16/06/2019 | 13 | DT Building Implementation    | Jan, Maxi | Implement the new buildings for the desirable target stage   | 15 | 0 |
| Not Yet Started | Desirable Target   | 10/06/2019 | 16/06/2019 | 6  | DT Ship Stats                 | Jan, Maxi | Define the statistics of the desirable target ships  | 1  | 0 |
| Not Yet Started | Desirable Target   | 10/06/2019 | 23/06/2019 | 13 | DT Ship Models                | Jan, Maxi | Build the prefab models for the desirable target ships   | 4  | 0 |
| Not Yet Started | Desirable Target   | 10/06/2019 | 23/06/2019 | 13 | DT Ship Implementation        | Jan, Maxi | Implement the new ships for the desirable target stage   | 4  | 0 |
| Not Yet Started | Desirable Target   | 03/06/2019 | 23/06/2019 | 20 | Game Menu UI                  | Alex      | Implement a game menu to start the game, as well as a pause menu during game play                        | 8  | 0 |
| Not Yet Started | Desirable Target   | 03/06/2019 | 23/06/2019 | 20 | Fancy In-Game UI              | Alex      | Implement fancy in-game UI for better usability of our game  | 10 | 0 |
| Not Yet Started | Desirable Target   | 10/06/2019 | 23/06/2019 | 13 | AI Additions for DT           | Lukas     | Add all new features from the desirable target to the AI system  | 35 | 0 |
| Not Yet Started | Desirable Target   | 03/06/2019 | 23/06/2019 | 20 | Visual Effects                | Alex      | Add different visual effects to the game   | 10 | 0 |

208 0



|                 |                  |            |            |    |                      |           |   |    |   |   |
|-----------------|------------------|------------|------------|----|----------------------|-----------|---|----|---|---|
| Not Yet Started | Desirable Target | 03/06/2019 | 23/06/2019 | 20 | Visual Enhancements  | Alex      | Add different visual enhancements to the game                     | 10 | 0 | 0 |
| Not Yet Started | Desirable Target | 03/06/2019 | 23/06/2019 | 20 | Soundtrack           | Maxi      | Add more soundtracks to the game (menu music, planet music, etc.) | 10 | 0 | 0 |
| Not Yet Started | Desirable Target | 03/06/2019 | 23/06/2019 | 20 | Sound Effects        | Maxi      | Add different soundeffects to the game                            | 10 | 0 | 0 |
| Not Yet Started | Desirable Target | 17/06/2019 | 23/06/2019 | 6  | Playtesting DT       | Everyone  | Playtest the almost final version of the desirable target game    | 5  | 0 | 0 |
| Not Yet Started | Desirable Target | 17/06/2019 | 23/06/2019 | 6  | Add Simple Tutorial  | Alex      | Add a simple tutorial for the upcoming playtests                  | 6  | 0 | 0 |
| Not Yet Started | Desirable Target | 17/06/2019 | 23/06/2019 | 6  | Adjust Gameplay      | Jan, Maxi | Adjust the gameplay based on the findings in the playtest         | 6  | 0 | 0 |
| Not Yet Started | Desirable Target | 17/06/2019 | 23/06/2019 | 6  | DT Victory Condition | Jan, Maxi | Add the victory conditions for the desirable target               | 3  | 0 | 0 |

### Playtesting Milestone

|                 |                    |            |            |    |                            |           |  |    |   |   |
|-----------------|--------------------|------------|------------|----|----------------------------|-----------|--|----|---|---|
| Not Yet Started | Functional Minimum | 01/07/2019 | 07/07/2019 | 6  | Report                     | Everyone  | Write the Report for the milestone and upload to the wiki                | 10 | 0 | 0 |
| Not Yet Started | Functional Minimum | 01/07/2019 | 07/07/2019 | 6  | Presentation               | Everyone  | Make the Presentation for the milestone and upload to the wiki           | 1  | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | Playtesting DT             | Everyone  | Playtest the desirable target game                                       | 6  | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | Adjust Gameplay            | Jan, Maxi | Adjust the gameplay based on the playtest                                | 10 | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | Fine-Tune DT AI            | Lukas     | Fine-tune the AI based on the playtest                                   | 10 | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | DT Bug Fixing              | Everyone  | Fix any bugs encountered during playtesting                              | 10 | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | Gameplay Polishing         | Jan, Maxi | Polish the gameplay for the playtest session                             | 5  | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | AI Polishing               | Lukas     | Polish the AI behaviour for the playtest session                         | 5  | 0 | 0 |
| Not Yet Started | Functional Minimum | 24/06/2019 | 30/06/2019 | 6  | Create Questionary         | Everyone  | Create the questionary for the the playtest session                      | 2  | 0 | 0 |
| Not Yet Started | Functional Minimum | 24/06/2019 | 30/06/2019 | 6  | Playtest Scenario          | Everyone  | Define the playtest session and what the participants are supposed to do | 2  | 0 | 0 |
| Not Yet Started | Functional Minimum | 01/07/2019 | 07/07/2019 | 6  | Playtest Session           | Everyone  | Playtest the game with external players                                  | 30 | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | Visual Polishing           | Alex      | Polish the visuals of the game   | 10 | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | Sound Polishing            | Maxi      | Polish the sound of the game   | 5  | 0 | 0 |
| Not Yet Started | Desirable Target   | 24/06/2019 | 30/06/2019 | 6  | UI Polishing               | Alex      | Polish the UI of the game  | 5  | 0 | 0 |
| Not Yet Started | High Target        | 24/06/2019 | 07/07/2019 | 13 | Advanced Tutorial          | Alex      | Create an advanced and more detailed tutorial                            | 6  | 0 | 0 |
| Not Yet Started | High Target        | 01/07/2019 | 07/07/2019 | 6  | Strategic Variation for AI | Lukas     | Start implementing strategic variations in the AI behaviour              | 10 | 0 | 0 |
| Not Yet Started | Desirable Target   | 01/07/2019 | 07/07/2019 | 6  | Apply Feedback to Game     | Everyone  | Apply the feedback from the playtest to the game and fix any complaints  | 20 | 0 | 0 |
| Not Yet Started | Desirable Target   | 01/07/2019 | 07/07/2019 | 6  | Bug Fixing                 | Everyone  | Fix any bugs encountered during playtesting                              | 10 | 0 | 0 |
| Not Yet Started | Desirable Target   | 01/07/2019 | 07/07/2019 | 6  | Polishing                  | Everyone  | Polish any unpolished aspects encountered during playtesting             | 10 | 0 | 0 |
| Not Yet Started | Functional Minimum | 01/07/2019 | 07/07/2019 | 6  | Feedback Analysis          | Everyone  | Analyse the feedback from the playtest session                           | 2  | 0 | 0 |

### Final Release Milestone

|                 |                    |            |            |   |        |          |   |    |   |   |
|-----------------|--------------------|------------|------------|---|--------|----------|---|----|---|---|
| Not Yet Started | Functional Minimum | 15/07/2019 | 21/07/2019 | 6 | Report | Everyone | Write the Report for the milestone and upload to the wiki | 10 | 0 | 0 |
|-----------------|--------------------|------------|------------|---|--------|----------|---|----|---|---|

**138** **0**

**169** **0**

|                 |                    |            |            |    |                            |                  |   |    |   |
|-----------------|--------------------|------------|------------|----|----------------------------|------------------|---|----|---|
| Not Yet Started | Functional Minimum | 15/07/2019 | 21/07/2019 | 6  | Presentation               | Everyone         | Make the Presentation for the milestone and upload to the wiki!                   | 1  | 0 |
| Not Yet Started | Functional Minimum | 15/07/2019 | 21/07/2019 | 6  | Video                      | Everyone         | Make a video that highlights exciting aspects of the game                         | 2  | 0 |
| Not Yet Started | Functional Minimum | 15/07/2019 | 21/07/2019 | 6  | Completed Game             | Everyone         | Completed final version of game with sources                                      | 1  | 0 |
| Not Yet Started | Desirable Target   | 08/07/2019 | 21/07/2019 | 13 | Bug Fixing                 | Everyone         | Fix all known bugs for final version  | 20 | 0 |
| Not Yet Started | Desirable Target   | 08/07/2019 | 21/07/2019 | 13 | Polishing                  | Everyone         | Polish everything for final version   | 20 | 0 |
| Not Yet Started | Desirable Target   | 08/07/2019 | 21/07/2019 | 13 | Playtesting                | Everyone         | Playtest the whole game to find any rough edges                                   | 20 | 0 |
| Not Yet Started | High Target        | 08/07/2019 | 21/07/2019 | 13 | Fancy Visuals              | Alex             | If time, add fancy visuals (clouds around planet)                                 | 10 | 0 |
| Not Yet Started | High Target        | 08/07/2019 | 21/07/2019 | 13 | Different Terrain          | Alex             | If time, add different terrain to planet generation (different production speeds) | 10 | 0 |
| Not Yet Started | High Target        | 08/07/2019 | 21/07/2019 | 13 | Save and Load System       | Jan, Maxi        | If time, implement a save and loading system                                      | 10 | 0 |
| Not Yet Started | High Target        | 08/07/2019 | 21/07/2019 | 13 | Resource Tier System       | Jan, Maxi        | If time, implement a tier system for the resources                                | 5  | 0 |
| Not Yet Started | High Target        | 08/07/2019 | 21/07/2019 | 13 | Strategic Variation for AI | Lukas            | If time, implement more variations for the playstyles of the AI                   | 10 | 0 |
| Not Yet Started | Extras             | 08/07/2019 | 21/07/2019 | 13 | Difficulty Settings        | Jan, Maxi, Lukas | If time, implement different difficult settings                                   | 10 | 0 |
| Not Yet Started | Extras             | 08/07/2019 | 21/07/2019 | 13 | Animated Buildings         | Alex             | If time, implement animated people walking around on the buildings on a planet    | 5  | 0 |
| Not Yet Started | Extras             | 08/07/2019 | 21/07/2019 | 13 | Monument Travel            | Jan, Maxi        | If time, make the goal to travel with the ship to the edge of the solar system    | 4  | 0 |

### 1.4.3. Task Timeline

For the high resolution task list PDF, please see our project Wiki page:

<https://wiki.tum.de/display/gameslab2019/Team+Rocket?preview=/234292590/234292894/Project%20Timeline.pdf>

| PHASE | TARGET CODE               | DEV               | DETAILS  | PROJECT WEEK:                                 |  |  |                            | APRIL                      |                            |    |   |  |  |  |  |  |  |  |
|-------|---------------------------|-------------------|--|---|--|--|----------------------------|----------------------------|----------------------------|----|---|--|--|--|--|--|--|--|
|       |                           |                   |  | 15  | 22   | 29   | 6                          | 13                         | 20                         | 27 | 4 |  |  |  |  |  |  |  |
|       | Functional Minimum Target | Low Target        | Desirable Target   | High Target                                   | Extra  |  |                            |                            |                            |    |   |  |  |  |  |  |  |  |
| 1     | Game Design               | Everyone          | - Deliverables<br>- Playlist<br>- Components   | Project Setup                                 | Report   | Critiques  | Report Presentation        | Playtesting PM             |                            |    |   |  |  |  |  |  |  |  |
|       |                           |                   |  | Game Concept Arts<br>Game Data<br>Game Design | Draw Concept Arts<br>Game Design<br>Technical Achievements<br>Development Schedule | Paper Prototype Design<br>FM Building State<br>Controls Design | Refining Paper Prototype   | LT Building State          |                            |    |   |  |  |  |  |  |  |  |
| 2     | Modelling                 | Jan, Maxi<br>Alex | - Base Models<br>- Tile Models<br>- Special Effects<br>- Moving Models   |   |  | Director's Plan!   | FM Building Models         | LT Building Models         |                            |    |   |  |  |  |  |  |  |  |
|       |                           |                   |  |   |  | Game Building Platform   |                            |                            |                            |    |   |  |  |  |  |  |  |  |
| 3     | Scripting                 | Jan, Maxi<br>Alex | - Gameplay<br>- Artificial Intelligence<br>- Player Generation<br>- Game Systems<br>- Tools<br>- Bugfixing & Polishing |   |  | FM Building Implementation                                     | FM Building Implementation | Build Solver system        |                            |    |   |  |  |  |  |  |  |  |
|       |                           |                   |  |   |  | Basic AI   | Basic AI                   | LT Building Implementation | Multiple Player Generation |    |   |  |  |  |  |  |  |  |
|       |                           |                   |  |   |  | Building Placement System!                                     | Loading Data System!       |                            |                            |    |   |  |  |  |  |  |  |  |
|       |                           |                   |  |   |  | Basic Control System<br>Unity Setup<br>Tools Setup             | Basic Resource System      |                            |                            |    |   |  |  |  |  |  |  |  |
| 4     | Rendering                 | Alex              | - Render Backend<br>- Tech Art<br>- Shaders  |   |  |  | Lighting and Sun           | Water Shader               |                            |    |   |  |  |  |  |  |  |  |
|       |                           |                   |  |   |  |  | Water Shader               | Water Shader               |                            |    |   |  |  |  |  |  |  |  |
| 5     | UI                        | Alex<br>Maxi      | - Menus<br>- InGame<br>- HUD<br>- Effects  |   |  |  |                            |                            |                            |    |   |  |  |  |  |  |  |  |
|       |                           |                   |  |   |  |  |                            |                            |                            |    |   |  |  |  |  |  |  |  |
| 6     | Sound                     | Maxi              | - Soundtrack   |   |  |  |                            |                            |                            |    |   |  |  |  |  |  |  |  |
|       |                           |                   |  |   |  |  |                            |                            |                            |    |   |  |  |  |  |  |  |  |

Game Idea Milestone

Prototype Milestone

| PHASE | TARGET CODE | DEV                          |                           |       | PROJECT WEEK:                | Q2                           |    |    | JUN |                     |
|-------|-------------|------------------------------|---------------------------|-------|------------------------------|------------------------------|----|----|-----|---------------------|
|       |             | Functional Low Medium Target | Devide High Target        | Extra |                              | IV                           | 20 | 27 |     | 3                   |
| 1     | Game Design | Everyone                     | - Deliverables            |       |                              | Report Presentation          |    |    |     | Report Presentation |
|       |             | Everyone                     | - Playtest                |       |                              | Playtesting LT               |    |    |     | Playtesting DT      |
| 2     | Modelling   | Jan, Maxi                    | - Base Models             |       | LT Building Models           |                              |    |    |     |                     |
|       |             | Alex                         | - Tie Models              |       |                              |                              |    |    |     | Visual Effects      |
| 3     | Scripting   | Jan, Maxi                    | - Moving Models           |       | LT Ship Models               | LT Ship Models               |    |    |     | Visual Effects      |
|       |             | Alex                         | - Special Effects         |       |                              |                              |    |    |     | Visual Effects      |
| 4     | Rendering   | Jan, Maxi                    | - Gameplay                |       | Add LT Resources             | LT Ship Implementation       |    |    |     |                     |
|       |             | Alex                         | - Artificial Intelligence |       | LT Building Implementation   | LT Ship Implementation       |    |    |     | Visual Enhancements |
| 5     | UI          | Jan, Maxi                    | - Game Systems            |       | AI Additions for LT          | AI Additions for LT          |    |    |     |                     |
|       |             | Alex                         | - Planet Generation       |       | Add Components to Generation | Add Components to Generation |    |    |     | Game Menu UI        |
| 6     | Sound       | Jan, Maxi                    | - Tools                   |       | Advanced Controls            | Resource Transfer System     |    |    |     |                     |
|       |             | Alex                         | - Bugfixing & Polishing   |       | Ship Purification System     |                              |    |    |     | Sound Effects       |
|       |             | Everyone                     | - Bugfixing & Polishing   |       |                              |                              |    |    |     | Adjust Gameplay     |
|       |             | Alex                         | - Render Backend          |       |                              |                              |    |    |     | Visual Enhancements |
|       |             | Alex                         | - Tech Art                |       |                              |                              |    |    |     | Visual Enhancements |
|       |             | Alex                         | - Shaders                 |       | Planet Shader                | Planet Shader                |    |    |     |                     |
|       |             | Alex                         | - Menus                   |       |                              |                              |    |    |     | Game Menu UI        |
|       |             | Alex                         | - InGame                  |       | Simple inGame UI             | Simple inGame UI             |    |    |     | Game Menu UI        |
|       |             | Alex                         | - HUD                     |       |                              |                              |    |    |     | Fancy In Game UI    |
|       |             | Maxi                         | - Effects                 |       |                              |                              |    |    |     | Sound Effects       |
|       |             | Maxi                         | - Soundtrack              |       | Final Soundtracks            | Final Soundtracks            |    |    |     | Sound Effects       |
|       |             |                              |                           |       |                              |                              |    |    |     | Soundtrack          |

Interim Demo Milestone

Alpha Release Milestone

| PHASE            | TARGET CODE        |  |                    |                 | DEV                                | DETAILS             |                            |   |                            | 08                         |                            |                            |  |
|------------------|--------------------|--|--------------------|-----------------|------------------------------------|---------------------|----------------------------|---|----------------------------|----------------------------|----------------------------|----------------------------|--|
|                  | Functional Minimum | Low Target   | Detail High Target | High Exits      |                                    | PROJECT WEEK:       |                            |   |                            | JUL                        |                            |                            |  |
| 1<br>Game Design | Everyone           | - Deliverables<br>- Playtest                         | Everyone           | - Components    | 24                                 | 1                   | 8                          | 15                                      | 22                         | 29                         |                            |                            |  |
|                  |                    |  |                    |                 | Playtesting DT                     | Report Presentation | Playtesting                | Report Presentation Video Complete Game |                            |                            |                            |                            |  |
| 2<br>Modeling    | Jan, Maxi          | - Base Modelle<br>- Tile Models<br>- Special Effects | Jan, Maxi          | - Moving Models |                                    |                     |                            |   |                            |                            |                            |                            |  |
|                  |                    |  |                    |                 | Jan, Maxi                          | Polishing           | Polishing                  | Polishing                               | Polishing                  | Animated Buildings         | Animated Buildings         |                            |  |
| 3<br>Scripting   | Lukas              | - Artificial Intelligence<br>- Panel Generation      | Jan, Maxi          | - Game Systems  |                                    |                     |                            |   |                            |                            |                            |                            |  |
|                  |                    |  |                    |                 | Alex                               | Polishing           | Strategic Variation for AI | Polishing                               | Strategic Variation for AI | Strategic Variation for AI | Strategic Variation for AI | Strategic Variation for AI |  |
| 4<br>Rendering   | Alex               | - Render Backend<br>- Tech Art<br>- Shaders          | Alex               | - Tools         |                                    |                     |                            |   |                            |                            |                            |                            |  |
|                  |                    |  |                    |                 | DT Bug Fixing<br>General Polishing | Bug Fixing          | Bug Fixing                 | Bug Fixing                              | Bug Fixing                 | Bug Fixing                 |                            |                            |  |
| 5<br>UI          | Alex               | - Menus<br>- In-Game                                 | Alex               | - HUD           |                                    |                     |                            |   |                            |                            |                            |                            |  |
|                  |                    |  |                    |                 | Advanced Tutorial                  | Polishing           | Advanced Tutorial          | Polishing                               | Polishing                  | Polishing                  | Polishing                  | Polishing                  |  |
| 6<br>Sound       | Maxi               | - Effects<br>- Soundtrack                            | Maxi               |                 |                                    |                     |                            |   |                            |                            |                            |                            |  |
|                  |                    |  |                    |                 | Sound Polishing                    | Polishing           | Polishing                  | Polishing                               | Polishing                  | Polishing                  | Polishing                  | Polishing                  |  |
|                  |                    |  |                    |                 | Playtesting Milestone              |                     |                            |   | Final Release Milestone    |                            |                            |                            |  |

## 1.5. Assessment

In our game players embark on a journey through a solar system in which they race for survival in an epic battle of expansion. Resource planning, strategy making or population organisation are only few of the many tasks awaiting players. Starting off in small scope with construction of resource facilities on the home planet, continuing with expansion to other sectors and growing more population, up to exploring the seemingly endless solar system and claiming one's leadership in the race to universe - there are endless possibilities.

Every game cycle will feel and play differently as the random generation of the solar system mixes the world together. Each playthrough can have a different outcome depending on the starting configurations and the decisions the players make throughout the game. As the computer controlled AI is the focus of our project, it contributes a lot to the diversity and is the best incentive for our players to enjoy another round in the manifold universe.

We aim for an audience that is driven by an explorative and construction-loving mind. While already highschool teenagers with sense for adventures might like the game, it is also compelling for every strategy lover who wants slightly more challenge. In general, the audience's age is not restricted by an upper bound. As no to few violence will appear in the game and due to the adjustable difficulty, a wide range of players can be addressed. As a comparable audience fans and followers of games like *Sid Meier's Civilization* or *Stellaris* could be named.

For judging the design success in the end there are multiple factors that have to be taken into account:

- The game itself should be attractive in terms of looks and sounds to the player and feel new every round. The random generation of worlds has to make players want to try the game again in new and different settings over and over again.
- It is necessary that the gameplay itself is immersive and pulls the player into the world by well balanced features, progression and decisions that a player can make.
- The AI has to pose a serious opponent for the player which makes him/her go with the flow in a balance between ability and challenge.

If all those aspects work together, the final product will be a very good looking and charming interstellar strategy game, that offers enough complexity for players to enjoy as well as a challenging, but not unfair, AI that can keep up to expectations of human players.

## 2. Game Prototype

### 2.1. Overview

As we got very diverse feedback for our game on the wiki page, we really wanted to evaluate every aspect of the game. As the only aspect almost every person favored and nobody disliked was the planets being made from hexagon fields, we left this featured unchanged. Everything else was reevaluated, because for every other feature we got both positive and negative feedback. This is why we tried to recreate the core gameplay loop with our paper prototype and evaluate if each feature contributes to our targeted gameplay feel, which is to have a fun and challenging real time strategic building game. Everything, that does not contribute to this, will be moved towards high target, extra, or removed entirely from the concept. As combat was already a high target feature, we decided to move it further back, as it does not add as much to our concept, compared to the time and energy we would have to spend for implementing it. This is also the reason, why it is not included in our paper prototype.

### 2.2. Rules and Gameplay

#### 2.2.1. Structure

The structure chapter of our game prototype will include all resources, buildings and ships used during the prototype process. All these things will be used with similar balancing later in our game (unless serious issues arise). By including the full range of our content in the paper prototype, we wanted to test, if our desirable target is fun and challenging to play and does feel like a strategic building game, similar to the Anno series. The abbreviations behind the names stand for the desired target for which we plan to implement this feature into our game (FM = Functional Minimum; LT = Low Target; DT = Desirable Target; HT = High Target). The time steps are for defining how long something takes. During the prototype, at each time step actions can be performed. In our final game, one time step will be measured in seconds and is currently thought to equal 15 seconds per time step.

##### 2.2.1.1. Resources

###### **Iron Ore (FM):**

This is the base resource in the game and one that is needed a lot, as many secondary products require iron as a base element.

###### **Steel Beam (FM):**

Steel beams consist of iron ore and are used to construct many buildings.

###### **Fuel (LT):**

This resource can only be mined on planets with this resource available. They are not found on the starting planet but usually on those close to the starting planet.

**Fuel Cell (LT):**

Fuel cells need iron ore and fuel as a resource. With this, the cell can be build and filled with fuel. Fuel cells are needed for electricity and ships. Fuel can only be produced on planets that have the required resource reservoirs.

**Ship Hull Plates (LT):**

Ship hull plates are made from iron and steel beams as the frame. These plates are mainly used for the ship construction.

**Electricity (HT):**

Electricity is used by every building in the game. This is a supply value which is not consumed, but rather needs to be high enough to allow all buildings to be supplied with enough electricity. New buildings can only be built if the electricity value is sufficient after the building is placed.

**Workforce (Population) (DT):**

Workforce is similar to the electricity resource. It is also not consumed and every building needs a certain amount of workforce to function. New buildings can only be built if the workforce value is sufficient after the building is placed.

**Food (DT):**

Food is a basic need for the population and one of the most important resource, because without food the population in a sector will decrease.

**Unobtainium Ore (DT):**

This ore is very rare and only found on planets on the edge of the solar system. It is mainly needed for completing the monument ship.

**Refined Unobtainium Ore (DT):**

The next stage of the unobtainium ore, before it can be processed into a building material.

**Advanced Circuits (DT):**

The last stage of the unobtainium ore, combined with iron ore, will result in this advanced building material.

## 2.2.1.2. Buildings

**Base (FM):**

- **Description:** The first base is always already built for the player and AI. The base is the center of all activity. Other buildings have to be connected to the base building in order to function. The base also supplies the sector with certain default values, so that the player can start to produce the basic needs, before focusing on the more complex mechanics, such as population and electricity. The first 3 bases on each planet have the same costs. The base as an unlimited depo for resources.



- **Construction Cost:** First: Free; 1-3: 70 Steel Beam, 50 Food; 4-8: 140 Steel Beams, 100 Food, 50 Hull Plates, 50 Fuel Cells; 9-12: 280 Steel Beams, 200 Food, 100 Hull Plates, 100 Fuel Cells, 30 Advanced Circuits
- **Default Supply:** 40 Steel Beams, 200 Electricity, 20 Workforce
- **Produces:** None
- **Consumes:** None

#### **Population Habitat (DT):**

- **Description:** This is the housing for the workforce/population on the planet and is a passive provider. When the food supply is not sufficient, the population will decrease. This can be placed on any planet.
- **Construction Cost:** 10 Steel Beams, 2 Electricity
- **Produces:** 30 Workforce
- **Consumes:** 1 Food per 2 time steps

#### **Iron Ore Mine (FM):**

- **Description:** Building is used to mine the iron ore. This can be placed on any planet.
- **Construction Cost:** 6 Steel Beam, 1 Electricity, 3 Workforce
- **Produces:** 1 Iron Ore per 1 time step
- **Consumes:** None

#### **Unobtainium Ore Mine (DT):**

- **Description:** This mine can only be placed on planets with the unobtainium resource available. This is most likely the case on planets at the edge of the solar system.
- **Construction Cost:** 60 Steel Beams, 40 Hull Plates, 100 Electricity, 10 Workforce
- **Produces:** 1 Unobtainium Ore per 1 time step
- **Consumes:** None

#### **Food Production Farm (DT):**

- **Description:** Produces food for the population
- **Construction Cost:** 5 Steel Beams, 1 Electricity, 1 Workforce
- **Produces:** 1 Food per 1 time step
- **Consumes:** None

#### **Unobtainium Ore Refinery (DT):**

- **Description:** This building refines the unobtainium ore for the advanced circuits
- **Construction Cost:** 75 Steel Beam, 40 Hull Plates, 100 Electricity, 10 Workforce
- **Produces:** 1 Refined Unobtainium Ore per 2 time steps
- **Consumes:** 1 Unobtainium Ore per 2 time steps

#### **Steelworks (FM):**

- **Description:** Produces the basic building material early in the game. This is a very important building to build at the beginning
- **Construction Cost:** 3 Steel Beam, 3 Electricity, 1 Workforce
- **Produces:** 1 Steel Beam per 2 time steps
- **Consumes:** 1 Iron Ore per 2 time steps

#### **Fuel Extraction Plant (LT):**

- **Description:** This extracts fuel from planets which have this resource available
- **Construction Cost:** 20 Steel Beams, 20 Electricity, 10 Workforce
- **Produces:** 1 Fuel per 2 time steps
- **Consumes:** None

#### **Fuel Cell Factory (LT):**

- **Description:** This produces the fuel cells, which can then be used on ships and other buildings
- **Construction Cost:** 30 Steel Beams, 15 Ship Hull Plates, 30 Electricity, 20 Workforce
- **Produces:** 1 Fuel cell per 1 time step
- **Consumes:** 1 Fuel and 1 iron ore per 1 time step

#### **Ship Hull Factory (LT):**

- **Description:** Produces Ship hulls, which are mainly used for building ships.
- **Construction Cost:** 10 Steel Beams, 5 Electricity, 5 Workforce
- **Produces:** 1 Ship Hull Plate per 2 time steps
- **Consumes:** 1 Steel Beam and 1 Iron Ore per 2 time steps

#### **Advanced Circuit Factory (DT):**

- **Description:** This factory produces the advanced circuits, which is the endgame resource. It is rare and expensive to produce, but used in all late game structures
- **Construction Cost:** 100 Steel Beams, 50 Hull Plates, 20 Fuel Cells, 100 Electricity, 20 Workforce
- **Produces:** 1 Advanced Component per 4 time steps
- **Consumes:** 1 Refined Unobtainium Ore, 1 Steel Beam, 1 Hull Plates per 4 time steps

#### **Ship Building Yard (LT):**

- **Description:** This shipyard is for building new ships of any size (except the monument ship) The production cycles of ships take longer and will consume resources at every step (see ships for more information)
- **Construction Cost:** 40 Steel Beams, 10 Ship Hulls, 50 Electricity, 20 Workforce
- **Produces:** Ships
- **Consumes:** Specified by the selected ship

#### **Powerplant (HT):**

- **Description:** This plant produces power for the sectors on that planet to use.
- **Construction Cost:** 100 Steel Beams, 5 Workforce
- **Produces:** 500 Electricity
- **Consumes:** 1 Fuel Cell per 1 time step

#### **Observatory (LT):**

- **Description:** This Building needs to be Build to discover the planets that are neighbours to the planet this was constructed on.
- **Construction Cost:** 20 Steel Beams, 5 Ship Hull Plates, 20 Electricity, 5 Workforce
- **Produces:** None
- **Consumes:** None

#### Hangar (LT):

- **Description:** This module is for transferring goods towards another planet. Goods can always be dropped on a planet, but can only be ferried to another planet with the hangar or the space station (for larger ships). Cargo Ship and small explorer can land here.
- **Construction Cost:** 50 Steel Beams, 20 Ship Hull Plates, 50 Electricity, 20 Workforce
- **Default Supply:** 1 Small Explorer, 1 Cargo Ship for the first Hangar built
- **Produces:** None
- **Consumes:** None

#### Space Station (DT):

- **Description:** This is a late game building and used for the larger ships to transfer goods between planets. While the base is constructed on the surface, the space station will use small ships for transferring goods visually between the planet and the station.
- **Construction Cost:** 100 Steel Beam, 100 Hull Plates, 100 Fuel Cells, 100 Food, 30 Advanced Circuits, 300 Electricity, 30 Workforce
- **Produces:** None
- **Consumes:** None

#### Monument Shipyard (FM):

- **Description:** The monument shipyard as such is not so expensive, but will need mostly workforce and electricity. The Monument ship will be built in space in a few stages and small ships will traverse between the planet and the ship construction visually.
- **Construction Cost:** 100 Steel Beam, 100 Hull Plates, 100 Fuel Cells, 100 Advanced Circuits, 1000 Electricity, 100 Workforce
- **Produces:** Monument Vessel
- **Consumes:** See Monument Vessel



Top row: Cargo Ship; Middle row: Small Explorer; Bottom row: Space Liner

### 2.2.1.3. Ships

#### Cargo Ship (LT):

- **Description:** This ship is build for moving goods between planets. If the planet has no hangar, it will drop the goods and travel back to the starting point if in automated route mode. This ship can only travel to the next planet that is a neighbour of the start of the route.
- **Capacity:** 30 of any Resources times 3 Slots (total of 90)
- **Construction Cost:** 12 time steps total construction time. Consumes per 1 time step: 3 Steel Beams, 2 Hull Plates, 1 Fuel Cell
- **Speed:** 3

#### Small Explorer (LT):

- **Description:** The small explorer is used to create a new base on another planet or just explore the solar system. If another base should be created, this ship needs to be filled with the resources for building a new base and the ship needs to be moved to the new planet.
- **Capacity:** The Resources for a new base. For Base 1-3: 70 Steel Beams and 50 Food. Can not be used as a cargo ship.
- **Construction Cost:** 8 time steps total construction time. Consumes per 1 time step: 2 Steel Beams, 1 Hull Plate, 1 Fuel Cell
- **Speed:** 3

#### Large Cargo Ship (DT):

- **Description:** This large cargo ship can travel between all planets, no matter the distance they are apart. Also its capacities are greatly increased compared to the normal cargo ship. It also needs the space station to be able to load resources from the planet.
- **Capacity:** 200 of any Resources times 6 Slots (total of 1200)
- **Construction Cost:** 40 time steps total construction time. Consumes per 1 time step: 6 Steel Beams, 3 Hull Plates, 3 Fuel Cells, 1 Advanced Circuit

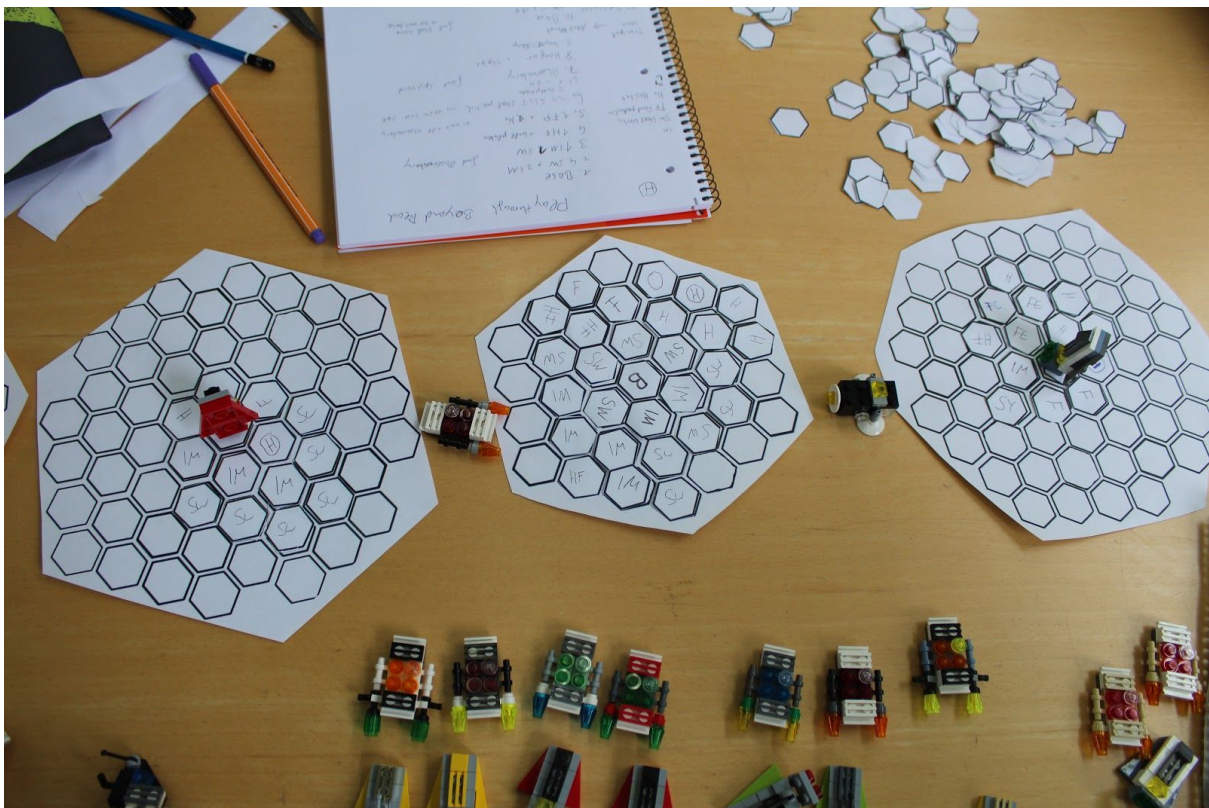
- **Speed:** 2

### Space Liner (DT):

- **Description:** The space liner can link the populations from two planets. If this ship is active between two planets their population count is shared.
- **Capacity:** Unlimited
- **Construction Cost:** 40 time steps total construction time. Consumes per 1 time step: 5 Steel Beams, 4 Hull Plates, 3 Fuel Cells, 3 Food, 1 Advanced Circuit
- **Speed:** 2

### Monument Vessel (FM):

- **Description:** This is the last thing you will build in the game and will be the most expensive construction. It will feature 3 building stages that have to be completed after the previous one. When this is finished the game is won.
- **Capacity:** Enough to save your race.
- **Construction Cost:** Phase 1: 2000 Steel Beams (every 1 time step. Consumes 50 -> 40 time steps / longer if insufficient supply); Phase 2: 1000 Fuel Cells and 1000 Ship Hull Plates (every 1 time step. Consumes 25 -> 40 time steps / longer if insufficient supply); Phase 3: 1000 Food and 1000 Advanced Component (every 1 time step. Consumes 25 -> 40 time steps / longer if insufficient supply)
- **Speed:** 1



Setup during a round: pen & paper, planet grids, tiles and space ships

## 2.2.2. Rules

The paper prototype game can be played with two players in a round based manner. For setting up the game, the following parts are needed:

- One similar planet sector grid sheet for each player
- Further planet sector grid sheets for extended play time
- A ton of labelled sector tile cutouts with labels for each of the available buildings
- 5 equal ship models made from Lego per ship type per player, excluding the endgame vessel. This type is only needed once per player.
- Pen and paper for drawing a table of resources for both players

### **Start of game:**

Every player places his/her base tile in the middle of the planet sector grid sheet. Decide which player starts first. A player goes through different phases each turn:

### **Phases:**

- Resource phase: Calculate and collect the amount of resources gained through production on each planet and subtract the ongoing production costs for this turn
- Action phase: Every round a player can choose to do any number of actions listed below.
- Endphase: The player hands over control to the opponent

### **Actions:**

- Build a building on an empty tile in any of the player-owned sectors. The necessary resources according to the type of building have to be paid right away from the player's inventory.
- Destroy a building on a non-empty tile that the current player owns. Only half of its building costs will be refunded and added to the player's inventory.
- Build a new ship in a player-owned shipyard. The ship will be spawned on the shipyard tile after X rounds where X is the amount defined by the ship type. The player has to pay for the ship's construction costs per time step.
- Only one of these per unit:
  - Move a ship to another planet. Ships can travel one planet per turn, unless specified differently, and will be available again for operation the next turn after moving.
  - Load a ship with any amount of resources you have available on one planet or unload the resources carried by a ship.
  - Spawn a new base on a new sector or planet, if an explorer ship is hovering above its center tile while carrying the necessary resources for a new base.

### **Goal of the game:**

The player who is able to build the monument vessel space ship first, wins the game.

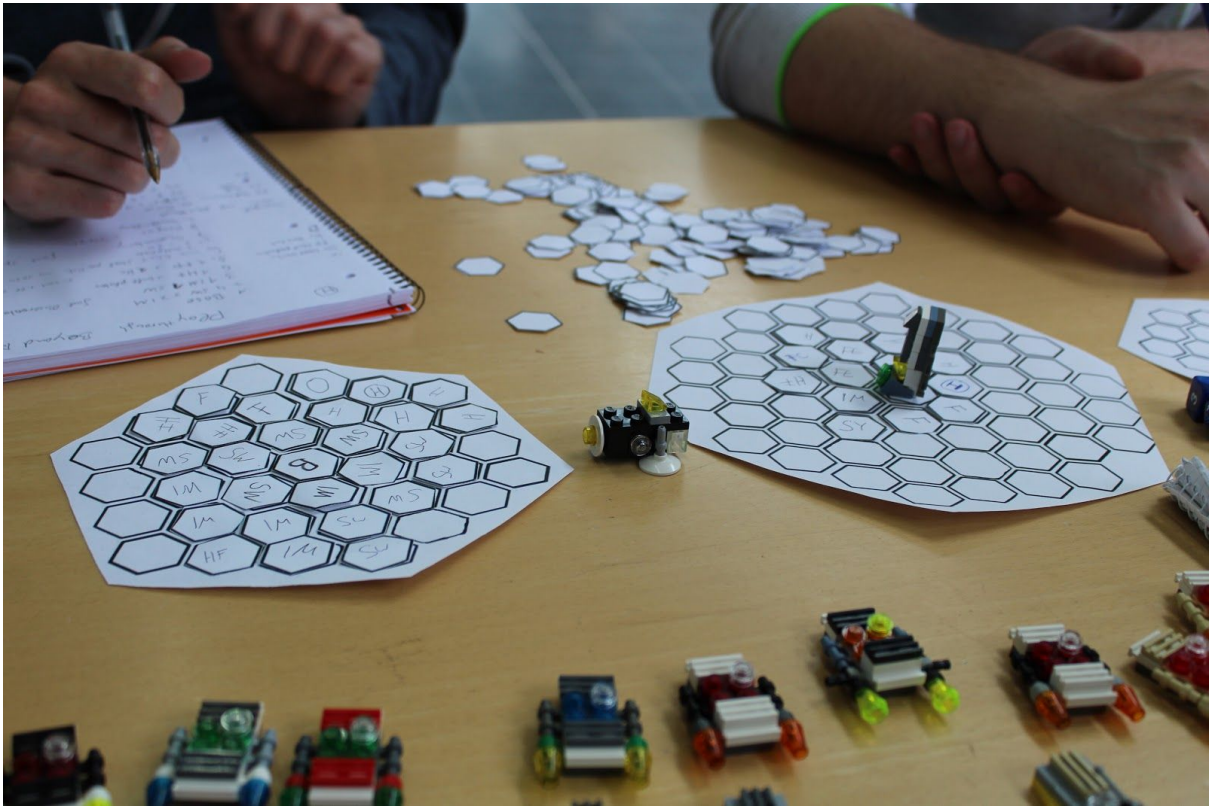


Figure 2.2.3.1: Every round the resources have to be calculated

### 2.2.3. Gameplay

The gameplay can be defined as a classic round-based strategy board game with the planet sectors being the boards and every time-tick in the game being referred to as a round in the paper prototype. One of the two players is in charge of the computer controlled AI player that

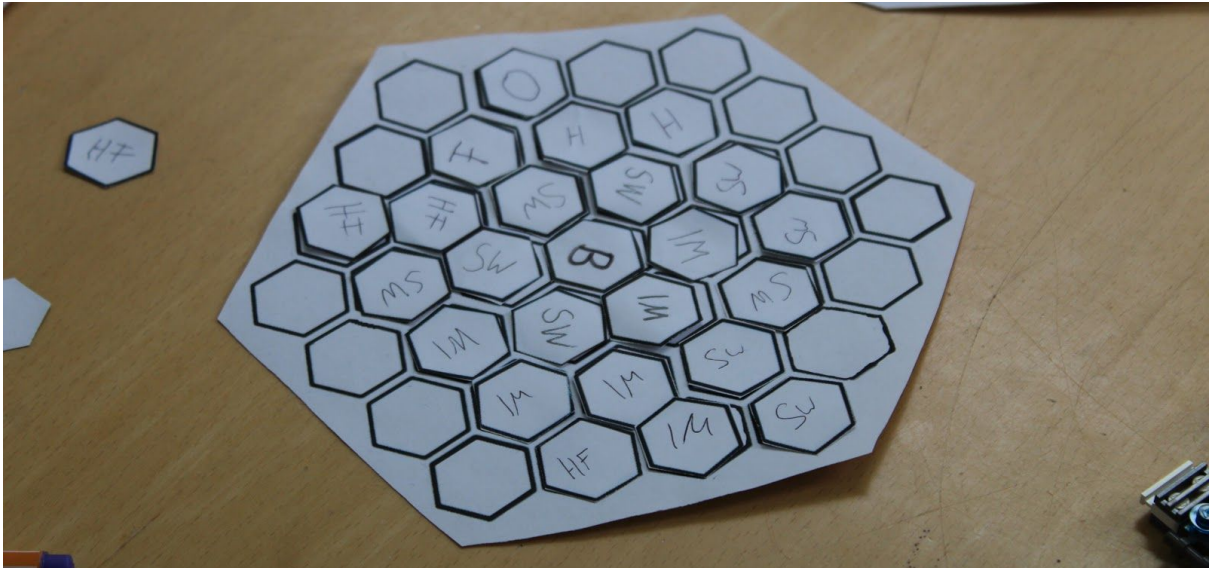


Figure 2.2.3.1: A planet tile after some rounds

will be the opponent in the final game later on. Both players take on the challenge to complete the construction of the monument vessel before the opponent does.

Every round players perform their available actions and try to grow their population and production as fast as possible. Each player first starts with a medium sized planet grid but can later expand to other planets, preferably before the opponent does, in order to choose between the best planets to settle on. As planets and settling space are limited, players have a limited income of resources. Every round they can place buildings by putting paper tiles with the correct label onto any of the free tiles in the sector they are paying for the building (see Figure 2.2.3.1). The paper tiles cannot be moved, but can be removed, which will grant a refund of half the cost. Logic and strategic experience as well as planning resources ahead can help a player to gain a slight advantage over the other.

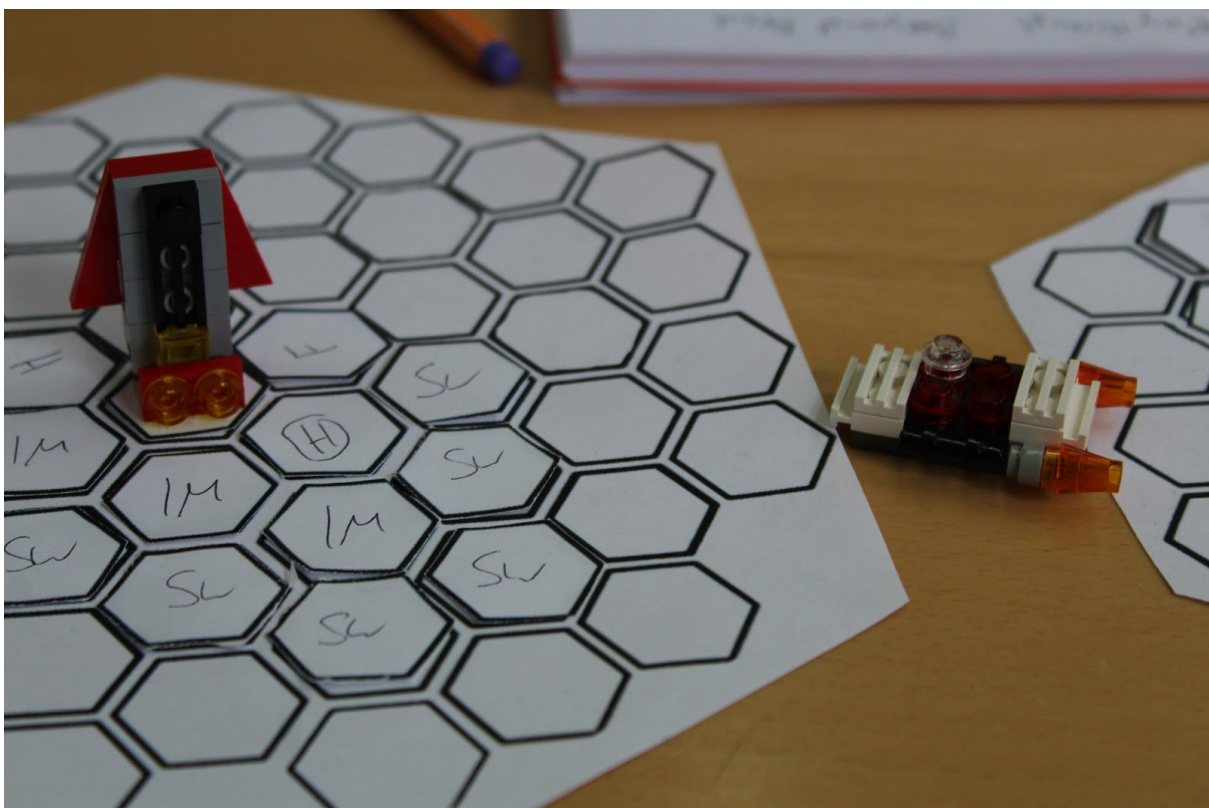


Figure 2.2.3.2: A cargo ship is delivering resources to a newly built base

As players move their spaceships during late game from planet to planet, a steady resource flow is necessary to provide for the construction of the monument vessel. Players want to settle on planets whose resources are necessary for the big ship and move those to, most likely the home planet, where they built the monument shipyard. However, first it is necessary to provide the newly founded sector base with resources itself. Cargo ships can take on the job and pick up resources on the home planet, transfer them to the other planet in the next round, and drop it finally in the third round (see Figure 2.2.3.1). At this point, intelligent planning from the beginning will pay off. For the paper prototype a resource and production table was necessary to handle the high amounts of calculation and as an orientation for players of what to build next during the late game (see Figure 2.2.3.3).



|                | Amount | Steel Beam | Food | Hull Plate | Fuel Cell | Advanced | Steel Beam | Iron Ore | Food | Population | Electricity | Hull Plate | Fuel | Fuel Cell | Unobtainium | Refined | Advanced |
|----------------|--------|------------|------|------------|-----------|----------|------------|----------|------|------------|-------------|------------|------|-----------|-------------|---------|----------|
| Base (1st)     | 1      | -40        | 0    | 0          | 0         | 0        | 0          | 0        | 0    | 20         | 200         | 0          | 0    | 0         | 0           | 0       | 0        |
| Iron mine      | 46     | 276        | 0    | 0          | 0         | 0        | 0          | 46       | 0    | -138       | -46         | 0          | 0    | 0         | 0           | 0       | 0        |
| steelworks     | 48     | 144        | 0    | 0          | 0         | 0        | 24         | -24      | 0    | -48        | -144        | 0          | 0    | 0         | 0           | 0       | 0        |
| Food           | 22     | 110        | 0    | 0          | 0         | 0        | 0          | 0        | 22   | -22        | -22         | 0          | 0    | 0         | 0           | 0       | 0        |
| Population     | 34     | 340        | 0    | 0          | 0         | 0        | 0          | 0        | -17  | 1020       | -68         | 0          | 0    | 0         | 0           | 0       | 0        |
| Ship Hull      | 20     | 200        | 0    | 0          | 0         | 0        | -10        | -10      | 0    | -100       | -100        | 10         | 0    | 0         | 0           | 0       | 0        |
| Observatory    | 4      | 80         | 0    | 20         | 0         | 0        | 0          | 0        | 0    | -20        | -80         | 0          | 0    | 0         | 0           | 0       | 0        |
| Hanger         | 4      | 200        | 0    | 80         | 0         | 0        | 0          | 0        | 0    | -80        | -200        | 0          | 0    | 0         | 0           | 0       | 0        |
| Fuel Extract   | 24     | 480        | 0    | 0          | 0         | 0        | 0          | 0        | 0    | -120       | -480        | 0          | 12   | 0         | 0           | 0       | 0        |
| Fuel Cell      | 12     | 360        | 0    | 180        | 0         | 0        | 0          | -12      | 0    | -120       | -360        | 0          | -12  | 12        | 0           | 0       | 0        |
| Base (1-3)     | 12     | 360        | 600  | 0          | 0         | 0        | 0          | 0        | 0    | 240        | 2400        | 0          | 0    | 0         | 0           | 0       | 0        |
| Shipyard       | 1      | 40         | 0    | 10         | 0         | 0        | 0          | 0        | 0    | -20        | -50         | 0          | 0    | 0         | 0           | 0       | 0        |
| Powerplant     | 7      | 700        | 0    | 0          | 0         | 0        | 0          | 0        | 0    | 0          | 3500        | 0          | 0    | -7        | 0           | 0       | 0        |
| Space Station  | 4      | 400        | 400  | 400        | 400       | 120      | 0          | 0        | 0    | -120       | -1200       | 0          | 0    | 0         | 0           | 0       | 0        |
| Unobtainium    | 4      | 240        | 0    | 160        | 0         | 0        | 0          | 0        | 0    | -40        | -400        | 0          | 0    | 0         | -4          | 0       | 0        |
| Refined        | 8      | 600        | 0    | 320        | 0         | 0        | 0          | 0        | 0    | -80        | -800        | 0          | 0    | 0         | -4          | 4       | 0        |
| Advanced       | 16     | 1600       | 0    | 800        | 320       | 0        | -4         | 0        | 0    | -320       | -1600       | -4         | 0    | 0         | -4          | 4       | 4        |
| Monument Yard  | 1      | 100        | 0    | 100        | 100       | 100      | 0          | 0        | 0    | -100       | -1000       | 0          | 0    | 0         | 0           | 0       | 0        |
| Base (4-6)     | 3      | 330        | 300  | 150        | 150       | 0        | 0          | 0        | 0    | 60         | 600         | 0          | 0    | 0         | 0           | 0       | 0        |
| Base (9-12)    | 1      | 250        | 200  | 100        | 100       | 30       | 0          | 0        | 0    | 20         | 200         | 0          | 0    | 0         | 0           | 0       | 0        |
| Cargo Ship     | 8      | 256        | 0    | 144        | 72        | 0        | 0          | 0        | 0    | 0          | 0           | 0          | 0    | 0         | 0           | 0       | 0        |
| Small Explorer | 2      | 32         | 0    | 16         | 16        | 0        | 0          | 0        | 0    | 0          | 0           | 0          | 0    | 0         | 0           | 0       | 0        |
| Large Cargo    | 4      | 960        | 0    | 480        | 480       | 160      | 0          | 0        | 0    | 0          | 0           | 0          | 0    | 0         | 0           | 0       | 0        |
| Space Liner    | 4      | 800        | 480  | 640        | 480       | 160      | 0          | 0        | 0    | 0          | 0           | 0          | 0    | 0         | 0           | 0       | 0        |
| Monument Ship  | 1      | 2000       | 1000 | 1000       | 1000      | 1000     | 0          | 0        | 0    | 0          | 0           | 0          | 0    | 0         | 0           | 0       | 0        |
|                | 289    | 10778      | 2980 | 4600       | 3118      | 1570     | 10         | 0        | 5    | 32         | 350         | 6          | 0    | 5         | 0           | 0       | 4        |

Figure 2.2.3.3: Production and Resource table for easier calculation

## 2.3. Experience

Right from the beginning we knew, that the experience turned out to be less engaging than the real time strategy game that we have in mind. That might be resulting from the missing satisfaction evoked by futuristic buildings and flying ships. Instead, the paper prototype offers increasing numbers of the players resource tables on sheets and plain tiles to build on the planet sector. Additionally we didn't consider how to distribute information, for instance, construction costs, so that the game stretched long by looking into our documents. In the video game, the User Interface will assist in that regard, so that the game is appealing and a good game flow emerges. With our prototype we wanted to be as close as possible to our desired target. That is why engaging combat with some action between the contrahents was discarded for the paper prototype.

The core goal of our paper prototype resided in the exploration of the fun in playing a strategic building game, where the excitement and motivation comes from optimizing the production and planning the next expansion of the base. While playtesting, we definitely had interesting and heated discussion about what the next move of our player should be. So the core gameplay loop and hook of our game was fun and motivating.

By playtesting playthroughs we discovered that variety in possible production sequences allows the player to choose more, and therefore enables more strategic decisions. It helped us to identify our strength, in this case planing your planet bases and managing your resources efficiently. That's why our focus is shifting now towards the base building. During the game, we discussed how to increase the quality of building choices rather than adding new game features. For instance we evaluated, while placing the buildings on our field, that adjacency bonuses would make the placement of tiles more meaningful. Our other findings are listed in 2.4.

## 2.4. Learnings from Prototype

We already discussed the focus towards building that has emerged from playtesting in our previous sections, now we reflect on some of our learnings.

First of all, writing down numbers on paper about how many resources you have isn't fun. It would appear that our game should do any tedious task like that on its own.

The Building types we designed for our desired target are to few and create an almost streamlined experience, which we will tackle by increasing the amount of different building types in the High Target. With this, we will add as many new buildings, in the polishing process, as allowed by the time constraint, increasing the complexity of our game. Another effective way to increase the complexity of building the base we introduced in 2.3. Adjacency bonuses that is. For instance, constructing food producing tiles next to each other could increase the overall means of production and would require the player to not just choose the location of building randomly.

Even though the player races against other players, our game does not offer much interaction between each other, therefore we want to explore how to increase that aspect. This could be done with trading between the players and possible third party NPCs.

We also discussed that the game should punish deconstructing buildings, so that there is a stronger emphasis on planning your sectors correctly.

## 2.5. Game Revisions

To close the results of playtesting our prototype, we would like to summarize the revisions we're playing on our game.

First and most heavy weighted decision for us to remove the combat from high target to extras, since we figured that making it work would require additional time which we don't have. Our core gameplay should be as well polished as possible, combat simply drops in our priority list.

Second, with combat removed, we need to experiment with other ideas how to increase interactions between the players. For instance we had trading in mind, yet it is something that won't be pursued before HT.

We limit resources to specific planets as an incentive to conquer these planets, which are rather difficult to reach. In addition we plan the necessary to transport the goods between planets to increase the complexity of resource management and to give build ships a purpose besides combat.

## 3. Interim Report

Looking back at the past three weeks of development, we can say that we are close to being on track, based on our project timeline. We finished a very large portion of our low target task, all of our functional minimum tasks, and a few desirable target tasks. Also, we can already play our full game loop, complete with main menu and victory screen. However, one large aspect that we expected to happen a lot later in development was optimization. Here we already had to invest a lot of time during our interims milestone development process, because otherwise we would have only had 1 FPS when fully settling a large planet. Moreover, our game is a lot more CPU bound, than GPU bound, which also already forces us to optimize our code. Part of these problems are based on the fact that we built all our models from small model prefabs, which caused us to have a huge vertex count and a lot of batches that the CPU had to process.

### 3.1. Gameplay

#### 3.1.1. Core Systems

For the core gameplay systems, almost all relevant systems are implemented in the current status of the game. The only aspects that are missing, are the discovery mechanic, resources only available on specific planets, fog of war and predefined start sectors on one planet for all players. These were moved to the next milestone, due to the fact that more time had to be put into code optimization already.

The core systems that are implemented, are data loading from files (for easy balancing later on), planet resource system, placing buildings on planets, building ships, victory condition, ship pathfinding and a resource transfer system. The first five tasks were fairly straight forward and had no big problems during the implementation process.

For the ship pathfinding system, we had to implement the start of a ship from the planet surface to the orbit, from there to space and back to the orbit of a planet. especially for transforms around the planet, we had many difficulties, as different rotations have to be made around the planet and ships. These operations are currently all functional, but still display the occasional bug, where a ship turns into the wrong direction. These and path smoothing have to be tackled in the next milestone.

Another task that proved to take longer than anticipated, was the resource transfer system between planets. This system is entwined deeply into all the other systems and has many special cases for trade routes, explorer ships and cargo ships. This resulted in a lot more code that needed to be written, just for those systems, including the UI for the player.

#### 3.1.2. Interaction Systems

In Beyond Reach there will be two different views that a player can navigate in between. The first view is an overview of the planets and shows the whole solar system from an orthogonal perspective above the sun. This view can be used for focussing on the greater image and travelling from one planet to the other. The second view is a close up perspective of the

selected planet and puts the camera right up front. In this view players can look at the planet in detail, perform building actions and manage the life on this planet.



(Left) In the space view players navigate forwards, backwards, left and right either by w-a-s-d keys or by pressing down the mouse wheel and moving the mouse in preferred directions. The player can also zoom in or out with the mouse wheel or -/+ buttons in order to get a closer or broader view. A double click on any planet will make the camera transition between space view and planet view and slowly approach the selected planet.

(Right) In the planet view, the camera can rotate around the planet either upwards/downwards or left and right as if it was moving on another sphere further away from the planet. Again, w-a-s-d keys or the mouse pinching with the scrolling wheel is used as input. Zooming in and out is equally implemented to the space view. However, in the planet view players can select hex fields by clicking on it and found new bases, construct buildings or send spaceships on missions. The interaction is very straight forward with few buttons and a clear design pattern.

The camera system and the two views are already working very smoothly. There is few fine-tuning to do, but overall I am very pleased with the result. The only minor hurdle is the iteration of playtesting and adjusting of values in order to make the camera smooth and feeling comfortable for the player in every situation. With the new addition of fog of war in the next milestone, there will be a medium size change to the current system and especially the space view will have to be adjusted to give the player only the possibility of seeing the parts the he/she is supposed to see.

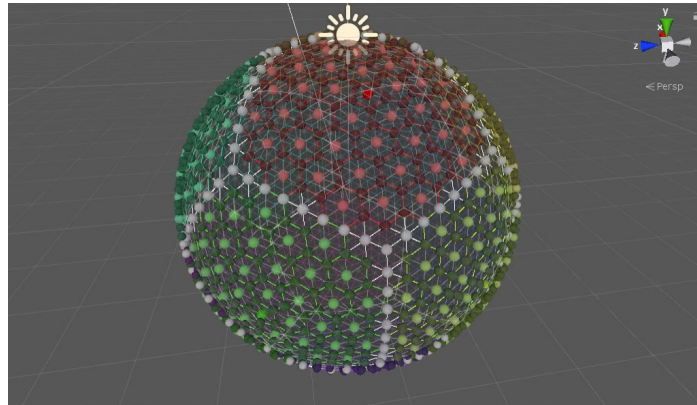
### 3.1.3. General Gameplay

Besides the core and interaction systems, we also implemented all relevant gameplay, that we listed for our functional minimum and low target. To these belong the following resources, buildings and ships: Iron Ore, Steel Beams, Fuel, Fuel Cell, and Ship Hull Plates; Base, Iron Ore Mine, Steelworks, Monument Shipyard, Fuel Extraction Plant, Fuel Cell Factory, Ship Hull Factory, Ship Building Yard, Observatory and Hangar; Monument Vessel, Cargo Ship and Small Explorer.

## 3.2. Planet Generation

The planet generator starts with an ico sphere, a sphere like object with 12 vertices and 20 triangles. By subdividing the object we can create more hex fields. To create the actual hex

field later on, we have to subdivide the surfaces as a last step. A couple of additional steps are performed during the generation stage, like the hierarchy setup of the planet, mesh merging by material for performance optimisations and the creation of random biome values for the field (which allows us to create different kinds of planets later on).



Debug view of a planet, it's sectors and fields during generation

### 3.3. AI

With growing complexity of your project and therefore increasing game logic, the AI module, that simulates enemy players, adapts consistently. For the functional minimum the AI is required to build a sequence of buildings that produce the resources to build the shipyard, that is required to build the arc vessel to win the game. Now, with increasing building tiles, ships, multiple planets and trade routes, the AI integrated these task into a set of actions. To generalize these actions into sets or patterns, the AI evolved from completing a queue of buildings to arrangeable actions called Wildcards.

Wildcards tailor, for instance, to inhabit a new planet, to build a combination of iron ore mines and steel factories to boost steel resources. The idea is that it is possible to design the AI's behaviour priority, but still give the AI the ability to insert new Wildcards based on reactive decisions. For instance, if the amount of free tiles is zero, the AI can insert the action to inhabit a new sector on the same planet.

During the development of the AI the most challenging thing was to work in advance, without knowing how the project internal Game logic and structure will look like. During the development, access of planets' tiles did change. In addition, the AI development was stalled to some degree,



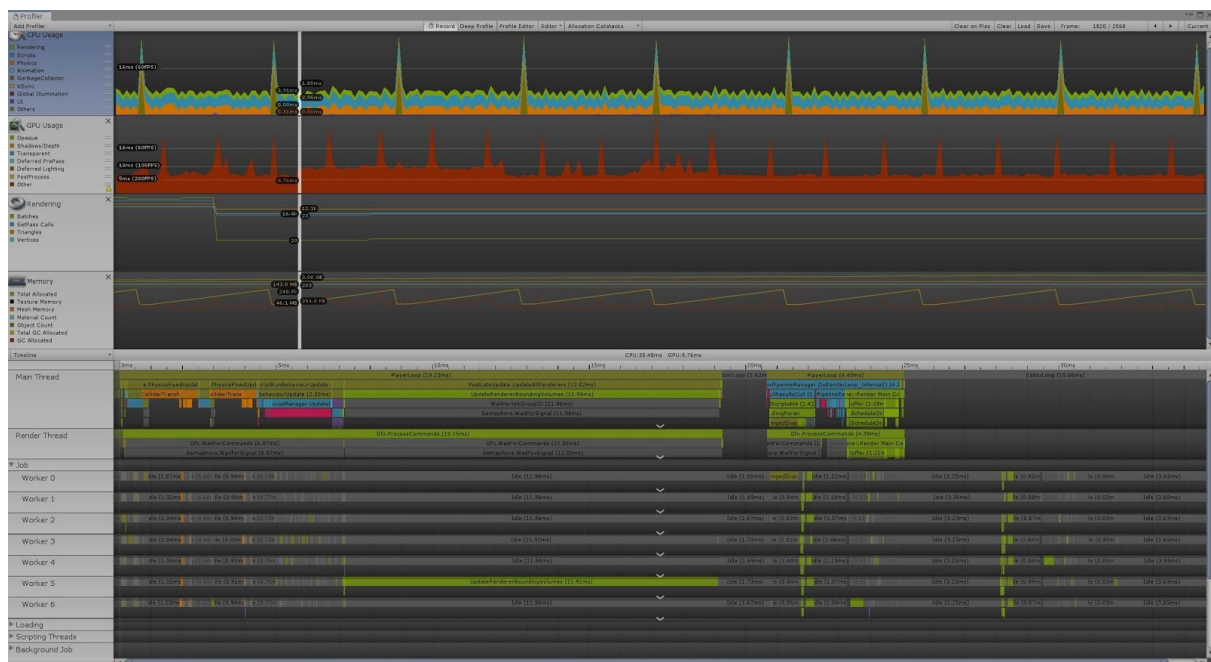
when certain features were not part of the game yet. For instance, settling to a new planet was something we implemented late, therefore, it was necessary to cheat the AI with resources on the new planet in order to test the management of multiple planets. The biggest revision in the AI module has been the Wildcard system, that replaced the State-based AI I had in mind. That was simply because RTS AI tend to have state machines

that separate tasks as manage combat and manage building. It is possible that states come back in later development, for now a linear sequence of states are sufficient for the AI. The image shows the AI sending its first cargo ship to a different planet.

### 3.4. Rendering

When it comes to rendering, the bulk of the work went into the setup of the pipeline, as well as optimisation. Unity's default render pipeline is built to support as many rendering features as possible and therefore comes with a massive overhead. Adjusting it to the needs of the project yields massive performance improvements.

Optimisation is a key area on this project. We have an extremely large object and vertex count across our multiple planets. We can reduce a lot of the load with material based merging of the meshes in the editor. In combination with our LOD system and the tools we've written for it we can massively reduce the vertex count in our scene. The lowest LOD is a billboarding system, which allows us to keep the details of our buildings, even when watching the whole planet from far away. A custom batcher, in combination with GPU instancing further decreases the frame time. However, as of now we are heavily CPU bottlenecked, with the GPU running at 30-40% depending on the device.



At the moment, our game has to wait for the render thread to submit all draw calls to the GPU.

Some shaders and effects are already implemented, including a PBR building shader, one simple Shader for the atmosphere, a placeholder shader for the planet to support the merged meshes and a building effect for newly built objects.

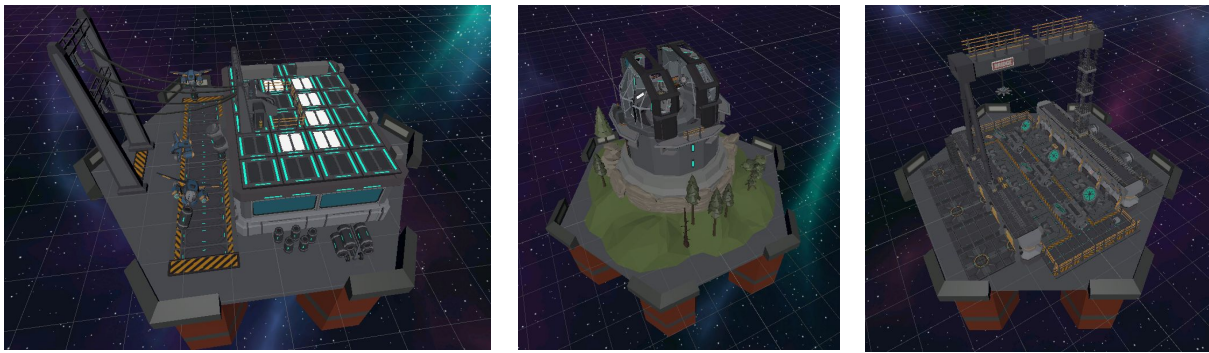


## 3.5. Models

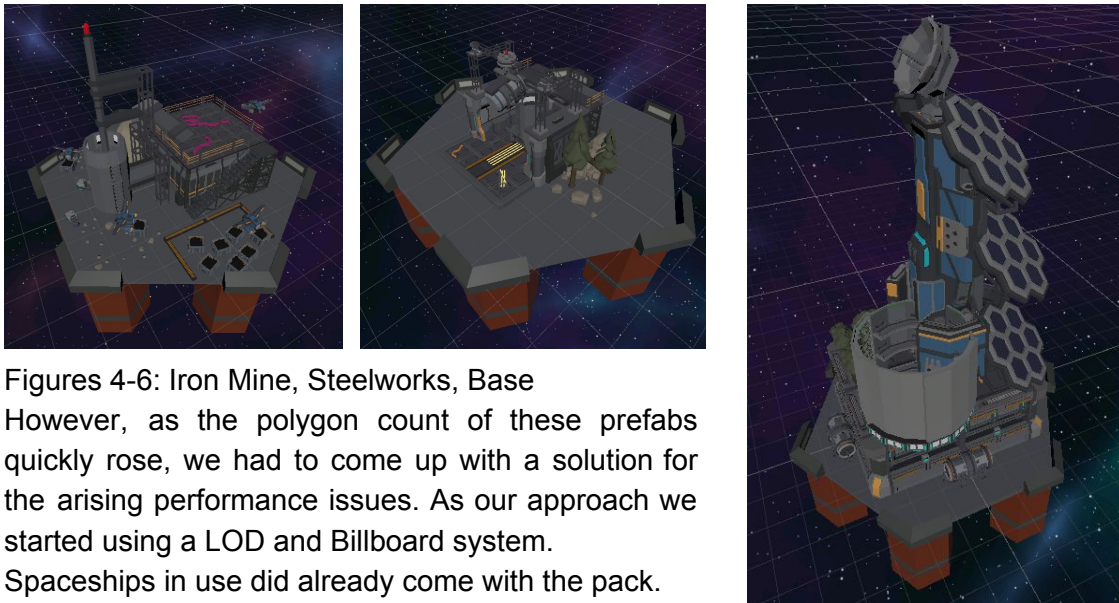
The models we use for our buildings and spaceships are part of two big model sets called “POLYGON - Nature Pack” and “POLYGON - Sci-Fi Pack”. Both sets contain many polygon-style 3D-models and textures that go well along with the hexfield design of planets. With these model prefabs we create buildings and spaceships by fitting the parts together and designing models to our individual needs directly in unity. Finished models will be saved as a new prefab that can be instantiated in the game, e.g. a building prefab can be placed on a hexfield of a planet.

### 3.5.1. Prefabs

As prefabs we have currently built all necessary low target buildings with more to come soon. In detail, those are the following:



Figures 1-3: Fuel Cell Factory, Observatory, Shipyard (from left to right)



Figures 4-6: Iron Mine, Steelworks, Base

However, as the polygon count of these prefabs quickly rose, we had to come up with a solution for the arising performance issues. As our approach we started using a LOD and Billboard system.

Spaceships in use did already come with the pack.

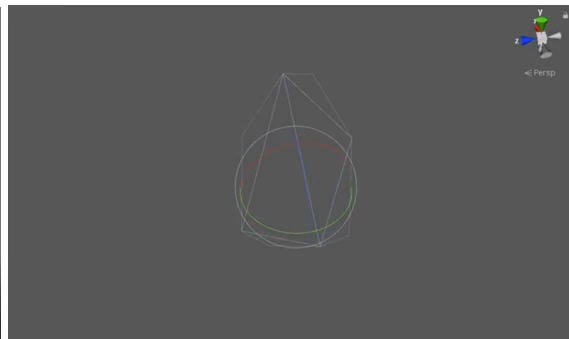
### 3.5.2. LODs

The LOD system currently consists of 4 different 3D LOD levels, as well as the billboard system. There is a crossfading system set up for them, however the 3D LODs are fairly traditional with no special implementations.

A complex billboard system allows us to render a large amount of objects from far away. We create billboards in the editor, i.e. we place cameras on a hemisphere around the object and bake albedo, alpha, metallic, roughness, depth and normals into texture atlases. During runtime, a simple planar object with 4-6 triangles is set up to always face the camera. A custom shader blends between the textures taken from different angles and uses the baked texture values to render the object as if it is a complex 3D geometry. This allows us to add proper shadows and other rendering features to the billboards with almost no difference in the visual quality.



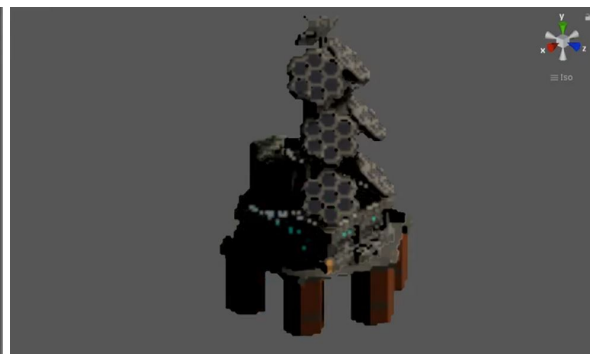
Billboard from far away



Wireframe view of the billboard



Close-up of a low res billboard without shadows...

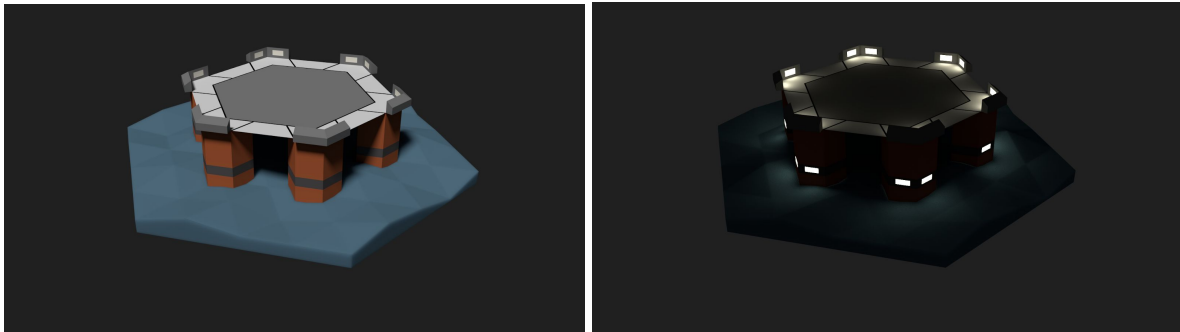


... and with realtime shadows

### 3.5.3. Platform Model

The platform is one of our custom models for the game, which is designed to adjust the building to the terrain it's built on. We have early tests showing the combination of emission, real-time GI and our platform models.





Platform rendered during day and night

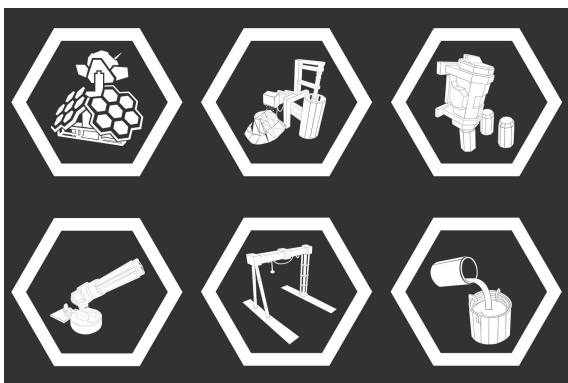
## 3.6. UI

### 3.6.1. Functional UI

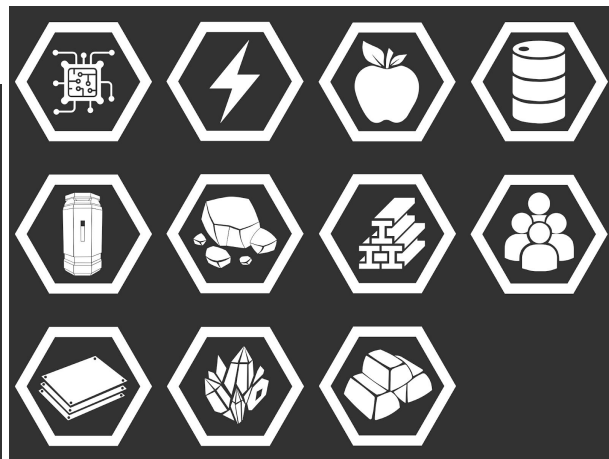
The functional UI was implemented for testing purposes, until the fancy UI is ready to replace it. This UI just incorporates the needed functionality, so a human player can actually play our game. This UI was done for all ten functional minimum and low target buildings, as well as the three functional minimum and low target ships. The UI for the ships took longer than expected to implement, as they are mostly more complex, compared to the building UIs, as they require a lot more functionality for trading and traveling to new planets. Another complex UI, is the trade route menu. Here the player can create, edit and delete his trade routes. We will share no screenshots of this UI, as it does not look very appealing and the functionality will be shown as soon as the fancy UI for each screen has been finished.

### 3.6.2. Fancy UI

When it comes to UI thus far we mostly implemented placeholder UI. However, we already designed Icons and other UI elements for the game. A masked blur shader for our custom render pipeline was also implemented to help us improve the visual quality of the UI in the future.



Building Icons



Resource Icons

## 4. Alpha Release

Following the interim milestone, we were hard hat work to meet our alpha release milestone goals. As we had most low target aspects of the game finished after the interim presentation, our main goals for this milestone were the remaining low target task and all desirable target task. Overall we can say that we met this goal and are currently feature complete, with only a few minor features not implemented into the alpha branch yet. Task that were moved into the first week of the playtesting milestone are sound, fancy in-game UI, the model of the powerplant, sound effects and field attributes. In this milestone, we implemented all core gameplay systems, further tweaked and adjusted the interaction system and had already time to start with the tedious task of balancing. The AI is currently also far along and can already win a game in a timely manner. Additionally, we finished almost all models and their respective LODs and implemented all UI screens and tutorials.

### 4.1. Gameplay

#### 4.1.1. Core Systems

The core gameplay system was finished one week before the end of the alpha release milestone, enabling the AI logic to catch up with the current state. Here we added the still missing low target tasks, such as the discovery mechanic. The discovery mechanic takes care of adding new planets to the known planet list, after building an observatory and restricting the player and AI to learn anything about the undiscovered planets. The predefined start sectors were also added, where the start planet is always the planet in the middle of the solar system, so the expansion process can go into both directions.

For the desirable target task, the following systems were implemented. Planets now have a fertility, which enables the base resource extraction buildings for fuel, iron and unobtainium to be mined on special planets. With this, we make sure that the player has to spread out over the solar system in his quest to build the monument vessel. We also added all of the desirable target resources, buildings and ships, as well as the powerplant and electricity of the high target. This was done to add more complexity and strategic variance to the gameplay. In the future, we might add more resources, buildings and/or ships, depending on the time we have to spend on optimization, polishing and balancing. With this step, we also introduced permanent resources with workforce and electricity, which can reduce the production if the supply is not sufficient. For the workforce, we also introduced special transfer routes, which were a little harder to implement than anticipated, as these are not simulated with actual goods, but with combining the workforce available of both planets.

We also added many little additions, details and edge cases to the core gameplay, restricting the player in its freedom. This ensured more complexity and a strategic challenge, as the player has to find new solutions to overcome these limitations. For example, small cargo ships can only travel to its neighbouring planets, leaving the user to manage more trade routes at the beginning. In the late game he can switch to the large cargo ship, which are expensive and need the space station to load and unload resources, as they allow travelling between any planets and can hold a lot more resources.

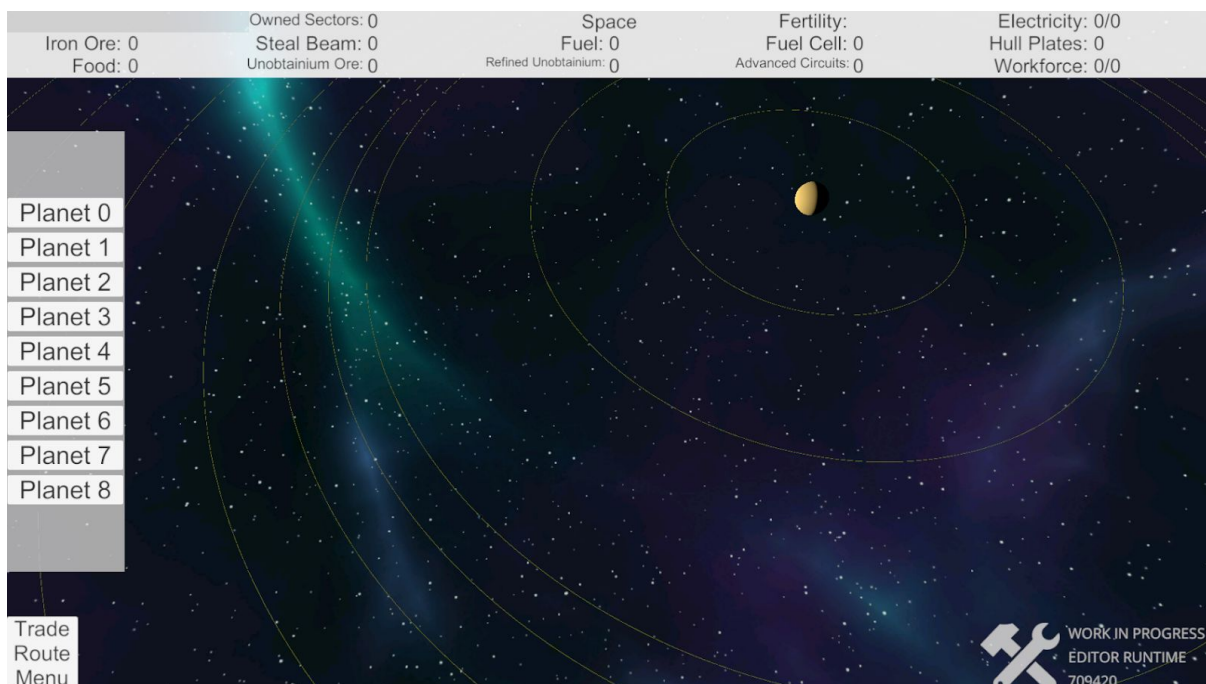
We also implemented the final stage of our monument vessel building phase with the new resources and fine tuned existing system. Here we rewrote the ship information script and building information script in preparation for the new fancy UI system and to optimize and reduce the active scripts in the scene. We also moved from a one tile monument shipyard to a 13 tile monument shipyard, giving the winning vessel a large scale and more visual feedback to the player.

In the last week, we mainly focused on tweaking, bug fixing and polishing the core gameplay system in preparation of the playtest. With this, we hope that we can deliver a smooth experience for our playtesters.

#### 4.1.2. Interaction Systems

The interaction system has received some minor improvements since the last milestone, that are especially catering towards ease of playability. First of all, it is no longer possible to leave the first planet view until the second planet is unlocked. This should create a feeling that the player is really able to reach new worlds and open the space just after expanding to new planets becomes available. In this regard, indicators for the orbits of planets around the sun have been included. The orbits show, where a planet will be travelling and make it easier to spot planets from the solar system view. A quick selection menu for planets furthermore helps with selecting and approaching planets that are not so visible at first glance once they are unlocked by a player. Orbits also just show up, after a planet has been discovered.

As a second measure, former split input scripts have been combined into one script to further speed up processing of input and for improving overview for the developers. For players now there is a new camera function that automatically locks on a planet tile that a player possesses, once he/she clicks on it. The camera will then rotate around the planet and center on the tile for easier interaction with the building menu.



### 4.1.3. General Gameplay

As we finished a week early and right in our schedule, we had one week already to do full internal playtest and check if our gameplay is working as intended and fun to play. Here we got already valuable feedback and many new tweaking task towards the gameplay. We also discovered a lot of bugs, which could be fixed during this week.

The biggest thing that we noticed, was that the player needed a lot more information presented in the UIs to make good decisions. Even with knowing what was going on in the game, it was hard to make the right decisions if the needed information was not presented on screen. Another thing we also noticed was that the dark side of the planet is really dark and when the player is building there, he definitely needs a light source.

We also learned that especially later in the game, it is hard to keep track of all your ships, so we also added a quick bar for selecting your ships.

Lastly, we could also already do the first balancing tasks in the game development process. For one, we noticed that the originally targeted tick rate of 15 seconds was way to long and we shortened it to 5 seconds. Also we reduced the trade route tick rate from 30 to 10 ticks, giving ships a more balanced feel concerning the load and the consumption of factory buildings. Additionally, we also sped up the manual travel time between planets, as they can get rather long if the destination planet is on the other side of the sun. As we increased the tile count of the shipyard, we also had to balance out the costs of the building, as it was currently too expensive. Here we drastically reduced the cost of electricity, workforce and advanced circuits. The current cost is now: 100 Steel Beam, 100 Hull Plates, 100 Fuel Cells, 50 Advanced Circuits, 100 Electricity, 30 Workforce.

## 4.2. Planet Generation

The generators biome system got a massive restructure. We are now awarding effects to each tile, based on its biome, height, climate and natural resources. Focusing on those specific variables allows us to visualize them easily without the need of additional UI.

For example we can have a small water planet, which already increases colling (and therefore the production of certain buildings) for each tile. In addition to that, each tile has a specific height value, in this case ocean or deep ocean. While ocean doesn't add any effects, deep ocean tiles have an increased production cost, but yield a higher fuel production. Water biomes can also have a specific climate which changes the field effects, resulting in a variety of different combinations for the fields.

This new generator increases replayability by making sure each planet is unique, and the player has to adapt to each specific planet individually.

## 4.3. AI

For the upcoming playtest, the game features two computer controlled players, which challenge the player in a race to build the Monument Vessel first. Therefore the alpha release includes a tailored sequence that not only is able to win the game, but also covers properties, that enforce an experience that is enjoyable. With some of the game features recently implemented, a difficult task, since it includes a lot of playtesting. To find a winning

strategy it was required to playthrough the game and to understand what sequence of action can win the game, and which lead to dead ends. The sequence itself should be working under all conditions, for instance the conditions the planet generation creates. Planets have different fertilities and sizes, that need to be considered. For the playtest, we come up with one sequence that can handle the different solar systems we produce.

In the early stages of the game the AI has two goals. First, produce Fuel Cells on a neighbouring planet, which are necessary to build ships. Second, colonize the solar system, till a planet with Unobtainium fertility is reached. Luckily it is enforced that planets on the outer rim of the solar system satisfy this condition.

Since these planets are colonized and with trade routes connected, the game traverses to the endgame that aims to build the monument vessel.

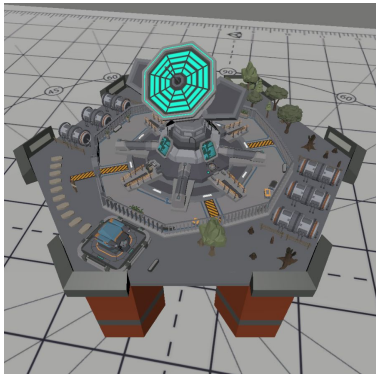
To do so, thirteen monument construction sides need to be built, that require workforce housing and electricity through power plants, meaning that AI needs to provide these resources.

Additionally the construction side requires Advanced Circuits that a produced from Unobtainium. With the game difficulty in mind, we allow the player some time to catch up with the AI since the Circuit production is minimal and therefore takes quite some time. What are the advantages and disadvantages has the player against the AI? Currently the AI has one sequence that can be optimized, as mentioned before. Additionally the AI waits for settling ships and building resource transfers, while the player can multitask in this time window. Disadvantage of the player is that he has to manual place buildings and navigate through UI.

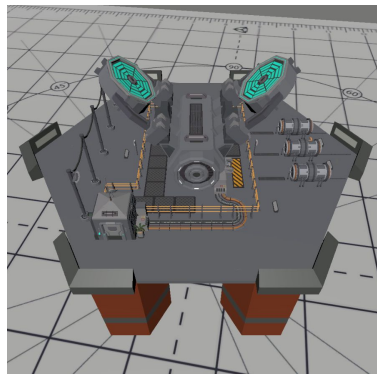
Finally it is safe to say that we look forward to seeing how players will do against our alpha sequence and how they rate the difficulty of the game.

## 4.4. Models

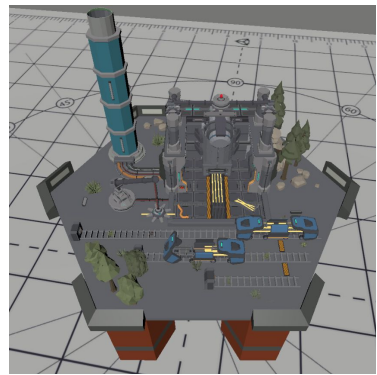
For the alpha release of Beyond reach, all desired target models have been created and included into the game. A total of 11 buildings were designed and modelled with the asset packs. In addition, few buildings were reworked in order to solve problems with the LOD system, e.g. flickering or disappearing objects that were not manageable by lower quality LODs. For this iteration, the monument shipyard has also been newly created with two models just for its own. The monument shipyard site is spanning multiple fields and already exists from the beginning of each game. On each field a part of the shipyard has to be built, therefore, there are middle pieces that are located directly underneath the monument ship and side pieces which will be located at the side, pointing towards the ship with its beams.



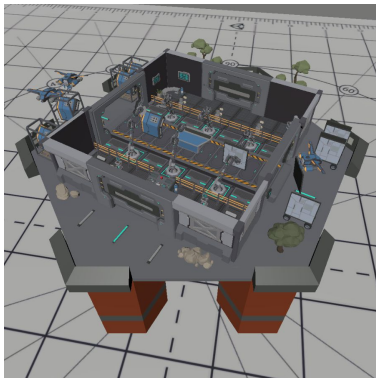
Monument Shipyard Side



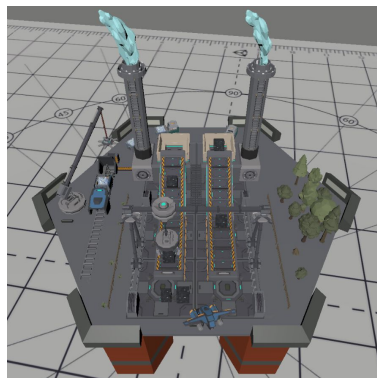
Monument Shipyard Middle



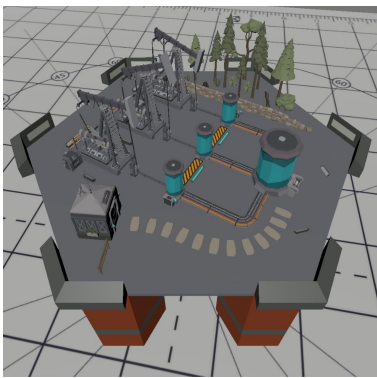
Steelworks Reworked



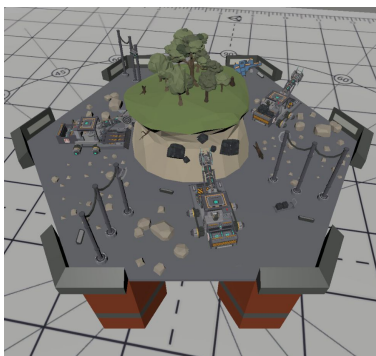
Ship Hull Factory



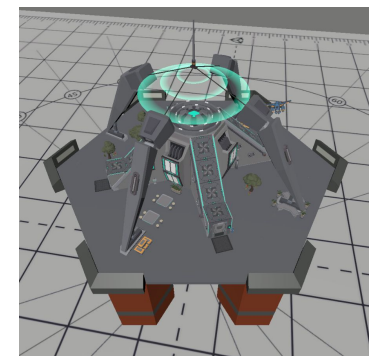
Unobtainium Ore Refinery



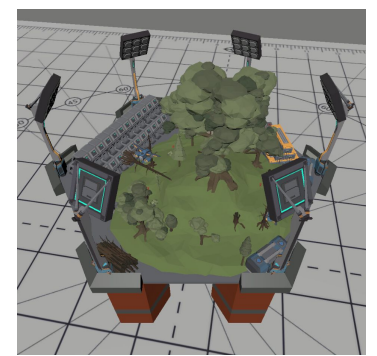
Fuel Extraction



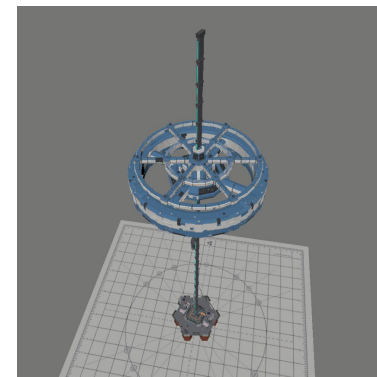
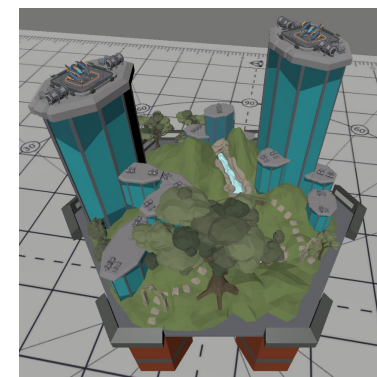
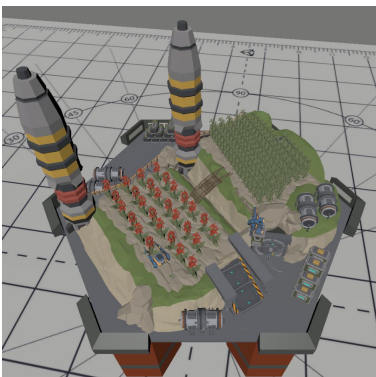
Unobtainium Ore Extraction



Advanced Circuit Factory



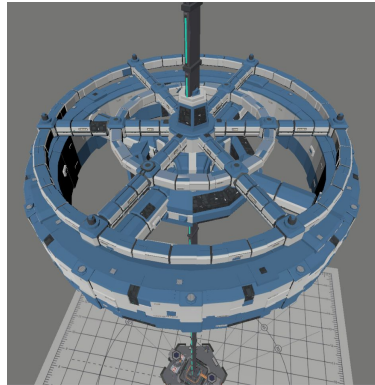
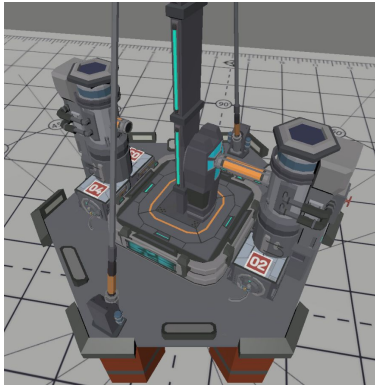
Construction Site



Food Farm

Population Habitat

Space Station



Space Station Bottom

Space Station Top

## 4.6. UI

As we implemented more core gameplay features, we also had to continue to expand the UIs. In the screenshot below, we show the key new elements of the UI that was added in this milestone. Box 1 and 3 show the new quick access bars for planets (1) and ships (3). With these, the player can jump to any known planets and all of his ships, which becomes very useful in the late game, where the player has a lot of ships to manage. Also new is the tutorial screen (2). This screen will pop up if triggered through certain code in the game. This is useful for giving the player parts of our story and useful information about the game, which will explain certain mechanics and elements to the player. As they contain a lot of text, we will voice these lines by a computer voice in the next milestone. We also updated the resource HUD of the planets, including all the new resources, the planet name, the owned sectors and the fertility. Also, the permanent resources have a current/maximum value, as the powerplant and population habitat do not instantly spawn the permanent resources, but accumulate them over time. This gives the player a better feel for how much of these resources will be available after a certain time. In 5, the player can access the trade route menu, which was also expanded with a new window for the workforce trade routes and gives more information about the selection. In the background of the below image, the keen observer can also notice the yellow line. This line represents the orbit of the planets and is only shown for the known planets.

Other UIs, which were adjusted but are not depicted in an image, are the UIs for selecting buildings and ships. All of these retrieved more useful information about the selected objects. Especially for the ships we had to add information, such as planet currently orbiting, next destination and part of a trade route. The names of ships and planets will come from a name generator in the future and are currently just placeholders.

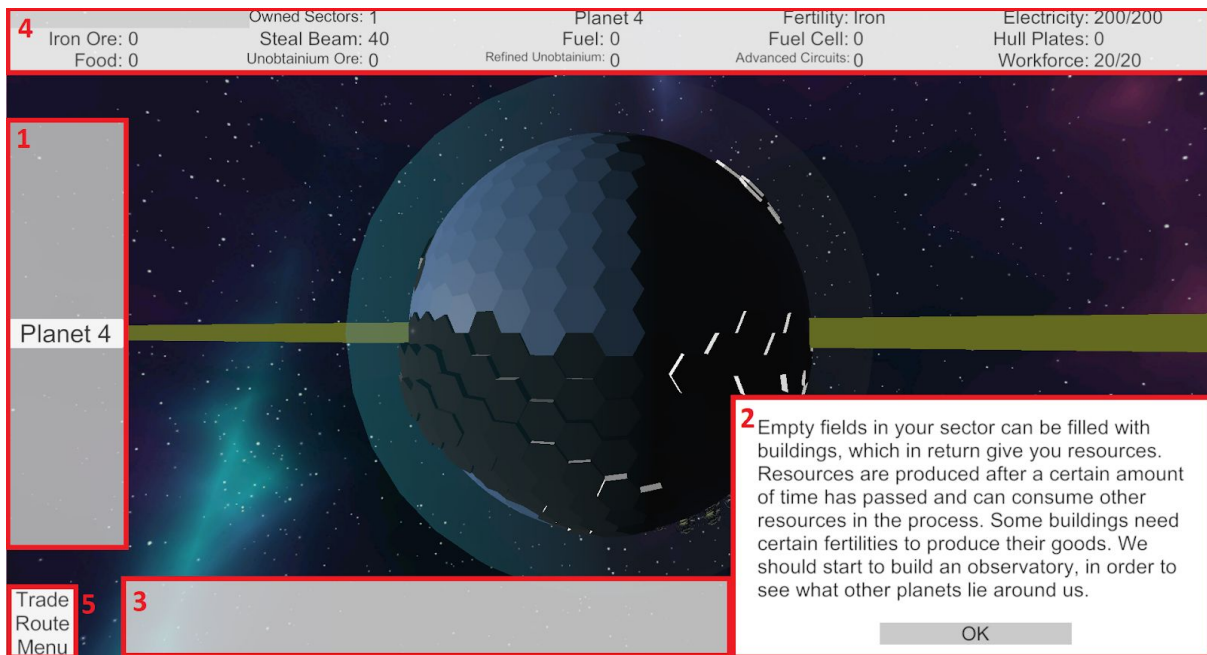


Figure 4.6.1.1. Image showing the five main UI screens present in our game. 1: Planet quick access bar, which allows the player to quickly jump between planets. 2: Tutorial screen, which will pop up at certain points throughout the game. 3: Ship quick access bar, which allows the player to access any ship. 4: Resource HUD, which gives the player current information about this planet. 5: Button to open up the trade route menu.

## 4.7. Tutorial

The tutorials were one of our latest additions for this milestone and are aimed at helping our playtesters better understand the mechanics behind the game. We added the following tutorial messages. These will probably still change after our playtest, depending on the feedback we got.

| Trigger  | Text  |
|--|---|
| When planets were loaded                           | [Initializing boot sequence for AI OLI342] ...<br>[Boot completed] ...<br>Hello OLI342, you have been initialized to save our civilization. Shortly after arriving in Solar System VK-615, our scientists discovered that the sun is older than estimated and is on the verge of collapsing. With resources scarce, we need a strong strategic mind to help us escape this solar system. Your program has been initialized to take over all strategic choices and save our civilization by building the monument vessel. In order to build this ship, we need rare resources located at the edge of this system.<br>Welcome to the strategic overview of our new home planet. Select our Base building, to retrieve more information about this planet. |
| When clicking on base for the first time           | This is the base building and the center of a sector. Each planet consists of 12 sectors, which can be added to our civilization by building a Base in the sector. In the top bar, you have all the relevant information about this planet at one glance, such as resources, owned sectors and the name of the planet.<br>You can navigate around the planet with the arrow keys, WASD, or by pressing the mouse wheel and moving the mouse. Zooming can be done by rotating the mouse wheel or pressing the '-' and '+' keys.  |
| When clicking on an empty field for the first time | Empty fields in your sector can be filled with buildings, which in return give you resources. Resources are produced after a certain amount of time has passed and can consume other resources in the process. Some buildings need certain fertilities to produce their goods. We should start to build an observatory, in order to see what other planets lie around us.   |



|  |   |
|--|---|
| When constructing the first Observatory                                | How convenient! A small explorer was crafted with the observatory. This means we can start exploring other planets. As you might have noticed, new planets are available in your quickbar at the left and the constructed ships become available in the quickbar at the bottom. You can also look at the strategic overview of the solar system, by pressing 'ESC'. Lets built also a Hangar, so ships can be loaded and afterwards select our Explorer and load it with resources, so we can build a Base on a new planet, by sending it to a planet of your choice. |
| When first viewing the solar system                                    | This is the strategic overview of the solar system. All discovered planets will be also shown here. You can also zoom in to a planet and select it, in order to reach the strategic view of the planet.<br>The navigation is the same, as found in the planet strategic view. With double click you can switch to the strategic view of the planet.   |
| When first explorer reaches another planet                             | As you might have noticed, ships need fuel cells to be constructed in the Ship Building Yard. Luckily this planet has large fuel resources we can tap. You can use your cargo ship, which came with the Hangar, to move the construction resources to this planet. As soon as you have enough fuel cells, you should consider constructing more Cargo Ships, so you can automate your trade routes. These can be created with the Button in the lower left.   |
| When the Trade Route UI is opened the first time                       | Here you can automate the Trade Route process between planets. Make sure that you correctly configure your trade routes, otherwise they will not work as you intend. You can select the planets that will be a stop of the trade route and the ship that will travel between them. The resources can also be configured, by defining the amount that will be loaded (+) and unloaded (-) at the planet. Also mind the limited cargo space of some ships.  |
| When the Monument Shipyard ConstructionSite is selected the first time | This is where you will be constructing the monument vessel that will save our civilization. We took the liberty of reserving the space for the monument shipyard with these construction sites. All sites have to be constructed, before you can start on the Monument Vessel. Hurry, before it is too late and the sun will consume us all.  |

## 4.8. Sound

The first background sounds have been included and the sound manager system was created. Starting from now it is possible to have music playing in the background while a player is playing the game. The idea is having a different music for both planet and solar system view. Optionally, each different planet type, if included in the next milestone, might also receive a unique soundtrack. For sound and effect selection we are using a music collection created by thirds. Until the playtest, sound effects will be added to the game for each interaction that the player can do in the game. This audio feedback will greatly help the playtesters getting into the game and enjoying it. Due to the sound system implemented, additions of effects are not time consuming and will require few additional codes until release of the playtest.

## 5. Playtesting

The playtesting session was for us a very important part of the development of our game. As we have a very complex and strategic challenging game concept, the playtest gave us the opportunity to test if our game mechanics were understood by players. In our internal playtests we could test, optimize, change and polish most game elements. However, we now know our game very well and, especially, strategic decision seems natural to us. We have a very clear idea on what we need to do after the playtest. By testing with other people, we got a new perspective on the gameplay and saw how they interacted with Beyond Reach. Through this and the questionnaire at the end of the testing session, we got very valuable feedback on how to improve our game and present a smooth and entertaining experience. But the most important feedback that we got was that our game is fun to play (many participants played more than the from us required 30 minutes) and the optimization and adjustment game loop, which is the heart of our game, works well and was noticed by our participants.

For our playtesting milestone, we made sure that no major bugs were present in our playtest release. We only encountered one game breaking bug (camera interaction would stall and take no further inputs), which we could luckily navigate around by instructing our participants to select a new planet or give them a cheat command if they had not discovered a new planet yet.

### 5.1. Testing Process

For the playtest we released a closed version of our game that included final corrections of the first playtest week and our first approaches towards a guiding tutorial and information shared via UI. This build was shipped over Steam to our playtest participants, so that they could test the game on their system. In most of the sessions, we engaged with the tester in a voice call session on Discord. We asked our participants to stream their monitor output to us with Discord's internal stream feature, so that help and advice could be offered if necessary, but also to see their actions live and to take notes about their playing behaviour. After communication established and monitor streaming was enabled on the testers side, we began our sessions. These sessions were planned to have a duration between one and two hours, it was communicated that the players have the freedom to stop the sessions as soon as they like.

During the playtest the participants were asked to play freely and with as little information from us as necessary. During the playtime, we assisted with answering questions and helping out if the player was stuck or elements of the game were unclear. While the participants were testing, we asked them to share their thoughts with us. All started a new game session and no preloaded game state or save file. This first playtest focused on how players react in their first interactions with the game, and if we are able to convey our game concept to the player. Having in mind that a strategy game takes quite some time, we gave the testers the option to use debug commands to finish the game if wanted. Before doing so, we made sure that all of the core features have been explored, including: Settling on new planets, using trade routes and managing the overall production until the players were able to build new ships in their home base.

Finally, our testers participated in a questionnaire form that we prepared in advance and that covered feedback which was maybe not covered in the mutual process.

### 5.1.1. Organization

We organized ourselves individually, by following our testing process loosely. Doing so, we had the freedom to react on our participants and to be much more mutual. For instance, it was possible that some play sessions turned out to be longer than others. By doing so, we invited our friends to talk freely about the game.

The game has been distributed to our players through steam product keys, that were only shared on the beginning of the session. With the question form distributed over Google Forms, all of the playtests were ended in the same fashion. Lastly, we met together and discussed our findings, grouped them together and summarized it for presentation.

### 5.1.2. Recruitment

We selected most of our participants on the criteria of having gaming experience and to at least enjoy taking part in testing a game. We took in consideration that our game's target group is people who enjoy playing games in their free time. Having in mind testing our game on different devices, it has been required to have a computer with a dedicated graphics card and to have a steam account, so that downloading and installing the game is possible. Our testers also needed to have a Discord account for screen sharing. Of course, not all of our testers we required to have a own device, and especially with close related participants we invited them to use our own pc. Our in total 15 participants were selected from acquaintance and none has been foreign.

## 5.2. Questions

For the questions we used a google forms sheet, which we gave our participants after the playtests. On the title page, the testers were greeted and thanked for their participation so far. We also reminded them that the answers to these questions will help us a lot to make our game even better and to remember that our game is in alpha stage with unpolished spots and rough edges and does not represent the final form of our game. We had the following six subcategories for our questionnaire: General Questions, General Game Questions, Formal Game Elements, Rules, Interface and Controls, Specific Question on Gameplay, and End of Session, which we will highlight in more detail below. At the end of the questionnaire we thanked the participants again for participating in our playtest session and for taking the time to answer the questions. On average, it took them between 20 and 30 minutes to finish the questionnaire.

### 5.2.1. General Questions

The purpose of these questions was to get to know the preferences of the player and helped us to evaluate the feedback better, as they specifically asked, among other things, about preferred genres and strategy games.

These are the questions which we asked in this category:

1. Please select your age group.
2. Please select your gender.
3. I love to play strategy games in my free time. (Please select how you relate to this statement)
4. Please select all game genres you enjoy playing in your free time.
5. Please select all of your preferred gaming platforms.
6. Please select all strategy games you have played for more than 20 hours.
7. Please place our game in the play matrix, where you think it belongs:
  - a. Your placement on the Y-Axis (Mental Calculation and Physical Dexterity) in the play matrix.
  - b. Your placement on the X-Axis (Skill and Chance) in the play matrix.

### 5.2.2. General Game Questions

This category of questions are about the general impression the player had about our game. These questions mainly focused on, if the player thinks the pace of our game was good and what his first impression was.

The following are all the questions we asked in this category:

1. What was your first impression of Beyond Reach?
2. My impression did not change over the course of my playtest. (Please select how you relate to this statement)
3. I found the game very frustrating to play. (Please select how you relate to this statement)
4. Additional space for feedback to any frustration you encountered during the play-testing session. (optional)
5. I encountered no dragging parts during my play-test. (Please select how you relate to this statement)
6. How long did you play-test the game?
7. How long did the game feel?
8. Additional space for feedback concerning the pacing of the game. (optional)
9. What was the most exciting/satisfying thing about the game?

### 5.2.3. Formal Game Elements

This section of the questionnaire concerns itself with fundamental things about our game, checking if our vision of the game was met during the playtest. Here we asked questions about general strategy, objectives and complexity.

The following questions were asked to our participants of the playtest session:

1. Describe the objective of the game.
2. I found the objective clear at all times. (Please select how you relate to this statement)
3. Additional space for feedback for the games objective. (optional)
4. What was your strategy for winning?
5. How did you find the strategic complexity of the game? (Please select how you relate to this statement)

6. Did you get stuck during any part of the playtest?
7. Additional space for feedback towards the strategic complexity in the game. (optional)

#### 5.2.4. Rules, Interface and Controls

This part of the questionnaire is about the rules interface and controls of our game. As our game is already very complex, we wanted feedback for if these parts of our game are clear and logical.

We asked the following questions in our questionnaire to our testers:

1. I found the rules of Beyond Reach very logical and easy to follow. (Please select how you relate to this statement)
2. Please name any rules you found illogical or idiotic and would like to see them changed. (optional)
3. I found the controls of the gameplay very intuitive. (Please select how you relate to this statement)
4. The control schemes were logical and easy to remember. (Please select how you relate to this statement)
5. I found no parts of the controls clunky or awkward. (Please select how you relate to this statement)
6. I found the tutorial very helpful and it appeared always at the right time. (Please select how you relate to this statement)
7. The planetary HUD was informative and easy to retrieve the needed information from. (Please select how you relate to this statement)
8. I found the UI screens easy to navigate and they provided me with all the information I needed. (Please select how you relate to this statement)
9. I found the quick access bars for ships and planets very helpful. (Please select how you relate to this statement)
10. Which things would you change/add about the interface and/or controls of the game. (optional)

#### 5.2.5. Specific Question on Gameplay

These questions asked the playtesters about specific elements of the gameplay in our game. With these questions, our goal was to get specific feedback on certain elements and get an impression on how they were perceived. We hoped to be able to adjust our gameplay to be better and smoother for the final release.

The following questions were asked to the participants:

1. Questions regarding gameplay: (Please select how you relate to this statement)
  - a. I always found the building I was looking for in a timely manner.
  - b. The ships were easy to click, when they were circling a planet.
  - c. It was always clearly communicated when I could load and unload ships.
  - d. It was always clearly communicated when I could place or destroy buildings.
  - e. I was never searching for any additional information, in order to make an educated decision.

- f. It was always clear which sectors and ships belonged to me and which belonged to my enemies.
  - g. I found it very challenging to maintain my trade routes between other planets.
  - h. I was fine with the construction costs of all buildings.
  - i. The time it took to build ships was too long.
  - j. It was clear to me, how the monument vessel construction phases worked.
  - k. During no parts of the playtesting session did I feel overwhelmed.
2. Questions regarding AI enemies: (Please select how you relate to this statement)
    - a. The AI enemies were building too fast and I felt rushed by them.
    - b. The AI beat me to building the monument vessel.
    - c. The AI settled too many sectors and there was no room left for me.
    - d. The AI enemies seemed to use the same functionality of the game as I did.
    - e. The AI's behaviour felt like it was cheating and having unfair advantages.
    - f. I could always tell how far along the AI was in their development compared to me.
  3. Additional space for any feedback regarding the AI enemy of our game. (optional)
  4. Questions regarding all kinds of aspects from our game: (Please select how you relate to this statement)
    - a. I found that the different planets looked very diverse.
    - b. I found the layout and visuals of the UI well arranged and clear to understand.
    - c. The difficulty of the game was too hard.
    - d. I found the mouse light for illuminating the dark side of a planet a good idea.
    - e. It was always easy for me to find the center of a planet sector to build the base building.
  5. The performance of the game was very smooth during my play-test and I had no frame stuttering or other issues. (Please select how you relate to this statement)

### 5.2.6. End of Session

On the last section of our questionnaire, we asked, amongst other things, questions about how appealing the players found our game, if they would buy it and to whom they would gift this game.

These were the questions which we asked our playtesters in this section:

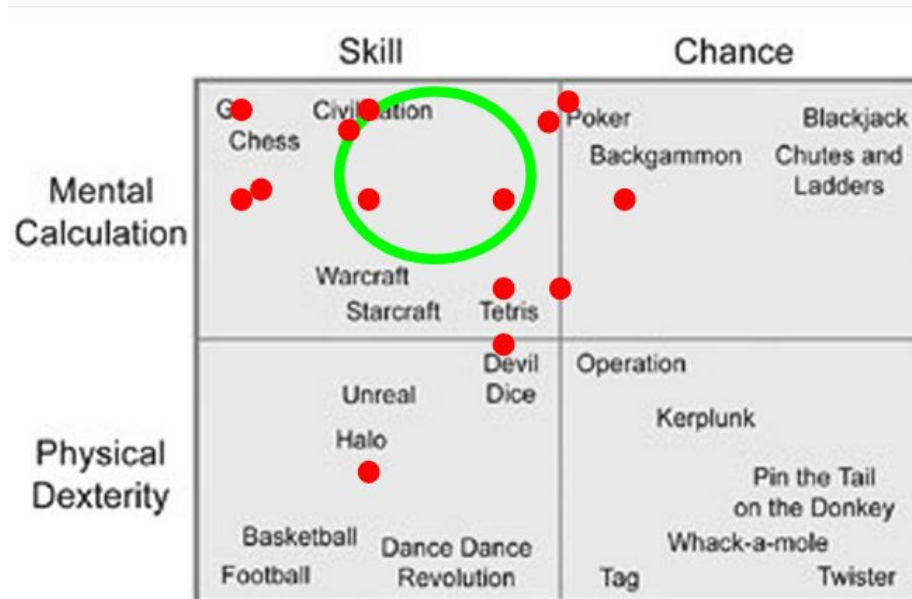
1. I found the overall appeal of the game very appealing. (Please select how you relate to this statement)
2. I would definitely purchase this game. (Please select how you relate to this statement)
3. What might be a reason preventing you from purchasing Beyond Reach? (optional)
4. If you could change just one thing, what would it be?
5. If you were to give this game as a gift, who would you give it to?
6. Any additional feedback you would like to give us (can be anything you would like to let us know). (optional)

## 5.3. Evaluation of Questionnaire

In the following section we will take a look at the answers given in the questionnaire and their effect on the polishing process for our development team before the release of Beyond Reach.

### 5.3.1. General Questions

The general questions revealed that all of the testers were in their mid 20s with three quarters being male. The pool of people was quite homogenous and mostly used to playing video games, especially on the PC. Still, the mixture between strategy game lovers and people who don't often play strategy games was quite balanced with slight advantage of lovers. Besides the genre strategy, testers also stated commonly that the genres Action, Action Adventure, Adventure and Role Playing are amongst their favorites. The strategy lovers were mostly experienced in the games of the Anno series, Civilization, XCOM 2 or Cities: Skylines, which partly have also been influences for our game. Concluding, the testers unanimously categorized our game Beyond Reach as determined by skill and mental calculation in the play matrix. It can be said that the game was tested by partly experienced and partly inexperienced young adults who have had played other genres, too. We were able to receive precise feedback by some more experienced players, but also have the game tested by adults not familiar with the genre, which gave us a broader overview and more diverse distribution of answers.



### 5.3.2. General Game Questions

First impressions of the game have revealed that, besides already leaving a positive image for most testers, that the start was quite overwhelming and confusing for a lot of the players. Too much information and not precise explanations made it hard for people to get the controls, understand the UI and focus on goals. This is one of our most important points

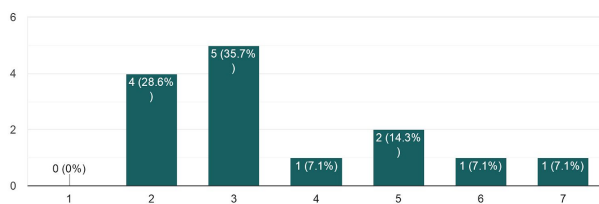
where we will put a lot of effort into polishing the game more by removing the current tutorials and replacing it with a task-based approach that gives feedback to players once concluded. We will explain controls step by step and avoid longer text passages. The UI will also receive a major addition of colored indicators for differentiation of a player's and enemy's sectors. Limiting the amount of available buildings and resources will also help getting the players started.

A high percentage of the players' impressions did not change throughout the course of the playtest and about 20% found our game frustrating to play. We hope to solve this issue with the above stated changes to UI highlighting, feedback and gameplay.

In an open answer section it got clear that, moreover, ship controls have to be reworked and streamlined and more information about each individual building is necessary for players to understand their functions.

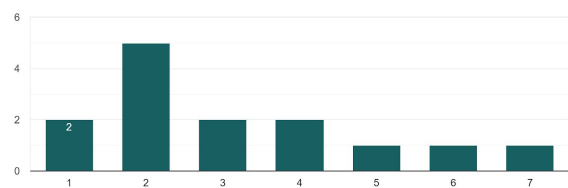
In terms of feeling about the length and whether the game had some too stretched and boring parts, testers stated that the overall time for a round was almost perfect. However, there have been some parts wearing on for too long, e.g. figuring out controls and basic gameplay. Moving ships from one planet to the other was also a negative point as it took too long in the opinion of a lot of players. As a result, we will make ships and routes more visible for players in the space view and speed the handling of ship menu and the travel time up. A speedup will also be applied to animation for changing planet view.

I found the game very frustrating to play.  
14 responses



Strongly disagree ←→ Strongly agree

I encountered no dragging parts during my play-test.  
14 Antworten



Strongly disagree ←→ Strongly agree

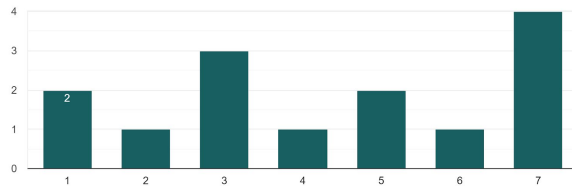
As positive feedback, many players liked graphics of planets, buildings and ships and finally being able to expand to new planets, which at least has proven that positive feelings are evoked by the main gameplay elements.

### 5.3.3. Formal Game Elements

While all players understood the main objective of the game quickly, it was not easy for them to know what to do at certain points in the game. A better overview of goals and guidance through task based feedback with better UI support will help get rid of this problem. Overall, it became clear that this was the biggest hurdle in the game, as all players were quite certain that the strategic complexity of the game was slightly easier than neutral and, therefore, already seemed very balanced. In an open answering section testers even wished for more parallel building branches and more diversity in resources. But still, they were also stressing that the player has to slowly be introduced to all features step by step. Lastly, players often felt like they were stuck during the playtest. Part of it was probably due to some resource locks that will be fixed in the upcoming polishing, the other part due to too few UI feedback, which is the general problem that will be addressed.

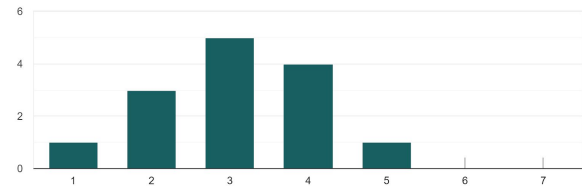


I found the objective clear at all times.  
14 Antworten



Strongly disagree  $\longleftrightarrow$  Strongly agree

How did you find the strategic complexity of the game?  
14 Antworten



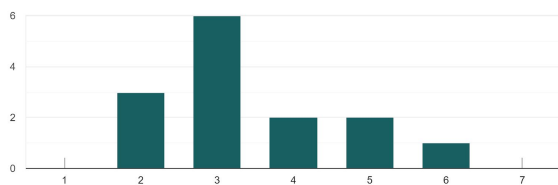
Too easy  $\longleftrightarrow$  Too hard

### 5.3.4. Rules, Interface and Controls

As for the rules of Beyond Reach, the majority of players agreed on those being logical and easy to follow, though slight enhancements would be necessary. Small cargo ships only being able to travel one planet at a time was considered a major slow down for the game as well as the first buildings costing its own resources could softlock the game. We will address these issues in the polishing process and also have a deeper look into controls, which some testers found intuitive and well functioning, whereas some didn't. The ease of remembering the controls, on the other hand side, has been evaluated as very good.

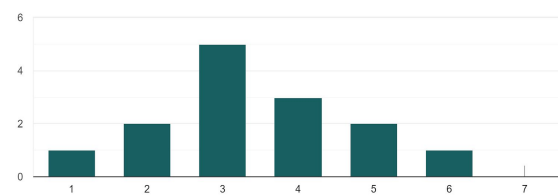
Again, tutorial and planetary HUD have been proven to not serve its purpose well, which led us to the conclusion to remove the tutorial voice and rework the UI and tutorial system. As a result, a clearer display of planetary resources, productions, buildings and better UI color coding will be added to the game. In general, more specific information in the right places is necessary such as error messages, for when some resources are missing when trying to build a building, or more mouse hover information. A positive impression was left by quick access bars of ships and planets, which will be kept in the game and expanded with further features.

The planetary HUD was informative and easy to retrieve the needed information from.  
14 Antworten



Strongly disagree  $\longleftrightarrow$  Strongly agree

I found the tutorial very helpful and it appeared always at the right time.  
14 Antworten



Strongly disagree  $\longleftrightarrow$  Strongly agree

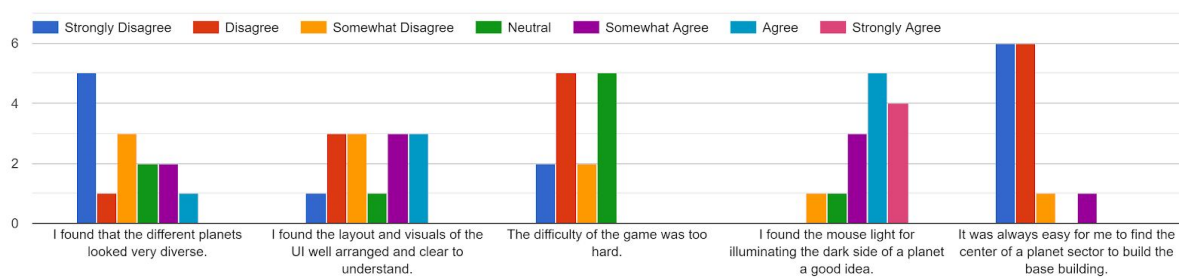
### 5.3.5. Specific Question on Gameplay

As for specific questions about the gameplay, we asked about the interaction between the player and the game, e.g. finding your buildings, navigating UIs or statistics like construction costs. Our conclusions we have drawn from them are, again, mostly the need for improvement of the user interface for ship controls, sector overview, trade route menu, etc.

As positive feedback we found out that the time that ships take for building and all building's construction costs were considered adequate.

As for questions about the AI opponents all players felt balanced about the strength of them. The AI was not rushing or settling on too many sectors and testers felt the AI's behavior was fair. During the different phases of the game, however, we discovered that the AI has a slightly different pacing that we want to address and balance more during the polishing weeks. The only disadvantage that players did not like, was that they could not exactly tell how far developed the AI was. The presence of the AI could not be felt, it was rather just a timer for the game. In this sense interaction with the AI will have to be increased and pop-ups about AI's progress should inform the player about it.

Questions regarding all kinds of aspects from our game.



More specific questions can be seen in the above graph. Additional conclusions are, that, although visuals have previously been rated to be one of the best aspects of the game, the planet generation still needs work for better distinguishing the different kinds of planets. In addition, the light attached to the mouse during night has been considered a good idea. Still, self illumination of buildings is not yet working in the game and we hope to increase visibility through that until the final release of the game.

Lastly, an aspect that we cared for very early in the development process, that has now proven very successful, is the performance of the game. Almost all players stated that there was no frame stuttering or other issues during their play session which is a great achievement for us, as there is a lot of graphics processed every frame.

### 5.3.6. End of Session

Although the game seemed to be appealing to many of the players, they are not yet convinced of purchasing the game. Problems preventing the testers were stated to be lack of content/objectives and issues with the UI and playability, besides some players who stated that they don't like the genre at all. Very surprisingly, the answers for "If you could change just one thing, what would it be?" were all different and summed up the changes we will try to implement in the upcoming two weeks. Here are some final examples:

|   |   |
|---|---|
| UI  | Ship travel times. Or a speedup button. |
| The voice! [Tutorial]   | Enemy colors.                           |
| Definitely the visibility of the tiles for base building and the addition of an outline for | The User experience design.             |

|   |  |
|---|--|
| my sector.  |  |
| Different details or lengths of the tutorial for strategy game noobs. | More Information on resources when being hovered over              |
| Orbit marker.   | Make the looks of the planet more diverse (maybe with more colors) |
| Mouse light size.   |  |

## 5.4. Testing Result

The amount of testers in this playtest provided us with a lot of insight into the game. About half the players never really played strategy games themselves, and their feedback especially showed us that we have to drastically improve the introduction into the game in terms of tutorial, UI and controls.

Having only a single playtest for every feature at once instead of focusing on specific aspects of the game can be quite exhausting for the testers, however all of them invested plenty of time into our game in order to get a good impression of all the features and provided lots of detailed information in our questionnaire despite its overall length.

Only two aspects of the game require major adjustments; the UI and the tutorial. The other feedback are mostly improvements, minor adjustments and bugfixes, all of which should easily be possible to implement in the remaining time.

## 5.5. Conclusion

In summary, the playtest session was quite successful and provided us with a lot of feedback for the final version of the game.

The criticism focused mostly on the UI, where we were not providing enough information to the players and where the structure was at parts extremely confusing. That led to some frustration among the players, and therefore is the most important aspect to address for the next build of the game.

We also received a lot of feedback regarding the camera movement and inputs in general, and we'll adjust both accordingly. The AI factions need to be more distinguishable from each other, and their current progress needs to be communicated better.

Some minor visual glitches (e.g. LOD transition effect) were visible in the playtest demo, however most of them weren't noticed by the players. Nonetheless, those things will be addressed for the final build as well.

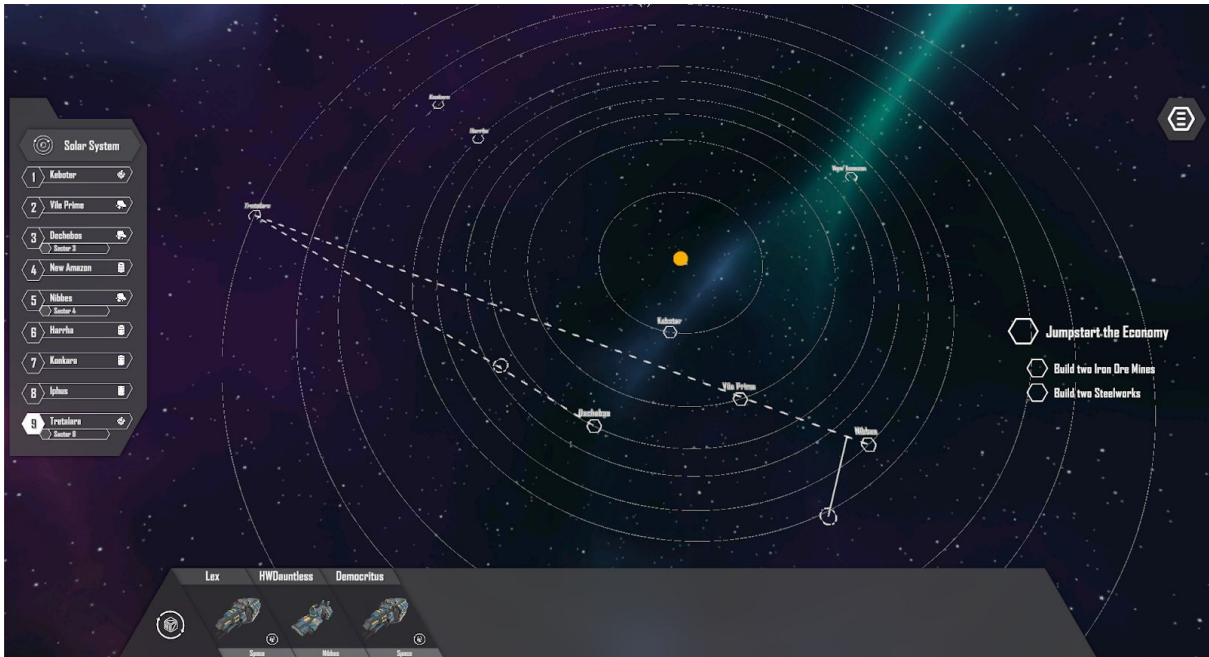
In addition to that we have some bugs to fix, however nothing major turned up during testing here.

## 6. Public Presentation and Conclusion

### 6.1.1. Summary of Final Results

In Beyond Reach the player takes part in a science fiction setting, in which he engages as the leader of a civilization to lead them out of the solar system that is about to collapse. In a fully procedural generated solar system, which consists of planets with hexagonal tiles. You and the computer controlled enemy players start with a planetary base. These bases mark the players territories, so called sectors. Inside these you are able to construct buildings on the planet. The players are able to expand on their planets by taking additional sectors under their territory, by building new bases. Or they construct ships to settle on new planets. These are required to finish the game, since each planet has its own natural resource and certain building materials. Especially the late game buildings and ships require the rare Unobtainium, that is usually located on the edge of the solar system or near the sun. Towards the later game, managing the construction costs becomes more challenging and require good management of production lines, automated trade routes via ships and the usage of the bigger ship types of the game. Besides the building resources, the players need to keep track on their workforce, the people that manage the factories and the other buildings. These can be even distributed between two planets by using SpaceLiners. Electricity is a resource that cant be distributed, but is also necessary for all of the buildings to have. The player races against two enemy players that begin on the same planet with the same win condition to complete the space ark. The two enemies follow a sequence of actions that lead towards winning the game. One of them is more difficult to beat since his strategy is more refined than the other one. Both of them have been tweaked with wait times. They take pauses between successful actions. To increase their presence, the player is informed if an enemy expands on a new planet. Additional notifications are the completion of own ships or when an explorer ships is fully loaded with the resources to settle. The human player is assisted by an improved UI experience, that we integrated since the last alpha release.

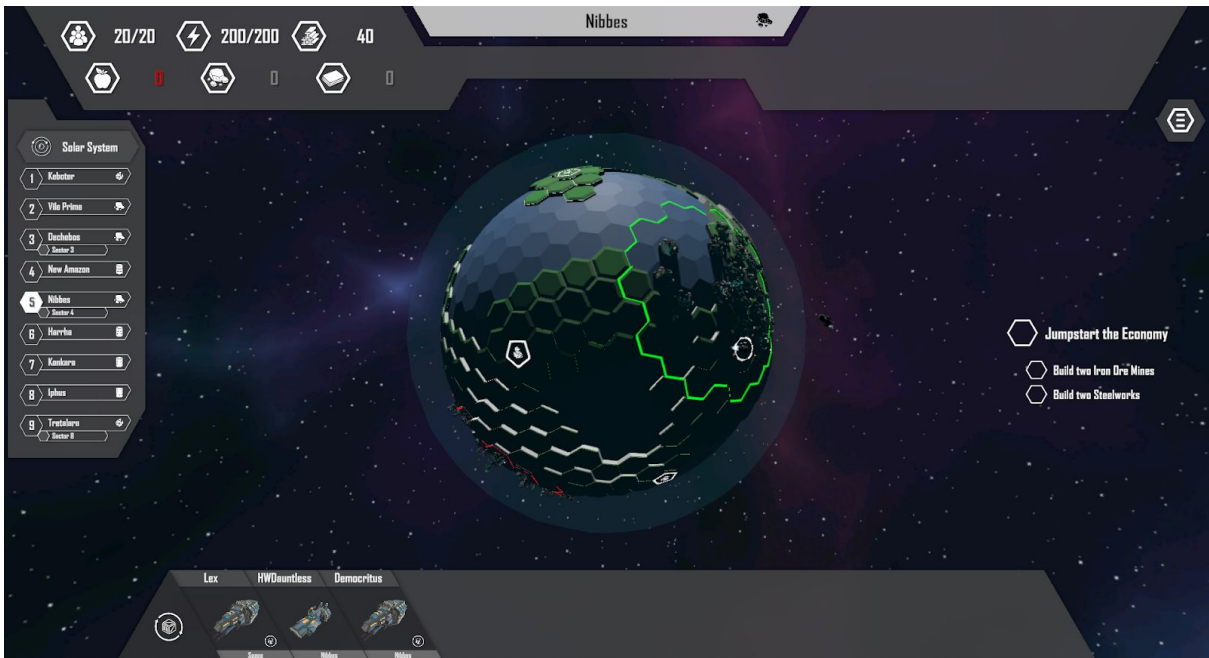
## 6.1.2. Screenshots



The space view of our game was completely reworked and now gives the player a lot of additional information. It now shows trade routes, planet names, highlights for ships and planets and trade route ships are connected to the correct trade route.



We also redesigned the information panels for everything in the game, so it is easier and nicer to get the needed information



We also redesigned key elements around the planets. The player ships are now highlighted by a round icon surrounding them. Pentagon fields that can be settled for a new sector are now also highlighted with an icon (Pentagon icon). The resource HUD at the top will now also unlock new resources only if certain buildings were built.

## 6.2. Changes Since Alpha Release

The key improvement for our game after the Alpha stage is the Information we communicate to the player. Especially from the mutual feedback, we confirmed that we have to take quite some effort into, how to present the information of our game to the player. The placeholder UI that compensated for the effort spent on the performance, is replaced by a polished UI

that visually pleasing and underlines the science fiction setting better. Additional information, such as how much resources are produced on the planet per gametime tick, helps the player to strategize. The Galaxy Map receives more relevance with visuals that enables the player to keep track of his ships and trade routes. Another valuable feedback is to guide the player through his game experience, by disabling buildings that are not supposed to be built yet.



The novel building UI informs the player how production lines of buildings are connected, and its building costs are much easier to identify compared to plain text

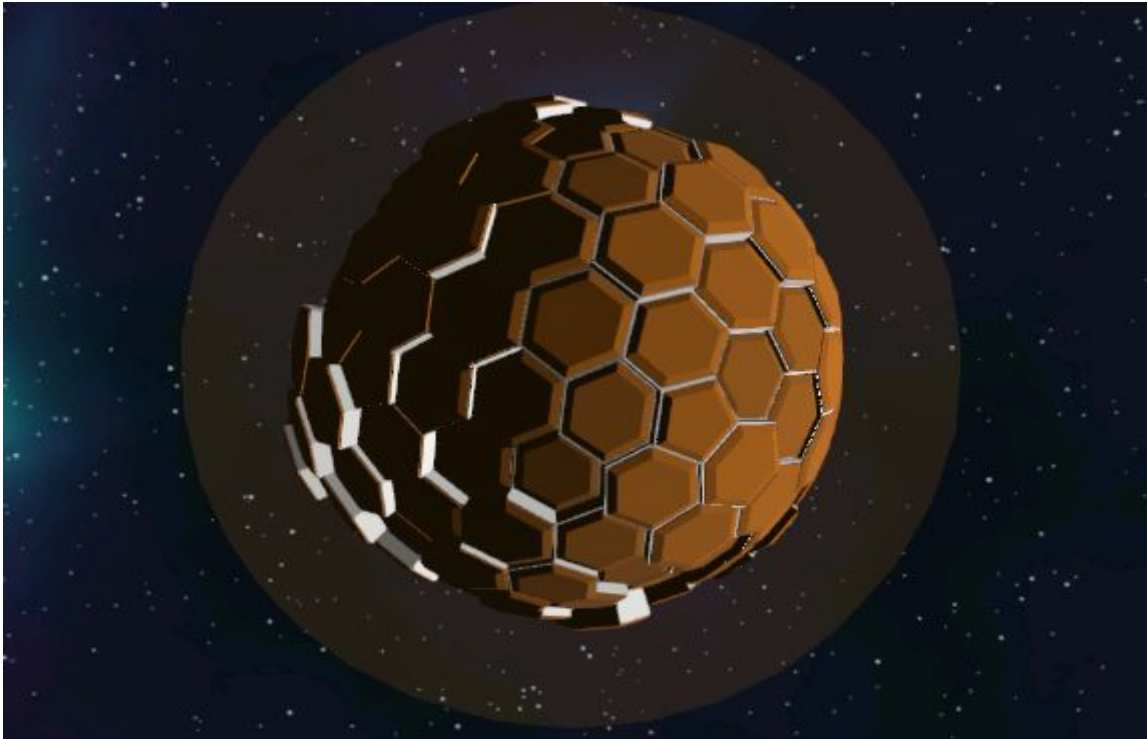
In the beginning of the game, it is not necessary to overstrain the player, with all the buildings to choose from. The new UI takes big effort to assist the player in his role as AI leader over his civilisation. Another big decision is to remove the Tutorial, with its verbose texts to read and the computer generated voice that has been perceived as annoying. Rather we included a Quest system, as an assistant and a guideline to the features of the game. The player learns to settle on new planets, by loading explorers first, or follows the steps of loading resources on a ship by following the checkboxes of the Quest UI. We look forward to see how players react on this system.



On the right side of the screen the player stays informed about advised tasks and notifications, also the green sector of the player stands out to the enemy ones.

With having two enemy players in the game, the player sector is highlighted by color, to give the player an indication of what is his and what not. We're hoping to get across right from the beginning that the player races against other players. To increase the presence of the enemies in total, a notification system has been implemented to inform the player not only about own events, such as the completion of a ship construction, but also if an enemy progresses by settling on a new planet. We're hoping that this last minute changes help us to communicate the idea of enemies in our game better. We also did changes to the core gameplay. Small cargo ships are allowed to travel not only between their in constellation 'neighbouring' planets, now they are enabled to be sent towards any planet. The distance of the planets can vary through their positions based on their rotation around the sun, in conclusion 'neighbouring' planets doesn't make sense. From the Gameplay perspective, it was tedious too. As eye candy, we included more planets types besides the regular earth.





On top: an alien planet with resemblance to Mars  
On bottom: A planet that resembles a rather harsh environment without an atmosphere

## 6.3. Development Overview

We organize ourselves in meetings twice a week, which were mostly held on Discord. Everybody summed up which tasks he pursued, and which parts did cause problems and why. Sometimes we even escalated tasks and rearranged them, for instance as we explored the performance on laptop machines. Tasks were only distributed in the group, as a general guideline everybody was assigned to a main task: Jan to Gameplay Core and Organisation, Alex to Solar System generation and Visuals, Lukas to enemy player simulation and Maximilian to Camera and Modeling. In general, this distribution worked well, in times of need, tasks were redistributed. With the project developing quite nicely, we plan to continue with the project afterwards. Towards the deadlines, we did not hesitate to work into the night to fix final bugs, to update the presentation or the document and to make sure that most of our milestones are completed.

In the first two weeks we came up with the idea of generated Planets and a strategy game that we plan to develop in iterations that increase in complexity, having the milestones in mind. That allowed us to focus on the mandatory gameplay elements that are required to make our strategy game happen. The early ideas about combat were scrapped, to allow us to narrow down our feature pool, having our schedules in mind. Nevertheless, the vertex complexity of our scene, with its rotating planets and complex building models, forced us to distribute our workforce early towards optimization on GPU and CPU side. For the alpha release we succeeded with our technical performance, with the cost of usability and eye candy. The results of the playtest showed that we were on track gameplay wise, but that we had to put a lot of work into the usability of our game. With our last development weeks we spend on polishing our game experience towards usability and how we enable players to understand in our game.

## 6.4. Personal Impression

### 6.4.1. Alexander Müller

- **Did it meet your expectations?**
  - Compared to last year's course this one was way better due to better organisation, structure and higher motivation.
- **Are you happy and proud of your game?**
  - Definitely, yes. I quite proud of what we achieved.
- **Do you feel there wasn't enough time or that the schedule was too compressed?**
  - The paper prototype phase really should just be a single week. Even for our quite complex prototype and design studies one week was plenty

- **What was the biggest technical difficulty during the project?**
  - Optimization. Having up to two thousand buildings with up to 250 objects (up to 750k vertices) is not easy to handle.
- **What was your impression of working with the theme?**
  - In my opinion the theme is rather generic, which makes it easy to find a project idea, however makes it less challenging.
- **Do you think the theme enhanced your game, or would you have been happier with total freedom?**
  - I don't think it enhanced our final game, but it helped us getting started by pointing us in a direction.
- **What would you do differently in your next game project?**
  - Code reviews and code architecture planning.
- **What was your greatest success during the project?**
  - Achieving a solid framerate on the notebook we used for our presentations, as well as the generated planets themselves.
- **Are you happy with the final result of your project?**
  - I am quite into rendering, but in those kinds of projects fancy shaders and advanced stuff usually ends up being cut due to the lack of time. Sadly, it is the same for this project.
- **Do you consider the project a success?**
  - Yes, even though I would have liked to implement more shaders, adapt the pipeline more, ... it was definitely a success for the team.
  - **To what extent did you meet your project plan and milestones (not at all, partly, mostly, always)?**
  - Mostly, except for our final UI which we had to delay due to time being spent on optimization.
- **What improvements would you suggest for the course organization?**
  - Maybe it's a crazy idea, but it might be awesome if every participant of the course would work on the same project. Clear structure and organisation would be necessary though, if not it would lead to a total mess.

#### 6.4.2. Maximilian Mayer

- **Did it meet your expectations?**
  - Yes, the course did meet my expectations. I was expecting to work in a highly motivated team on a game that would be more "complete" than any other game I have been working on. This aspect was fully satisfied with special attention to the very independent organization that the course allowed us to do which improved me as a part of a team a lot.
- **Are you happy and proud of your game?**
  - I am very proud of the game considering the amount of time that was put into it. It is definitely a project that can not only be shown to friends or family, but to companies, too. It has a more fine tuned touch and feels complete as a whole.
- **Do you feel there wasn't enough time or that the schedule was too compressed?**

- I don't think the schedule was too compressed, the short meeting intervals of two to three weeks were perfect for keeping working on the project gradually. However, with the planned scope of the project, it consumed a lot of time more than expected. Taking many courses next to this one was not an option. Therefore, the scope needs to be planned smaller in the future so that the final product would be polished as much as possible, even though it might not be the most complex one.
- **What was the biggest technical difficulty during the project?**
  - The biggest technical difficulty was surely the use of high polygon 3D assets, which resulted in high vertex counts and slow frame rates. However, with the incredibly skilled teammates handling the problems never put us to a dead end.
- **What was your impression of working with the theme?**
  - As one of my teammates fully focused on AI implementation, I did not have a lot of contact with the theme. Very basic game mechanics were more important to me, but I always kept the theme in mind.
- **Do you think the theme enhanced your game, or would you have been happier with total freedom?**
  - I believe the theme does to some extent enhance the game. The theme is not as prominent in our game because the player is very limited in the interactions with the AI. In that sense, it is necessary in future versions of the game to introduce more player-AI interaction possibilities that make the player realize who he/she is competing against. Having a theme was positive, because it gave our game a direction, but to fully utilize the potential we would have to work more on the game.
- **What would you do differently in your next game project?**
  - I would build some tools for finishing touches of the game like a spline tool for flights of cameras when shooting a trailer first. Because in the end there is few time for investing in building not yet existing tools, which can lead to a lot of frustration. Thus, I would try to be more prepared for the final phase of the project and maybe extend it for even a week longer.
- **What was your greatest success during the project?**
  - Thinking about code I would say the greatest success were the predictions of future positions of ships in the orbit around a planet so that the camera could center on them. As a whole I would say the greatest success is always starting the project with motivated people.
- **Are you happy with the final result of your project?**
  - I am happy with it, but I have so many improvements code-wise in mind, that I could continue working for another month right away. Everything is working, still there are more elegant and more understandable ways of coding. So maybe the final result might not be that final.
- **Do you consider the project a success?**
  - Yes, the project is a success as team work, scheduling and individual programming worked out nicely. We are considering continuing to work on it, which underlines its future potential.

- **To what extent did you meet your project plan and milestones (not at all, partly, mostly, always)?**
  - We mostly met our milestones, only few tasks had to be pushed back while some were worked on already earlier. However, there were a lot of tasks that could not have been foreseen which stretched the working hours slightly.
- **What improvements would you suggest for the course organization?**
  - For the organization I would have liked to have some information about the “exam” sign up, once the period in June came.

### 6.4.3. Jan-Philipp Fahlbusch

- **Did it meet your expectations?**
  - Yes, the course and game we created definitely met my expectations. For the course I expected that I will create a game in a small team, which I can then use in my portfolio. We had to invest a lot of man hours, but looking at the final result, it was definitely worth it. We got a great game with a lot of features.
- **Are you happy and proud of your game?**
  - Yes, I am very proud of the game we created in such a short time. We set out to create a complex strategic game and I think we succeeded. We did have to cut a few features, but overall we created a very fun and strategic challenging game.
- **Do you feel there wasn't enough time or that the schedule was too compressed?**
  - For us it did feel like a very compressed schedule. However, we wanted to achieve a lot in this short time and we all knew from the beginning how much time we will have to invest to create this game. We set out to create a very large and content heavy game, which we achieved with a very tight schedule. But this was by choice and not by wrong design from the course .
- **What was the biggest technical difficulty during the project?**
  - This was definitely the performance. We had very early on huge problems with vertex count, as our buildings are very detailed and we can have more than 2000 on a single planet, we had to find new approaches and had to reallocate our work tasks. But with the billboard system and reduced vertex count, we overcame the challenge.
- **What was your impression of working with the theme?**
  - The theme was very interesting and had a lot of different opportunities, as it was very broad, which I found good. Compared to last semester's theme (Twister), we had more ideas from the start and I think we nailed the theme by using an AI opponent and the player controlling an AI overlord.
- **Do you think the theme enhanced your game, or would you have been happier with total freedom?**
  - I think the theme enhanced our game, as it gave us something to focus on and be more specific on our game design.
- **What would you do differently in your next game project?**

- I think we did a lot better, compared to last semester. We still had some technical challenges we could have minimized by better planning and thinking about the challenges. Also some reordering of tasks and giving them other priorities is definitely something I would do differently, as we had to redo some parts of our game due to task being in the wrong order.
- **What was your greatest success during the project?**
  - That, after most of the core system was finished and implemented, everything worked and the strategic thinking started to take over while playtesting. This meant that our designs made sense gameplay wise and we could focus on more content, instead of redesigning the game loop.
- **Are you happy with the final result of your project?**
  - Yes, I am very happy. Our game turned out very great, I learned a lot coding and optimizing wise and I can use this in my portfolio.
- **Do you consider the project a success?**
  - Yes, as everything works as intended, we have most features in, which we set out to implement and also got a good reception during our playtests. So it is not just us that likes to play the game.
- **To what extent did you meet your project plan and milestones (not at all, partly, mostly, always)?**
  - I would say almost always. I was sometimes a little behind, due to optimization and technical issues. But I did finish the core gameplay mechanics a week before the alpha release and thus was ahead of my schedule and could help with other parts of the project.
- **What improvements would you suggest for the course organization?**
  - Some feedback after the presentation would be great, even if it is just that the game looks good. This would give one more confidence that the project is also on track from the course organizations side.

#### 6.4.4. Lukas Goll

- **Did it meet your expectations?**
  - Going into the project I expected quite some motivation to work on a project that has the potential to be continued after the Demo Day.
- **Are you happy and proud of your game?**
  - Yes, I never was part of a team project in University with all contributing to the cause, such as this time.
- **Do you feel there wasn't enough time or that the schedule was too compressed?**
  - No, in regards of time, we put the pressure on yourself through our game design choice. I think even in the beginning everybody of us did know that it is going to be tough. Nevertheless nobody was discouraged.
- **What was the biggest technical difficulty during the project?**
  - Pressing the big idea of Real Time strategy building on multiple planets in a SiFi setting into a concept that can be realized in the given time.
- **What was your impression of working with the theme?**

- Personally I felt the theme AI gives enough freedom to go towards many directions, in regards of game genre and setting. Something that struck me very early in the project is the idea to separate the theme from the features of the game, especially the technical ones. Doing so we prevented to narrow our game design down to something that focuses on AI development rather than game development and organization.
- **Do you think the theme enhanced your game, or would you have been happier with total freedom?**
  - The idea gave us the direction towards a sifi setting for our building strategy game, therefore it is safe to say that this early direction helped us to develop our game idea fast enough. Since we planned implementation right in the first week, it helped us.
- **What would you do differently in your next game project?**
  - Doing the AI in parallel is something i would not do on a next game development project, that isn't this seminar with that tight time schedule. With having in mind that our game needs conflict, it was clear that an AI system needs to pressure the player. And that system had to be ready for the Alpha release. Constant changes to gameplay and features required additional work on the AI to adapt their strategies.
- **What was your greatest success during the project?**
  - Greatest success has been the finished Enemy players that use the same actions as the player and are tweaked in a way, so that they will finish the game on any circumstances, if the player is not fast enough. And without cheating, which is a very typical approach for strategy games, especially with the more difficult enemies.
- **Are you happy with the final result of your project?**
  - Personally I was intrigued by the idea to work on a building strategy, since I never considered to do something similar. Having in mind that our core mechanics work, and you have a decent play experience, that feels like a very small Anno accessor, I am happy about the project and feel like this is something you can put into your portfolio.
- **Do you consider the project a success?**
  - From an aspect of organization absolutely! Having in mind the very tight time schedule, and the big amount of functionalities our game includes, we succeed in keeping our project organized. Second the communication in the team worked very well. Having in mind that we consider to continue with the project, calling the project successful is quite appropriate. (Scheiß satz)
- **To what extent did you meet your project plan and milestones (not at all, partly, mostly, always)?**
  - In my opinion we did a good job on planning our game in multiple releases, the early ones stripped down to the gameplay core, yet complete and finishable. Towards the alpha release we definitely had a phase in which optimization cost us the usability we would liked to have. Having in mind important aspects like player guidance or distributing information to the player, would have been nice to have.
- **What improvements would you suggest for the course organization?**

- In my opinion, the self organisation is the most valuable thing to learn in the course, and that works well with the milestones. On the other hand I would like to see some feedback during the project. After the presentations, it would be excellent if there were some input to work with and information given on how the team progresses and what elements could be improved.