



Bilkent University

Department of Computer Engineering

Object Oriented Software Engineering Project

CS319 Project: Terra Mystica

Analysis Report

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Progress Report

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1. Introduction

Terra Mystica is a strategy board game. We, as group 1J-TM, are digitizing this board game by building a desktop app for it. The game can be played by 2-5 people and in our implementation the users will be able to play the game using the same computer by taking turns. At the beginning of the game, each user chooses a faction to play. This faction becomes theirs for the whole game and it is called their “Home Terrain”. The game consists of several domains in which players perform actions. The main domain is the TerraLand, in which there are 77 terrains of 7 different types. Factions have home terrains, and similar to factions, these terrains will be matched with the player throughout the game. The main goal of the game is to govern and build the best faction among the other players. Building the best faction is measured by the player’s faction’s progress through all the domains of the game. Not only the success of the player’s faction in the TerraLand is important, but also the progress on the Cult board is considered as a factor in the final calculation of the winner. Another domain in which the players progress is the victory points chart. Throughout the game each player performs actions by taking turns to eventually progress in the Cult board, earn victory points and to build several powerful structures and/or towns on the TerraLand.

2. Overview

2.1. Game Elements

2.1.1. Factions

In Terra Mystica, each player governs over 14 different factions, which consist of, Chaos Magicians, Giants, Fakirs, Nomads, Halflings, Cultists, Alchemists, Darklings, Mermaids, Swarmlings, Auren, Witches, Engineers and Dwarves. Each of these factions have different

abilities, costs for buildings and income from buildings. Each of these factions have their home terrain, which allows the player to terraform and build structures.

2.1.1.1. Darklings

Darklings start the game by gaining the income of one worker, fifteen coins and a priest, also they have the advantage on the cult track one step beyond on the water cult and the earth cult. Their home terrain is the Swamp.

They can pay priests to have spades when they are performing the transformation of any terrain instead of paying workers and they earn two victory points in each transformation.

After updating any trading house to a Stronghold, they can trade three workers for three priests (one priest each).

2.1.1.2. Halflings

They start the game with their income of three workers, fifteen coins and also they start the cult board with the advantage of one step at the earth and water signs. Their home terrains are the Plains.

Halflings' have the ability to obtain one additional victory point for each spade that may have been gained in any case.

After updating a structure to a Stronghold, they gain three spades for the usage of transforming the terrains and they can build a dwelling by paying the necessary amount on one of these terrains.

2.1.1.3. Cultists

Cultists' start the game with their income of three workers, fifteen coins and they have the advantage of one step beyond

on both earth cult and fire cult. Their home terrains are the Plains.

If one of the opponents of the cultists' determines to take the power which is coming from the building or updating action they perform, they gain advance in the cult track which is one step at the element that they prefer.

When cultists' build stronghold, they immediately gain seven victory points.

2.1.1.4. Fakirs

Fakirs' start the game with their initial income of three workers, fifteen coins, and also they have the advantage in cult track one steps in both air and fire signs. Their home terrains are Desert.

Fakirs have the ability that is called "carpet flight" when they are performing the transform and build action. Using that feature, as long as they pay one priest, fakirs can fly one Terrain or river space and they gain four victory points each time that they perform this action. During the calculation of final areas at the end of the game, structures that are reachable using carpet flight will be counted as connected.

When fakirs build a stronghold, they can skip two rivers or Terrain spaces using carpet flight in exchange for one priest.

2.1.1.5. Nomads

Initial income of nomads contains two workers and fifteen coins, the initial cult board advantage of nomads is advancing one step in fire and earth cults. Their home terrains are Desert.

Nomads have the ability to start the game by placing three dwellings instead of two and the third one is placed after every player has placed their two dwellings.

Right after building a stronghold, nomads can take an action token. From now on, they are able to transform a neighbor terrain space to their home terrain once in each action phase. They can immediately build structures on it if they prefer.

2.1.1.6. Chaos Magicians

Initial income of the chaos magicians are four workers and fifteen coins. Their initial cult board advantage is beginning two steps ahead in the earth cult. Their home terrains are Wastelands.

At the beginning of the game, they can only place one dwelling to the Terralands after all players place their starting dwellings. They can take two favor tiles instead of one immediately after they have built a temple or a sanctuary.

When they build their stronghold, they can take one action token. From now on, once per action phase, they can take two turns and passing is counted.

2.1.1.7. Giants

Initial income of the giants are three workers and fifteen coins. Their initial cult board advantage is beginning one step ahead in fire and air cults. Their home terrains are Wastelands.

Each time they perform the terraforming action to any terrain, they pay exactly two spades.

Giants take an action token immediately after they built their Stronghold. From now on, once per action phase, they gain two spades without paying in order to terraform and they can build

a dwelling on that terrain at that action phase if they pay its expense.

2.1.1.8. Mermaids

Mermaids start the game with their income of three workers and fifteen coins. Their cult board advantage is advancing two steps in the water cult at the beginning. Their home terrains are Lakes.

Mermaids are able to skip a river space if they have found a town.

When they build their stronghold, they move one step further at their shipping level without paying its cost.

2.1.1.9. Swarmlings

Initial income of the Swarmlings is eight workers and twenty coins. Their cult board advantage is advancing one step in each cult at the beginning. Their home terrains are Lakes.

Swarmlings have the ability to collect three workers each time they have found a town.

Swarmlings take an action token immediately after they built their Stronghold. In every action phase, they can upgrade any of their dwelling into a trading house without paying its cost.

2.1.1.10. Auren

They start the game with their income of three workers and fifteen coins. Their initial cult board advantage is beginning one step ahead in water and air cults. Their home terrain is forest.

They do not have any special abilities.

When they build their stronghold, they obtain one favor tile. Also, they gain an action token which advantages them on two steps in any cult on the cult track in each action phase.

2.1.1.11. Witches

Witches start the game with their income of three workers and fifteen coins, their initial cult board advantage is beginning two steps ahead in the air cult. Their home terrain is forest.

They have the ability to get additional five victory points immediately after they have found a town.

They take an action token when they build their stronghold. From now on, once in every action phase, they can build a dwelling to a forest space without paying its cost and the forest terrain does not have to obey the adjacency rule.

2.1.1.12. Engineers

Engineers start the game with their income of two workers and ten coins. They do not have any cult board advantage. Their home terrains are the mountains.

They can build a bridge by paying two workers.

After they have built their stronghold, they gain three victory points for each bridge they have when they pass a round.

2.1.1.13. Dwarves

Dwarves start the game with their income of three workers and fifteen coins, their initial cult board advantage is beginning two steps ahead in the earth cult. Their home terrains are the mountains.

By paying two additional workers, they can skip a terrain or a river space when they are terraforming terrain and this action is

called “tunneling”. Each time they perform tunneling, they gain four extra victory points. They do not have any shipping level on their faction board since they have tunneling. Terrains can be reached by tunneling are counted as connected when calculating the final score.

After building their stronghold, from now on they pay only one worker in order to perform tunneling.

2.1.1.14. Alchemists

Alchemists’ start the game with their income of three workers and fifteen coins, also they have the advantage on the cult track which is one step beyond at the water cult and one step beyond at the fire cult. Their home terrain is the Swamp.

Alchemists’ have the ability of trading one victory point with a coin or trading two coins with a victory point whenever they prefer.

After updating any trading house to a Stronghold, Alchemists’ gain twelve power and henceforth, they gain two power for each spade that is obtained in any case.

2.1.2. Terrains

In Terra Mystica, a faction either lives in the Plains, the Swamp, the Lakes, the Forest, the Mountains, the Wasteland or the Desert.



- Chaos Magicians and Giants live in the Wasteland.

- Fakirs and Nomads live in the Desert.
- Halflings and Cultists live in the Plains.
- Alchemists and Darklings live in the Swamp.
- Mermaids and Swarmlings live in the Lakes.
- Auren and Witches live in the Forest.
- Engineers and Dwarves live in the Mountains.

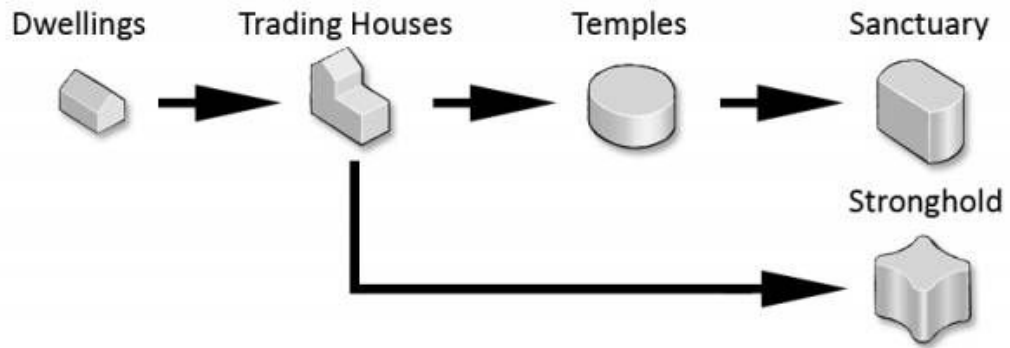
Every faction needs to transform the terrain space into their home terrain in order to construct buildings on them. The transformation requires the usage of different amounts of spades depending on the distance shown at the faction board to the factions' home terrain and these spades can be obtained by the payment of specific amounts of workers, by the bonus cards or by using specific amounts of power.

2.1.3. Structures

There are four different types of structures in Terra Mystica. At the start, each player gets eight dwellings, four trading houses, a stronghold, three temples and a sanctuary. Existing Dwellings can be upgraded in multiple steps: to a Trading house at first, then to a Stronghold or Temple. One temple can be upgraded to a Sanctuary. Dwellings provide Workers. Upgrading a Structure increases your income in Coins, Power, or Priests.

After building a Stronghold, each faction achieves their unique ability. On the other hand, after building temples and a sanctuary, the players gain a Favor Tile and immediately acquire the bonus that comes with it. Building and upgrading structures costs different amounts depending on the faction and the amounts are visible on their faction board.

Dwellings have a power of one, trading houses and temples have power of two and the sanctuary and the stronghold have the power of three. In total, the power of seven is needed in order to build a town.



2.1.4. Coins

Coins are used to build and upgrade structures. Each player earns a certain amount of coins according to the buildings that they have built.

2.1.5. Workers

Workers are used to build structures in the action phase. In the setup phase of the game each player gets a certain amount of workers according to their faction. Later, in the income phase of each round, players get new workers as income.

2.1.6. Power

Each player starts with a total of 12 power tokens. Power is distributed among the three “power bowls”. Power is shifted from Bowl I to Bowl II and then finally to Bowl III. You can only move the power tokens from Bowl II to Bowl III if Bowl I is empty. A player can only spend Power tokens that are in Bowl III. The power that was spent is moved to Bowl I.

There are seven different ways to earn power:

1. When an opponent builds a structure directly adjacent.
2. Income from your Trading houses and Stronghold.
3. Income from two specific Bonus cards.
4. Income from two specific Favor tiles.
5. A one-time reward when founding a Town and taking the specific Town tile.
6. A one-time Cult bonus in Phase III if the specific Scoring tile is up for the current round.
7. When advancing on the Cult tracks

2.1.7. Priests

Each player is given seven Priests in the beginning of the game. A player has to earn a Priest to be able to spend it. Priests are used for advancing on the Cult tracks and while upgrading structures. Priest that have been sent to the cult track are not re-earnable. A player can earn priests from:

1. Income from Temple.
2. Income from Sanctuary.
3. A specific Bonus Card.
4. A Power Action.
5. A one-time Cult bonus in Phase III if the specific Scoring tile is up for the current round.

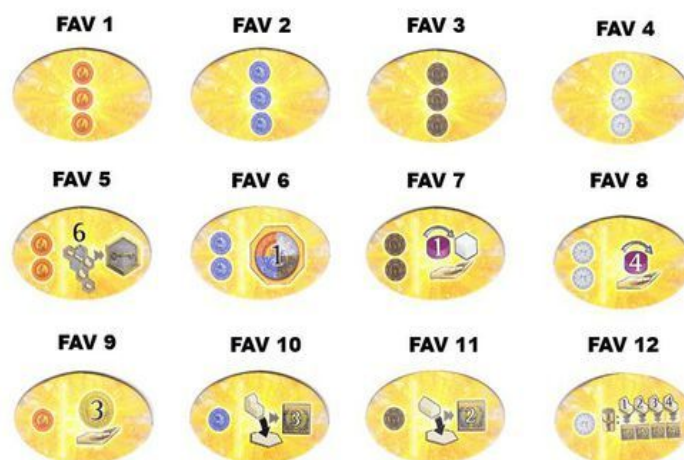
2.1.8. Bonus Cards

There are nine different Bonus Cards in Terra Mystica. Their purpose is to get additional income in Phase I. A Bonus Card is only valid for a single round. At the end of the round, each player returns their Bonus Card.



2.1.9. Favor Tiles

There are twelve different Favor Tiles in Terra Mystica. After building a Sanctuary or a Temple, a player immediately chooses and takes one of the favor tiles (Chaos Magicians take two). Four of the favor tiles increase the position of a player in the corresponding Cult by three. The remaining eight tiles unlock a special ability, and increase the position of a player in the corresponding Cult by one or two.



2.1.10. Town Tiles

There are two of each unique different Town Tiles in Terra Mystica. After founding a town, a player immediately chooses and takes one of the town tiles and places it under a building in that town. Each town tile provides an immediate one-time bonus. In addition to a bonus, town tiles provide considerable amounts of victory points which are essential for the identification of the winner at the end of the game.

2.1.11. Scoring Tiles

Each Scoring Tile represents a round in the game. There are a total of eight different Scoring Tiles in Terra Mystica. The left side of each Scoring Tile indicates how to get extra Victory Points during the Action Phase. Their right side shows the Cult Bonuses awarded at the end of the round.



3.Flow Of The Game

3.1 The Setup of the Game

A game of Terra Mystica takes place over six rounds, which consist of three phases. The game is played by a minimum of two and maximum of five players. In the beginning, the starting player chooses a faction out of the fourteen unique factions. After each player has chosen their faction, they receive their starting income, which may vary from faction to faction. Finally, each player places two dwellings on their home terrain to start the game. Then, the income phase of the first round begins.

3.2 The Income Phase

Each player receives an income based on their Bonus Card and the Structures that they have built on the previous round or in the setup.

3.3 The Action Phase

Each player performs one of the possible eight actions at a time. These actions are:

1. Transform and Build
2. Advancing on the Shipping Track
3. Lowering the Exchange Rate For Spades
4. Upgrading a Structure
5. Send a Priest to The Order of a Cult
6. Power Actions
7. Special Actions
8. Passing and new Starting player

3.3.1 Transform and Build

Players may change the type of a Terrain space and immediately build a dwelling on it. To build a dwelling on a Terrain space, its type has to

be the same as the terrain of the player's faction and, it has to be directly or indirectly adjacent to one of the structures of the player. Also the user has to pay the cost of building a dwelling. To transform the type of a Terrain space, the player must pay the cost of the required spades. The cost is calculated by the number of steps it takes to travel to the terrain to be changed. Each step costs one spade. A transformation can cost at most three spades.

3.3.2 Advancing on the Shipping Track

In order to transform Terrain spaces or build Structures beyond River spaces, as an Action, you may move the Marker on your Shipping track forward one space. Your Faction board displays the costs of this Action: 1 Priest and 4 Coins.

3.3.3 Lowering the Exchange Rate For Spades

Players may increase their spade levels to pay less when they are terraforming. It decreases the spade exchange rate when transforming a land. Increasing spade level also enables the player to earn victory points. The level can be increased by paying the amount of worker which depends on the level.

3.3.4 Upgrading a Structure

Structures can be upgraded by paying the amount indicated in the faction board near each structure type. Dwellings can be upgraded to a Trading house. If at least one of the opponent's Structure is adjacent* to your dwelling, you need to pay 3 coins otherwise, pay 6 coins. Trading houses can be upgraded in two ways: either they become a Temple or a Stronghold. Building Stronghold enables you to gain a

special ability depending on the faction you choose. Upgrading a Trading house to a Temple will enable you to choose a Favor tile. Also, you can upgrade one of your Temples to a Sanctuary. This upgrade will also give you a Favor tile. While upgrading structures, beware of that rounds Scoring tile to earn Victory points.

*In the case of adjacency the player who upgrades Structure should give the choice to the opponent that earning Power which requires losing Victory points equal to the one fewer amount of Power gained. The opponent can gain power as the amount indicated in the Faction board for that Structure.

3.3.5 Send a Priest to The Order of a Cult

You may send one of your Priests to the Cult that you have chosen. Placing a Priest in one of the places will enable you to move on that Cult track depending on your Priest's place, either 3 or 2. You will earn power every time you pass on those power spots. Only one player can be placed in a Cult place. Once you send a Priest to the Cult, you cannot get it back.

3.3.6 Power Actions

Power actions consist of two different actions: Power action on the game, pop up screen, or Sacrificing Power.

Power action on the game can be done by transforming power tokens from the bowl 3 to 1. In the pop-up screen, you can see what you can do with those power transformations. For instance, you can gain a

bridge by moving 3 power tokens from bowl 3 to bowl 1. *This action can be done only once in a round.

You can also sacrifice power if you do not have enough tokens in bowl 3. You can move tokens from bowl 2 to 3 by sacrificing the equal amount of power that you are going to move. Once you sacrifice power you cannot get it back.

3.3.7 Special Actions

It can be performed in three ways: building a Stronghold, using a Favor tile and using a Bonus card.

Special actions can be taken when building a Stronghold. This special action can be seen in each faction board when a Stronghold is built. Special actions differ and it is unique for each faction. By Favor tile or Bonus card you can also perform an action that is indicated in the cards. Special actions can be taken once in a round.

3.3.8 Passing and new Starting Player

If you cannot take any action or you do not want to then, you can pass. After passing you cannot take any action on that round anymore. First player that passes becomes the first player that will play in the next round. As soon as you pass take a new Bonus card. *You may earn rewards from your Bonus card when you have passed.

3.4 Cult Bonuses and Clean-up Phase

If all players have passed then this phase starts. Players earn their Cult bonuses, which are indicated on the right side of each Scoring tile, for that

round. Those rewards can be given multiple times if it is possible. Cult bonuses are calculated according to your whole progress, total space, in a Cult track, it does not consider your improvement for only in that round.

*Income, Action and Clean-up phases are performed in all 6 rounds. However, the Clean-up phase is not included in the last round. After 6. round, final scoring should be performed.

3.5 End of The Game and Final Scoring

After the last action phase game ends without having Clean-up. There are several scoring types to decide who is the winner.

Cult Scoring: For each Cult track the first 3 players are rewarded based on their positions. First player gets 8, the second player gets 4, and the third player gets 2 Victory points.

Area Scoring: It is calculated based on the number of structures you own which are adjacent to each other. If you have increased your shipping you can add your terrains that are across the river. You can count your each shipping for each river terrain. For instance if you have 2 shipping then you can calculate your area by skipping 2 river spaces at a time, and you can do this for your several structures. After calculation, Players earn Victory points 18,12,6 respectively to their positions.

Resource Scoring: Calculated based on the left coins. 1 Victory point should be given for 3 coins. *Exceptions may occur: e.g. Alchemist should get 1 Victory points per 2 coins.

In the end, the player who has the most Victory points wins.

4. Requirements

4.1 Functional Requirements

Play Game

When the user chooses this option from the main menu, the new game starts. Before playing, the number of players is required. The minimum player number is 2 and the maximum player number is 5. On that page, all of the players also have to choose their factions. Factions have different features, home terrains and incomes. So, each player plays with different abilities.

There is going to be a page for choosing bonus cards. Game includes (player number + 3) bonus cards. Each player chooses one of them for the next round after they are passing their turn. Also, the 3 bonus cards that are left are going to have 1 more coin income for the next round in order to be more preferable.

The game includes 6 rounds and before the first one starts, the game engine is going to sort the round cards. Each round card has two sides, one for the in-game actions the other one is for the end of the round.

After having the factions, initial incomes, bonus cards and round cards, the game board is going to be opened and players start the game by placing their dwellings one by one.

When they complete the dwelling placing, round 1 starts and players do one of the actions when it is their turn. Rounds continue until every player passes.

As the game continues, players are going to try to make the longest path with placing structures, make progress on cult boards, improve their

shipping and digging levels and use their special and power actions for gaining victory points.

After the 6th round is completed, players' victory points are going to be compared. Player that has the highest victory point is going to be the winner and the game is going to be finished.

Also, while the game continues there are going to be the tabs for viewing sequent 6 round cards of the game, favor tiles, bonus cards which are not chosen until that time, victory points all of the players have, cult board and players level on it and special actions for that round. Other than those, players are able to view every player and their victory points, shipping and digging abilities, workers, coins, improvement on cult board, priests and resources.

Terra Mystica has so many features and sections in it. For the reason that it is a strategy game, it might take so much time and there must be a time limit for that. If a player doesn't do anything in 5 mins, their turn is going to be passed.

Load Game

The player must be able to load and continue to play a previously saved game.

Save Game

The player must be able to save the current state of an ongoing game in order to continue to play in the future.

Display Game Manual

When the user chooses this option from the main menu, the game leads them to the manual. It provides the instruction for incomes, actions, faction features, placing structures and the other details for playing the game.

Change Settings

When the user chooses this option from the main menu, they can turn off the sounds in the game.

See History

The player must be able to observe the history of the last played game (e.g. chosen factions, victory points earned etc.) and overall statistics (e.g. average victory points earned per game, total games played etc.) as well.

4.2 Nonfunctional Requirements

4.2.1. User Interface

Players should be able to learn to navigate between the controls of the gameplay in 5 minutes.

4.2.2 How to Play

This game requires the players to play on the same screen. Even though it is not always possible, when people come together it is going to be a pleasant time for them to feel like playing a board game in a digital area together.

4.3 Pseudo Requirements

The implementation language must be an object-oriented language. Git must be used as a software development version control system. GitHub must be utilized as a host. Google Docs must be used for documentation purposes.

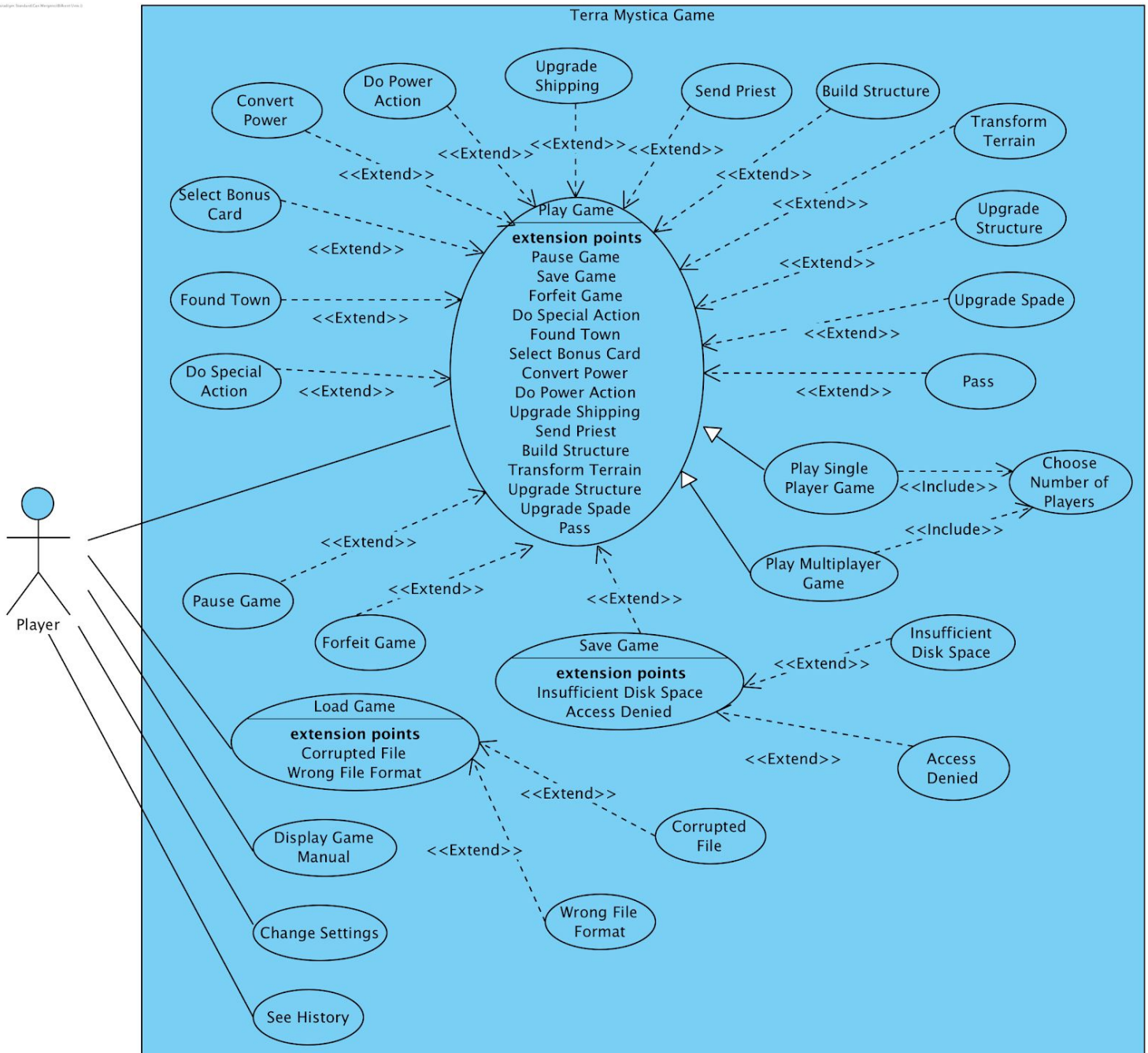
5. System Models

5.1. Use Case Model

There are 5 main use cases for Terra Mystica game. Most of the other use cases extend the "Play Game" use case. Players have different options while playing the game. Some of them are directly related with the gameplay (e.g. "Build Structure", "Select Bonus Card", etc.) whereas some others are related with game control (e.g. "Save Game", "Pause Game", "Forfeit Game"). All these options depend on the "Play Game" use case thereby the player cannot perform them without an ongoing game.

"Play Single Player Game" and "Play Multiplayer Game" specialize (inherit) "Play Game" use case. Because they add more detail to the "Play Game" use case by specifying game type. Since choosing the number of players is common for both single player and multiplayer games, both of them include the "Choose Number of Players" use case.

"Save Game" and "Load Game" actions may not be accomplished successfully because of different reasons (e.g. Insufficient Disk Space, Wrong File Format etc.). These cases represent the failure of the corresponding use case, thus they are extensions.



5.1.1. Use Case Descriptions

Name: Play Game

Participating Actor: Initiated by Player

Flow of Events:

1. The Player activates the “Play Game” function in the game.
2. GAME responds by presenting game mode options (Single Player or Multiplayer) to the Player.
3. The Player selects the game mode (Single Player Game or Multiplayer Game)
4. GAME responds by presenting player specifications (Number of Players and Faction Types) to the Player.
5. The Player fills out the player specifications and submit it by activating the “Start Game” function.
6. GAME displays the game map and starts the game.
7. GAME presents the available actions out of all actions to the Player:
 1. Do Special Action
 2. Found Town
 3. Select Bonus Card
 4. Convert Power
 5. Do Power Action
 6. Upgrade Shipping
 7. Send Priest
 8. Build Structure
 9. Transform Terrain
 10. Upgrade Structure
 11. Upgrade Spade
 12. Pass
8. The Player chooses one action from available actions.

Entry Condition:

1. The Player launches the game.

Exit Condition:

1. There are no available actions for all players in the game at the 6th round, OR
2. The Player has forfeited the game.

Quality Requirements:

1. Available and unavailable actions are easily distinguishable to the Player.
2. Response of the GAME does not take too much time.

Name: Pause Game

Participating Actor: Initiated by Player

Flow of Events:

1. The Player activates the “Pause Game” function during gameplay.
2. GAME responds by presenting options (Resume Game, Save Game, Forfeit Game) for the paused game.
3. The Player selects one of the options.

Entry Condition:

1. This use case extends the Play Game use case.

Exit Condition:

1. The Player resumes the game, OR
2. The Player forfeits the game.

Name: Save Game

Participating Actor: Initiated by Player

Flow of Events:

1. The Player activates the “Save Game” function in the game.
2. GAME responds by presenting directory browsing options for the game to be saved.
3. The Player chooses the directory where the file is to be saved, specifies the name of the file and submits it.
4. GAME saves the current state of the ongoing game.

Entry Condition:

1. This use case extends the Play Game use case.

Exit Condition:

1. Game has been saved, OR

2. The Player has canceled the operation.

Name: Forfeit Game

Participating Actor: Initiated by Player

Flow of Events:

1. The Player activates the "Forfeit Game" function in the game.
2. GAME responds by exiting the gameplay.

Entry Condition:

1. This use case extends the Play Game use case.

Exit Condition:

1. Game has been forfeited.

Name: Load Game

Participating Actor: Initiated by Player

Flow of Events:

1. The Player activates the "Load Game" function in the game.
2. GAME responds by presenting directory browsing options for the game to be loaded.
3. The Player chooses the file with appropriate extension and submit it for loading.
4. GAME loads the specified game by restoring its state from the time when it was saved.

Entry Condition:

1. The Player launches the game.

Exit Condition:

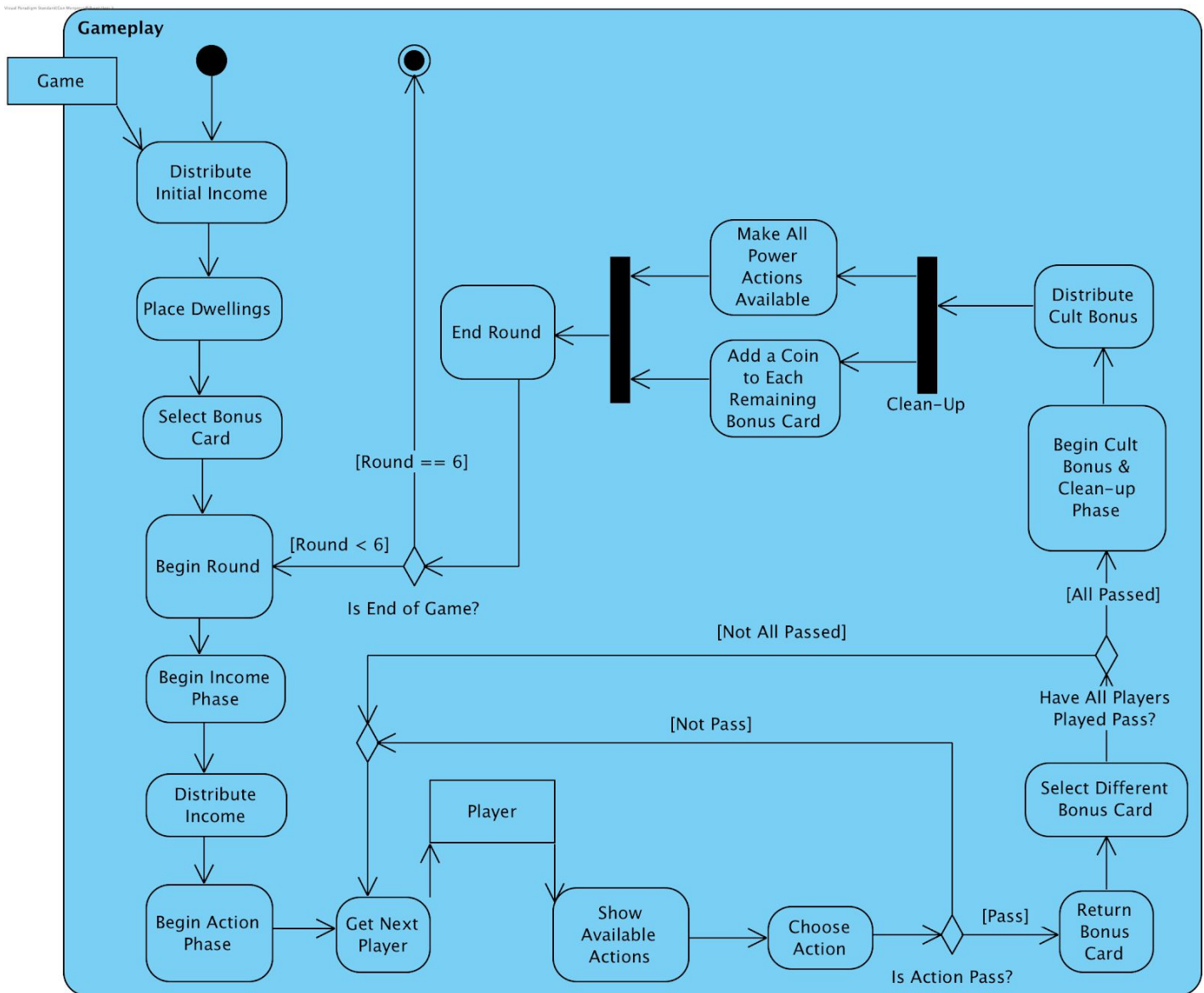
1. Game has been loaded.
2. The Player has canceled the operation.

Quality Requirements:

1. Loading operation does not take too much time.
2. Loading error types are specified clearly to the Player.

5.2. Dynamic Models

5.2.1. Activity Diagrams



There must be a game object in order to observe the gameplay activity (e.g. Initial income cannot be distributed if there is no game.) So it is an activity parameter node.

The game starts with the distribution of income to each player, based on their faction. Then, beginning with the starting player each player places a single dwelling on the

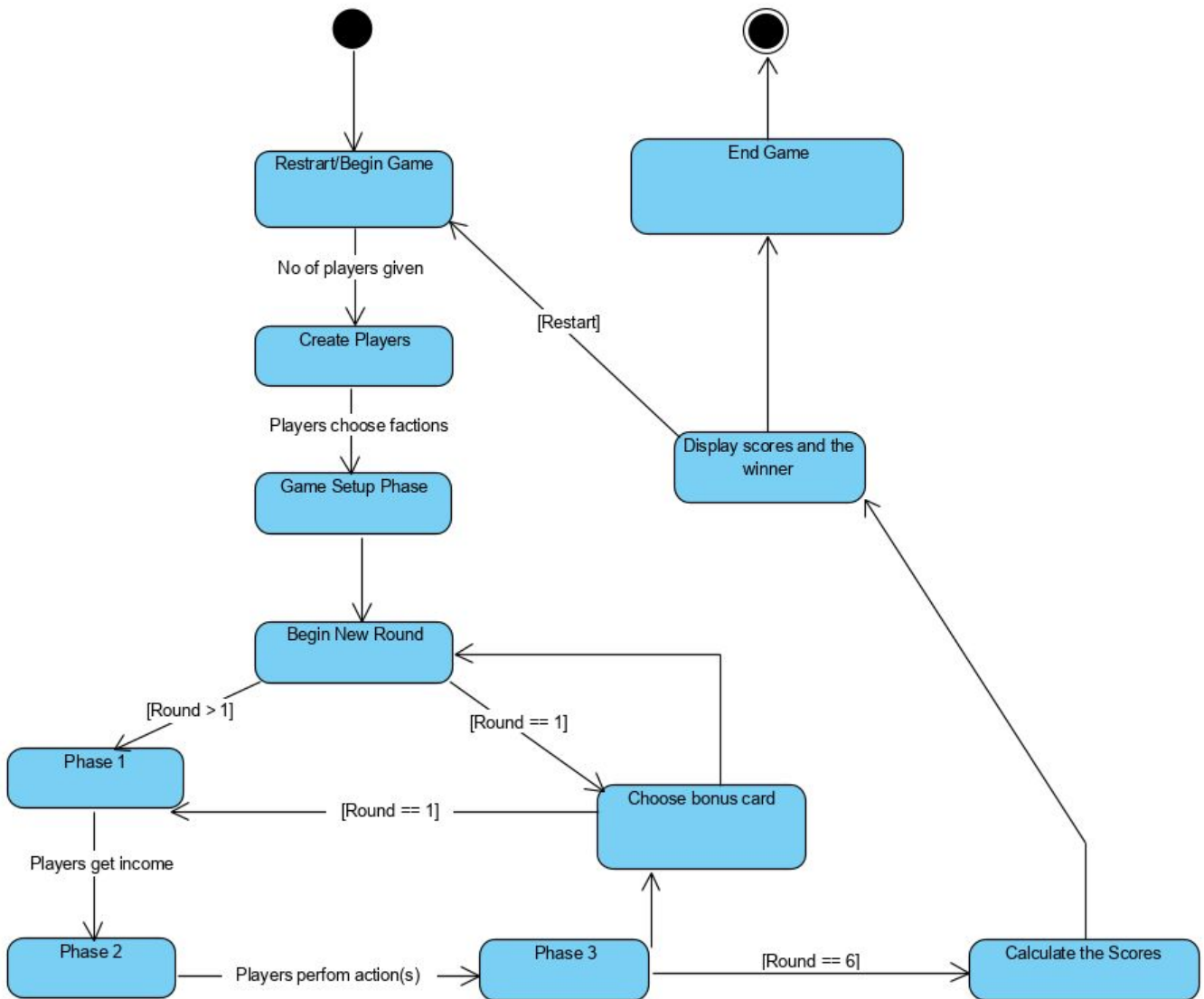
faction board in turns, twice. Finally to round up the setup of the game, each player chooses a bonus card. This concludes the setup of the game.

Each round starts with the income phase, where each player gets their income based on their structures on the board, from their Bonus Card and their Favor tile, if they have one. Then, the Action Phase starts.

Game determines the player in turn and shows the available actions. There must be a player object, since available actions depend on the player. Each player chooses one of the maximum eight possible actions. If the Player chooses to Pass, they return their bonus card and select a new bonus card. Moreover, that player cannot do any action anymore for that specific round. Action phase continues with the remaining players who do not choose to pass. When every single player chooses to Pass, the Action Phase ends and the Cleanup Phase starts.

In the Cult Bonus & Clean-up Phase, first each player earns their Cult bonus. Then, actions for the clean-up phase are done concurrently: All the Power Actions are made available for the next round, and a coin is added to the Bonus cards that have not been chosen. Then the round ends. The game ends after the sixth round, if that's not the case, the next round begins with its income phase.

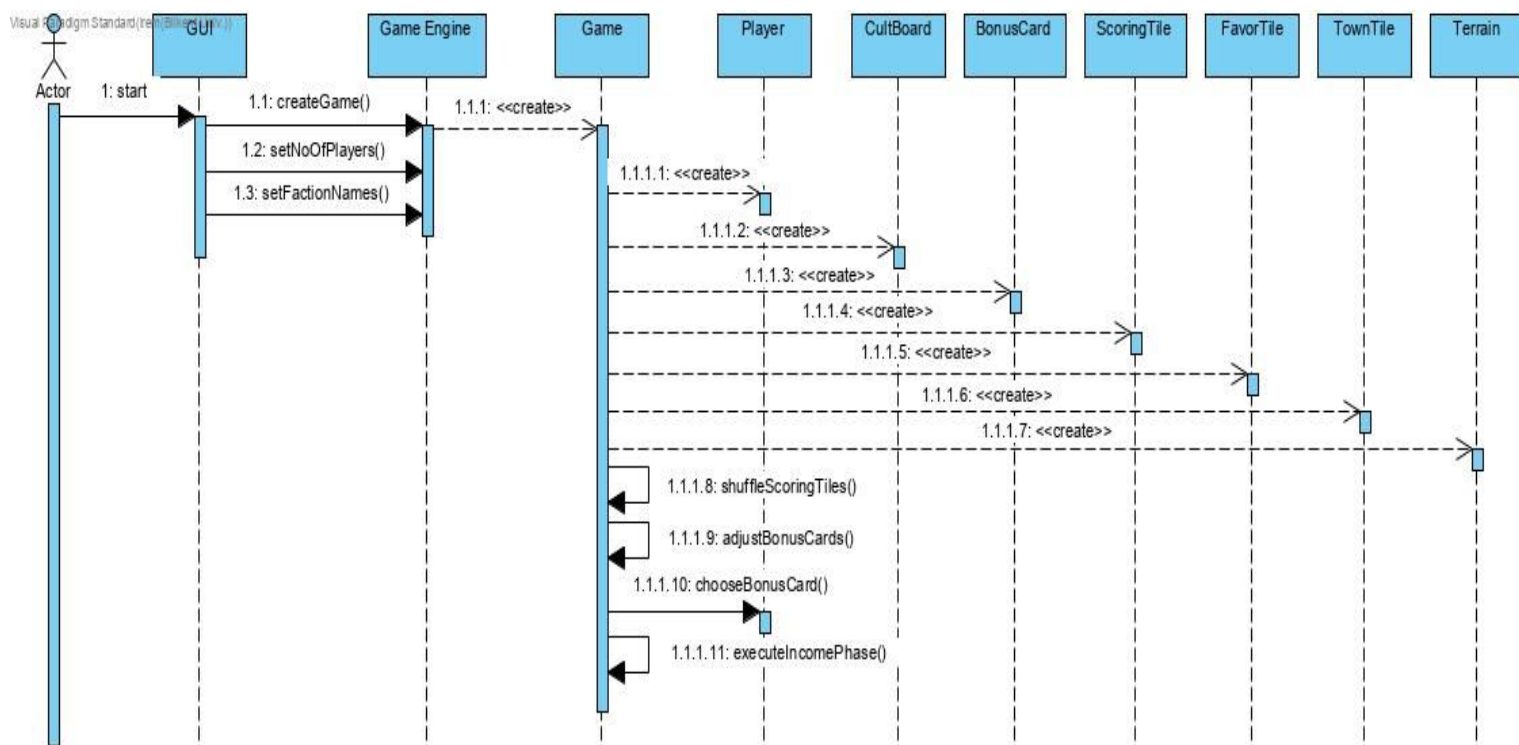
5.2.2. State Machine Diagram



When the game is started or restarted, the program waits for the number of players to be given by the user. Once the number of players is determined, the program moves to the state of creating players. After each player chooses a faction to play, the game setup phase begins. The details of what happens in the game setup state is specified in the section 3.1 of this report. After this state, the program immediately moves to rounds. In the Begin New Round state, the number of the round is checked. Depending on the value of the round, the program either moves to the chosen bonus card state (only happens in round one), or the phase one state. In this state the program waits for each player to get their income. After this, the program moves on to phase two in which it waits for each player to perform action(s). After each

player has finally performed the pass action, phase three begins. After phase three, if round number is not six, the program executes the Choose Bonus Card state which is followed by a new round. If on phase three state and the round value is six, that state is followed by the Calculate the Scores state. Afterwards the program displays scores and the winner in the specified state. In this state, if restart is chosen, the game moves back to the Restart/Begin Game state. If not, the game ends.

5.2.3. Sequence Diagrams

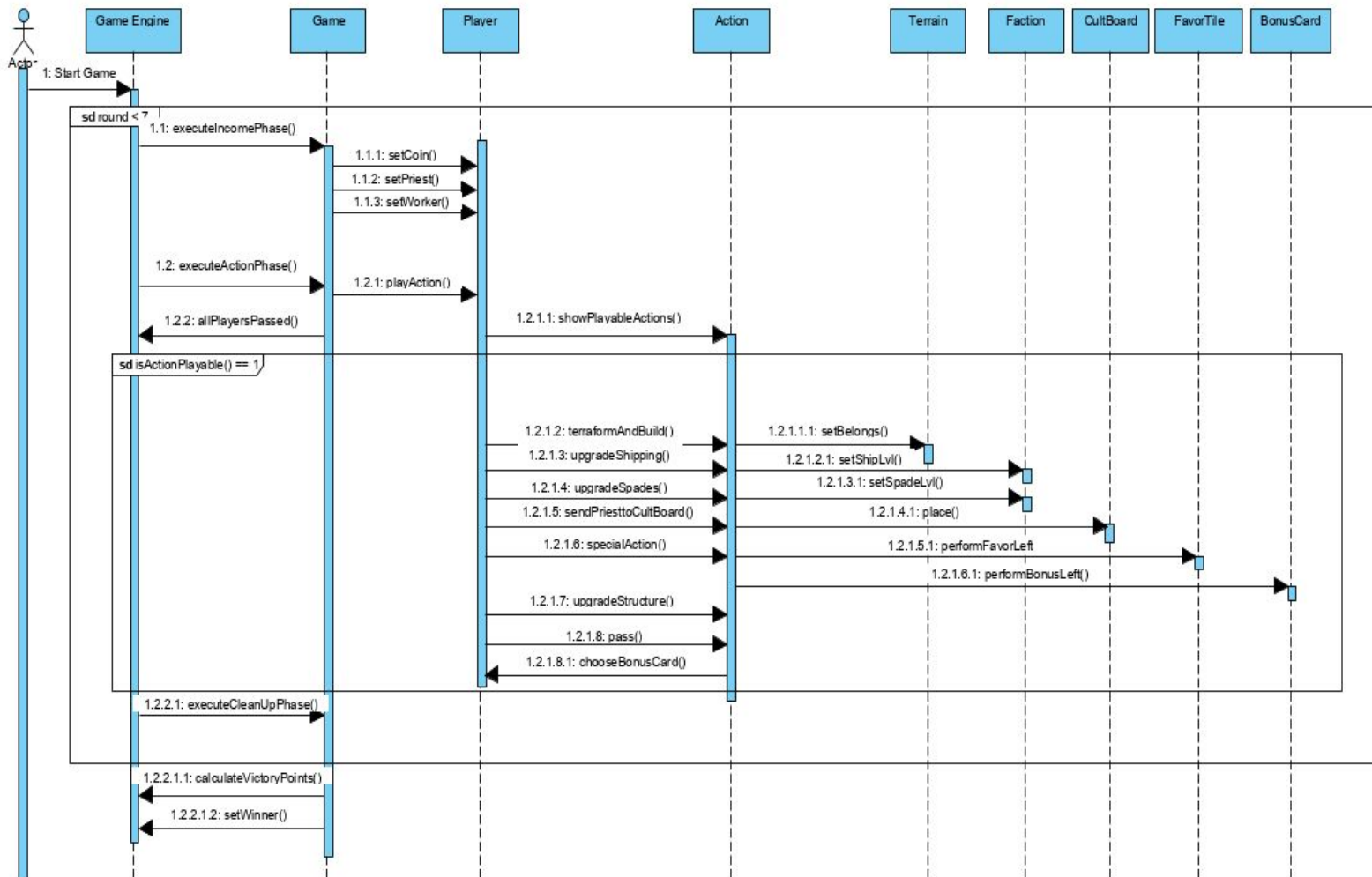


Sequence Diagram of Initializing Game

When a user starts the game, the number of players and the faction types for each player should be specified by the user. If the start game is confirmed then the GameEngine object is created. It calls createGame function to create a Game object. Also, it sets the no of players and the corresponding factions. Game object will use those attributes to create and initialize the Player objects in its constructor. Game object will also create CultBoard, BonusCard, Scoring Tile, FavorTile, TownTile and Terrain objects. After creating all needed objects, Game will shuffle scoring tiles and assign each of them for one of the 6 rounds. Game will also adjust Bonus Cards by first randomly choosing some of them according to the player number. Then each Player object will call chooseBonusCard function which

will enable the user to select one of the bonus cards. Finally as a last step of initializing the game, the first Income Phase will start when the Game object calls executeIncomePhase function.

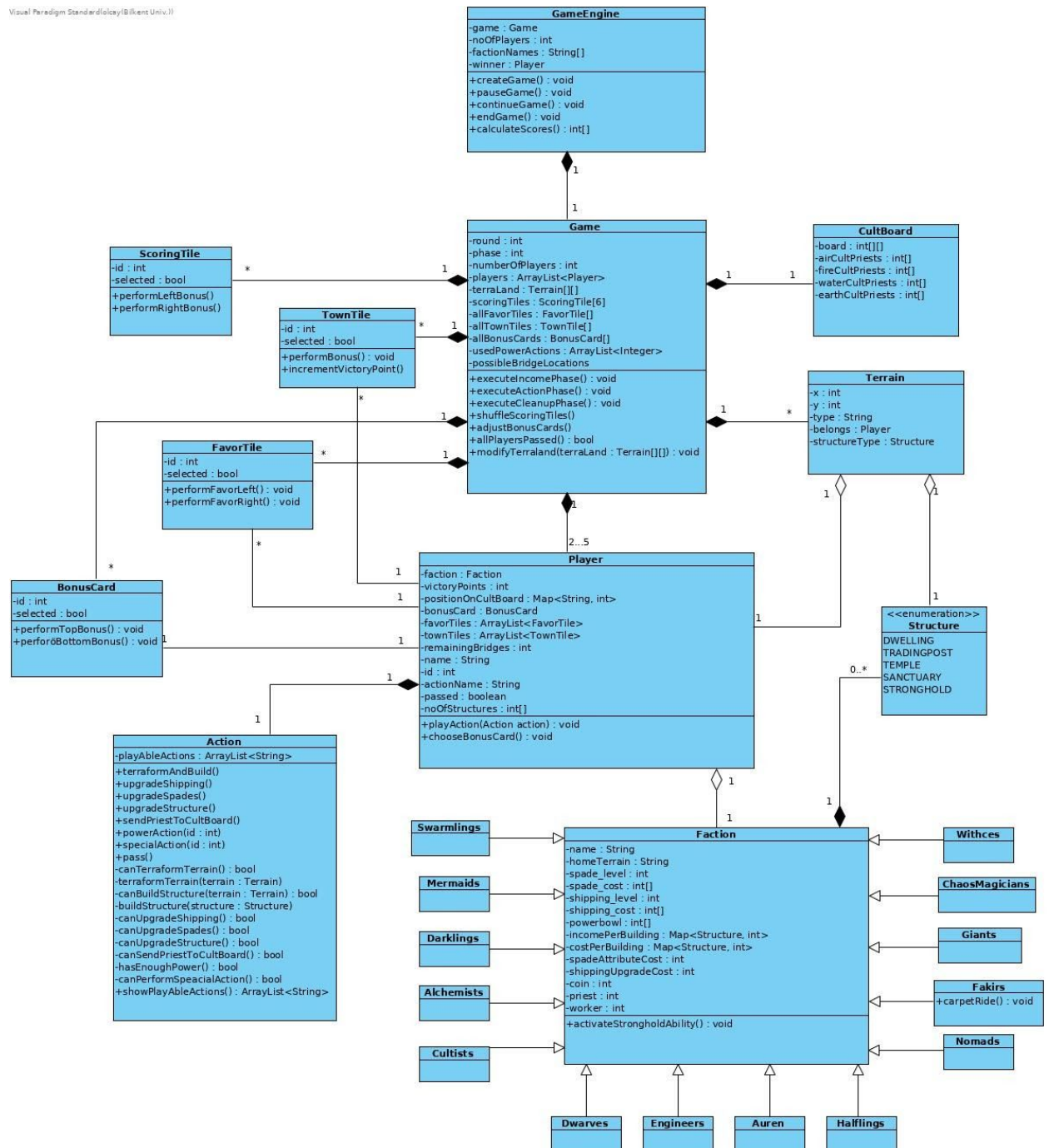
Sequence Diagram for Rounds



When the user starts the game, the Game object is going to do income phase, action phase and clean up phase for 6 rounds. In the Income Phase, Player object is going to be used for setting its worker, coin and priests. After the incomes are set, Game executes the Action Phase. This phase represents actions for one round and it is going to be executed until every player has passed. In this phase, there are going to be 7 actions. Terraform and build method is going to call Terrain object and it is going to set selong and change its owner with this method. Upgrade shipping and Upgrade Spade is going to call Faction and set their level of shipping and spade. Send Priest to CultBoard is going to call CultBoard object and set the level of player in the cult board that is chosen. Special Action method is going to call Favor Tile

or Bonus Card objects and they are going to do their perform methods. Pass is going back to Player for his/her bonus card for the next round. After all of the players have passed, GameEngine object is going to calculate victory points and set the winner of the game.

5.2.4. Class Diagram



The class diagram of Terra Mystica

GameEngine class: This class manages the entire game. It has the following properties and functions:

- game: Game. The Game class is explained below.
- noOfPlayers: int. Keeps the number of players.
- factionNames: String[]. Keeps the number of players in the game.
- winner: Player. Keeps the player who has won the game.
- createGame(): void. creates a game object
- pauseGame(): void. Is executed when the player pauses the game.
- endGame(): void. When the game ends, this function is called.
- calculateScores(): int[]. Called when the game is over, calculates the scores of each player and returns them in an array.

Game class: This class represents the game and its components, and is managed by the GameEngine class. It has the following properties and functions:

- round: int. Keeps what round the game is currently in.
- phase: int. Keeps what the current phase of the current round is.
- numberOfPlayers: int. The number of players playing the game.
- players: ArrayList<Player>. Keeps the player objects.
- terraLand: Terrain[[]]. Keeps all the terrains in the TerraLand in a graph data structure implemented by a 2D array/matrix.
- scoringTiles: ScoringTile[6]. Keeps the scoring tiles of all 6 rounds.
- allFavorTiles: FavorTile[]. Keeps the favor tiles stack.
- allTownTiles: TownTile[]. Keeps the town tiles stack.
- allBonusCards: BonusCard[]. Keeps the bonus cards stack.
- usedPowerActions: ArrayList<Integer>. Used to keep track of the power actions that have been used.
- possibleBridgeLocations.
- executeIncomePhase(): void. Executed at the beginning of each round to distribute income among players.
- executeActionPhase(): void. Executed at each round once, after the income phase. Allows the players to perform actions in turns.
- executeIncomePhase(): void. Executed as the last phase of each round.
- shuffleScoringTiles(): void. Shuffles the scoring tiles.
- adjustBonusCards(): void. Adjusts the bonus cards.
- allPlayersPasses(): bool. Returns a boolean value signaling whether all the players have passed or not.
- modifyTerraland(terraLand: Terrain[[]]): void. Takes the graph representation of the terraland nodes and their relations to modify it when necessary.

Player class: Represents a player of the game. It has the following properties and functions:

- faction: Faction. Holds the faction of the player.
- victoryPoints: int. Holds the current victory points of the player.
- positionOnCultBoard: Map<String, int>. Keeps the current position of the player on each lane of the cult board.
- bonusCard: BonusCard. The bonus card the player currently holds.
- favorTiles: ArrayList<FavorTile>. All the favor tiles the player holds.
- townTiles: ArrayList<TownTile>. All the town tiles the player holds.

- remainingBridges: int. The number of remaining bridges that the player can use.
- name: String. The name of the Player.
- id: int. The player id.
- actionName: String. The last action the player has played.
- passed: boolean. A boolean value that holds whether the player has passed or not.
- noOfStructures: int[]. Holds the number of each structure the player has.
- playAction(Action action): void. Allows the player to play the action specified.
- chooseBonusCard(): void. Lets the player choose a new bonus card.

Faction class: The Faction superclass as the parent of all factions. There are 14 different factions to be implemented as the child of this class. The superclass has the following properties and functions:

- name: String. The name of the Faction.
- homeTerrain: String. The home terrain of the faction.
- spadeLevel: int. The current spade level of the faction.
- spadeCost: int[]. The cost of upgrading spades for that function.
- shippingLevel: int. The current shipping level of the player.
- shippingCost: int[]. The cost of upgrading shipping for that faction.
- powerBowl: int[]. The amount of power the faction has on each one of the three power bowls.
- incomePerBuilding: Map<Structure, int>. The amount of income the faction will earn due to each building they own.
- costPerBuilding: Map<Structure, int>. The map of the cost of each building the faction can build/upgrade on the terralands.
- spadeAttributeCost: int. The cost of spade attribute.
- shippingUpgradeCost: The shipping upgrade cost.
- coin: int. The amount of coin the faction has.
- priest: int. The number of priests the faction has.
- worker: int. The number of workers the faction has.
- activateStrongholdAbility(): void. Allows the faction to activate the Stronghold ability they possess only if they have at least one stronghold built on the terralands.

The 14 child classes of the Faction superclass: Each of them are implemented with a common parent of Faction class. Each faction implements the methods and has the properties of the Faction superclass. These factions are:

- Witches
- ChaosMagicians
- Giants
- Fakirs
- Nomads
- Halflings
- Auren
- Engineers
- Dwarves

- Cultists
- Alchemists
- Darklings
- Mermaids
- Swarmlings

Action Class: This class represents the actions played by players throughout the game. It has the following properties and functions:

- playableActions: ArrayList<String>. Keeps the actions that are playable for that round.
- terraformAndBuild(). Allows the player to terraform and/or build (on) a terrain.
- upgradeShipping(). Allows the player to upgrade their shipping level.
- upgradeSpades(). Allows the player to upgrade their spade level.
- upgradeStructure(). Allows the player to upgrade one of their structures' level.
- sendPriestToCultBoard(). Allows the player to send a priest to any lane they prefer on the cult board.
- powerAction(id: int). Allows the player to play a power action by specifying the power action of choice by giving its id.
- speacialAction(id: int). Allows the player to play a special action by specifying the special action of choice by giving its id.
- pass(). By using this the player passes their turn for that round.
- canTerraformTerrain(): bool. Returns a boolean value saying whether they can terraform terrains or not by checking current coins and workers.
- terraforTerrain(terrain: Terrain). Terraforms the specified terrain on the Terraland to the hometerain of the player's faction.
- canBuildStructure(terrain: Terrain): bool. Returns a boolean value specifying whether the player can build a structure on a given terrain.
- buildStructure(structure: Structure, terrain: Terrain). Allows the player to build the specified building on the specified terrain.
- canUpgradeShipping(): bool. Returns a boolean value specifying whether the player can upgrade their shipping depending on their possessions.
- canUpgradeSpades(): bool. Returns a boolean value specifying whether the player can upgrade their spade level depending on their possessions.
- canUpgradeStructure(): bool. Returns a boolean value specifying whether the player can upgrade their structures depending on their possessions.
- canSendPriestToCultBoard(): bool. Returns a boolean value specifying whether the player can send a priest to the cult board depending on their possessions.
- hasEnoughPower(action: Action): bool. Returns a boolean value specifying whether the player has enough power for the action specified.

- `canPerformSpeacialAction(): bool`. Returns a boolean value specifying whether the player can perform a special action or not depending on their possessions.
- `showPlayableActions(): ArrayList<String>`. Returns an ArrayList containing the actions that can be played by the player that is calling it.

BonusCard class: This class represents a single bonus card object. It has two properties: `id` and `selected`, and two functions.

- `id: int`. Since there are unique bonus cards, it represents the `id` of a single card object.
- `selected: boolean`. A bonus card can only be used by a single player for each round. In order to prevent controversies, `selected` will hold if the card is selected by a player or not so that another player cannot be able to select it in the bonus card selection time.
- `performLeftBonus()`. Allows the player to perform the action to the left of the card.
- `performRightBonus()`. Allows the player to perform the action to the right of the card.

Favor Tile Class: This class represents a single favor tile object. It has the following properties:

- `id: int`. Since there are different favor tiles, `id` should be kept.
- `selected: boolean`. There are limited amounts of favor tiles for each. Thus, selection should be kept in order to prevent other people from selecting the owned cards.

Town Tile Class: This class represents a single town tile object. It has the following properties:

- `id: int`. Since there are unique town tiles, it represents the `id` of a single card object.
- `selected: boolean`. Since the town tiles are unique, this property should be kept in order to prevent other people from selecting the owned town tiles.

Scoring Tile Class: This class represents a single scoring tile object. It has the following properties.

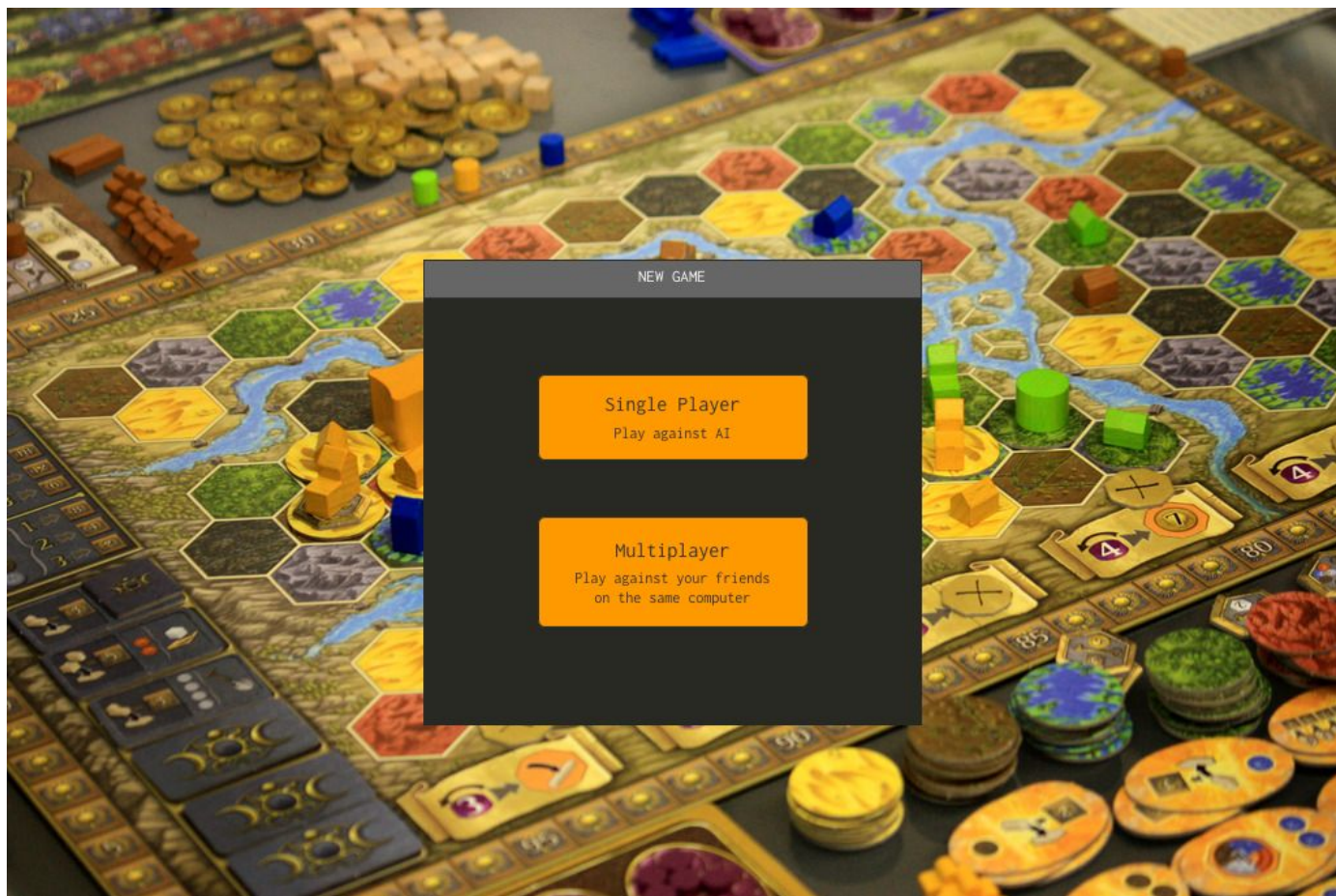
- `id: int`. Since there are unique scoring tiles, it represents the `id` of a single card object.
- `selected: boolean`. Since the town tiles are unique, this property should be kept in order to keep track of the cards since only six of them are selected for a single game.
- `performRigthBonus(): void`. performs the right bonus after each round is finished.
- `peformLeftBonus(): void`. performs the left bonus after each round is finished.

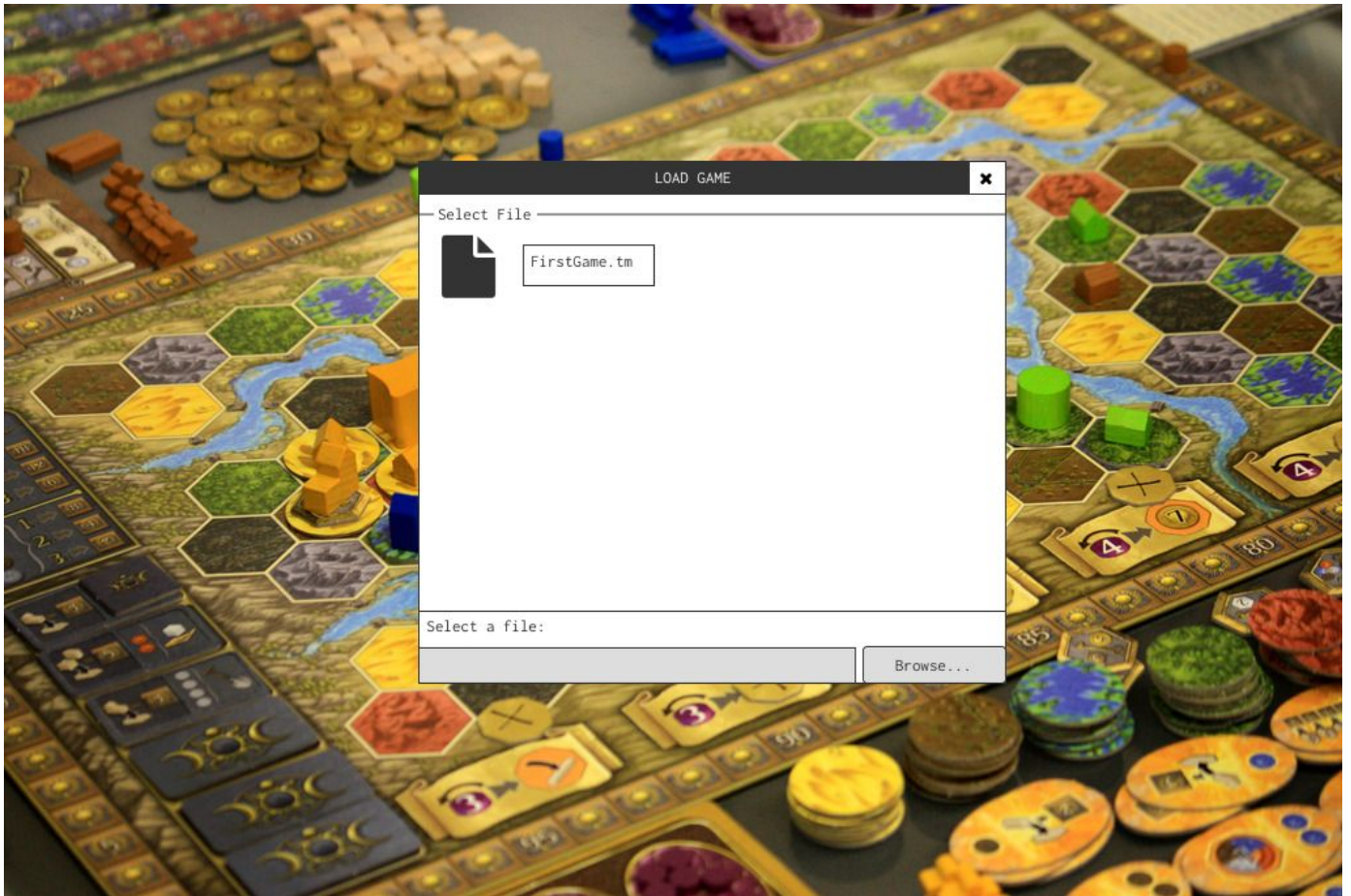
5.3. User Interface

5.3.1. Menu Structure



Menu structure can be inspected in an interactive way with its .pdf version, located at GitHub repository ([Interactive Menu Structure Mock-up.pdf](#)). Note that file must be downloaded for interaction to work properly.



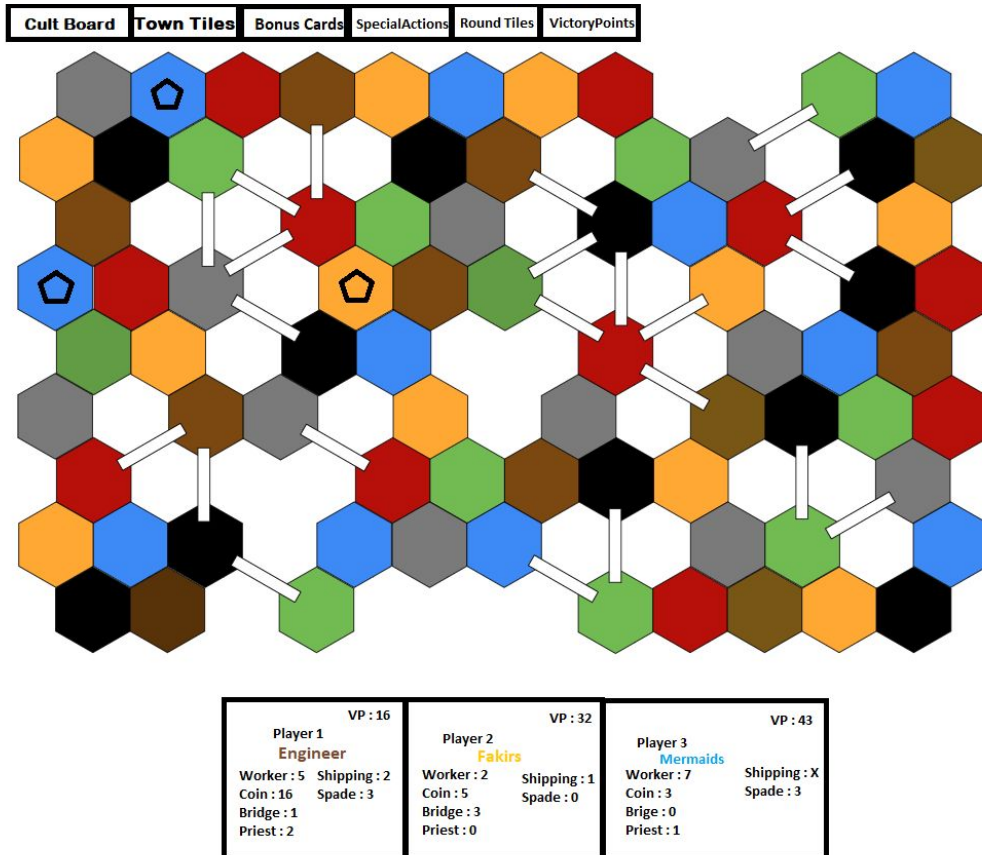








5.3.2. Gameplay



5.3.3 Cult Board

3	2	1	2	3	4	5	6	7	8	9	10
2	2										
3	2	1	2	3	4	5	6	7	8	9	10
2	2										
3	2	1	2	3	4	5	6	7	8	9	10
2	2										
3	2	1	2	3	4	5	6	7	8	9	10
2	2										

6. Glossary

Glossary for any domain-specific terms you use in your report.

7. References

[1] Object-Oriented Software Engineering, Using UML, Patterns, and Java, 2nd Edition, by Bernd Bruegge and Allen H. Dutoit, Prentice-Hall, 2004, ISBN: 0-13-047110-0.

[2] http://www.feuerland-spiele.de/dateien/Terra_Mystica_EN_1.0_.pdf

[3] <https://stonemaiergames.com/wp-content/uploads/2013/10/Terra-Mystica.jpg>