Bilkent University

Department of Computer Engineering

Object-Oriented Software Engineering Project

CS 319 1J-TM: Terra Mystica

Analysis Report

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Progress Report
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Contents

Analysis Report

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 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.

Overview

Game Elements

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.

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 both 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).

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.

Cultists

Cultists start the game with their income of three workers, fifteen coins and they have the advantage of one step beyond both on 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 their stronghold, they immediately gain seven victory points.

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.

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.

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 Terraland 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.

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 build 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.

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.

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.

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.

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.

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.

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.

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 powers and henceforth, they gain two powers for each spade that is obtained in any case.

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.

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.
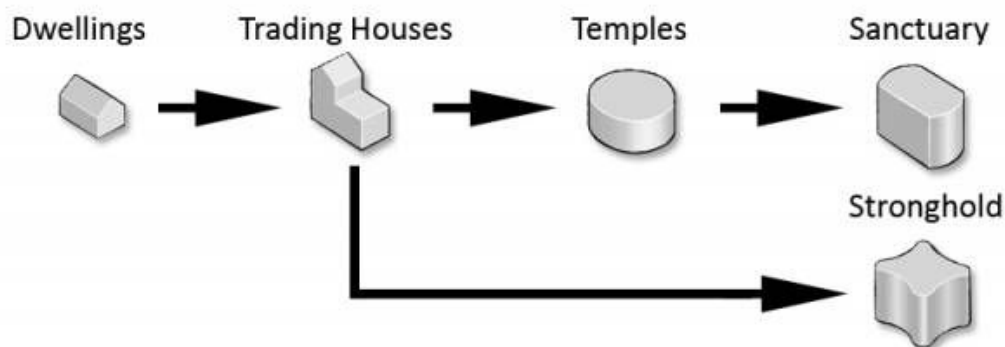
Coins

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

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.

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 II. 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 1.

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

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. Priests 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.

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.

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. For more information, see page 18 of the official game manual listed in References.
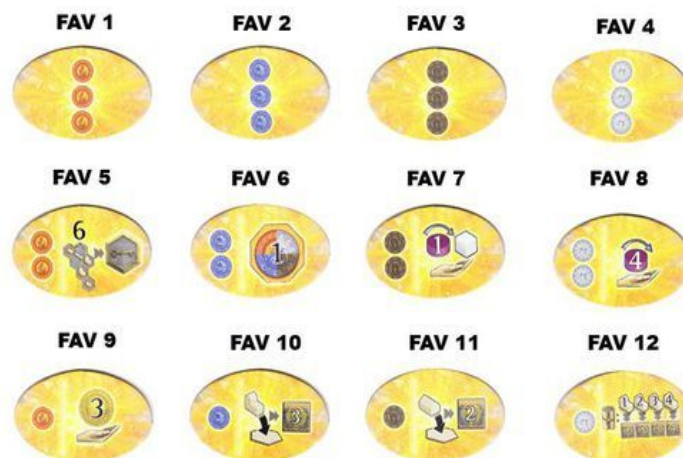
Town Tiles

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. For more information, see page 19 of the official game manual listed in References.

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. For more information, see page 18 of the official game manual listed in References.

Flow Of The Game

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.

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.

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

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.

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.

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.

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.

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.

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.

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.

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.

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 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.

End of The Game and Final Scoring

After the last action phase the 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.

Extra Features

Victory Map Expansion

In victory map there exist certain points that will enable players to earn some specific rewards, or cause them to lose any of their victory points. This condition will cause the players to take their actions more cautiously. For instance, a player may prefer to earn fewer victory points than he/she could, to be able to earn 3 workers since it will make the player earn more victory points in the long run. Similarly, if a player does not consider the point which will make him/her lose some victory points then the player will face the fact that he/she wasted his/her resources. This feature will make the game harder to play since it requires players to develop some sort of extra strategy.

Surrounded by the Other

When a player's terrain is surrounded by three adjacent territories of another player, the building on that terrain will be decreased by one level and if it is a simple dwelling, it will be destroyed. The attacker earns the loss of the victim. As a result, players should be more cautious about their terrains and towns. This feature adds another aspect to the competitive side of the game among players.

Saving the Game

Completing the game may sometimes take a long time. Players, on the other hand, may not have sufficient time to complete it. To solve this problem the game will have a save option which will save the current status of the game. Thus, players can later play the game where they have left.

Requirements

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.

Nonfunctional Requirements

User Interface

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

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.

Safety

System does not allow playing more than 2.5 hours in order to avoid endangering the health of players. When the time limit is reached, the screen is going to be frozen for 15 minutes and then become playable again.

Fault Tolerance

The system should automatically save the ongoing game at each state to prevent data loss in case of system crash or power failure.

Performance

The player should get a response from the system within a second in order to have a more convenient user experience.

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.

System Models

Use Case Model

There are 5 main use cases for the system and 12 main use cases for the gameplay. These are shown in different diagrams for clarity.

"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.

Every gameplay action (e.g., Upgrade Structure, Found Town, etc.) may not be available to the player at all times. So, the "Unavailable Action" use case extends all these different gameplay use cases.

System

Play Game

extension points
Pause Game
Save Game
Forfeit Game

<<Include>>

Choose
Number of
Players

<<Extend>>

Pause Game

<<Extend>>

Forfeit Game

<<Extend>>

Save Game

extension points
Insufficient Disk Space
Access Denied

<<Extend>>

Insufficient
Disk Space

<<Extend>>

Access
Denied

Player

Load Game

extension points
Corrupted File
Wrong File Format

<<Extend>>

Corrupted
File

<<Extend>>

Wrong File
Format

Display Game
Manual

Change Settings

See History

Game

Transform Terrain

extension points
Unavailable Action

Build Structure

extension points
Unavailable Action

Upgrade Shipping

extension points
Unavailable Action

Upgrade Spade

extension points
Unavailable Action

Upgrade Structure

extension points
Unavailable Action

Send Priest

extension points
Unavailable Action

Do Power Action

extension points
Unavailable Action

Do Special Action

extension points
Unavailable Action

Pass

extension points
Unavailable Action

Convert Power

extension points
Unavailable Action

Select Bonus Card

extension points
Unavailable Action

Found Town

extension points
Unavailable Action

Unavailable
Action

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

<<Extend>>

Player

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 player specifications (Number of Players and Faction Types) to the Player.
3. The Player fills out the player specifications and submit it by activating the "Start Game" function.
4. GAME displays the game map and starts the game.
5. 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
6. 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.

Dynamic Models

Activity Diagram

Highlighted activity diagrams of the "Gameplay" activity for different scenarios can be found in the Appendix section of this document.
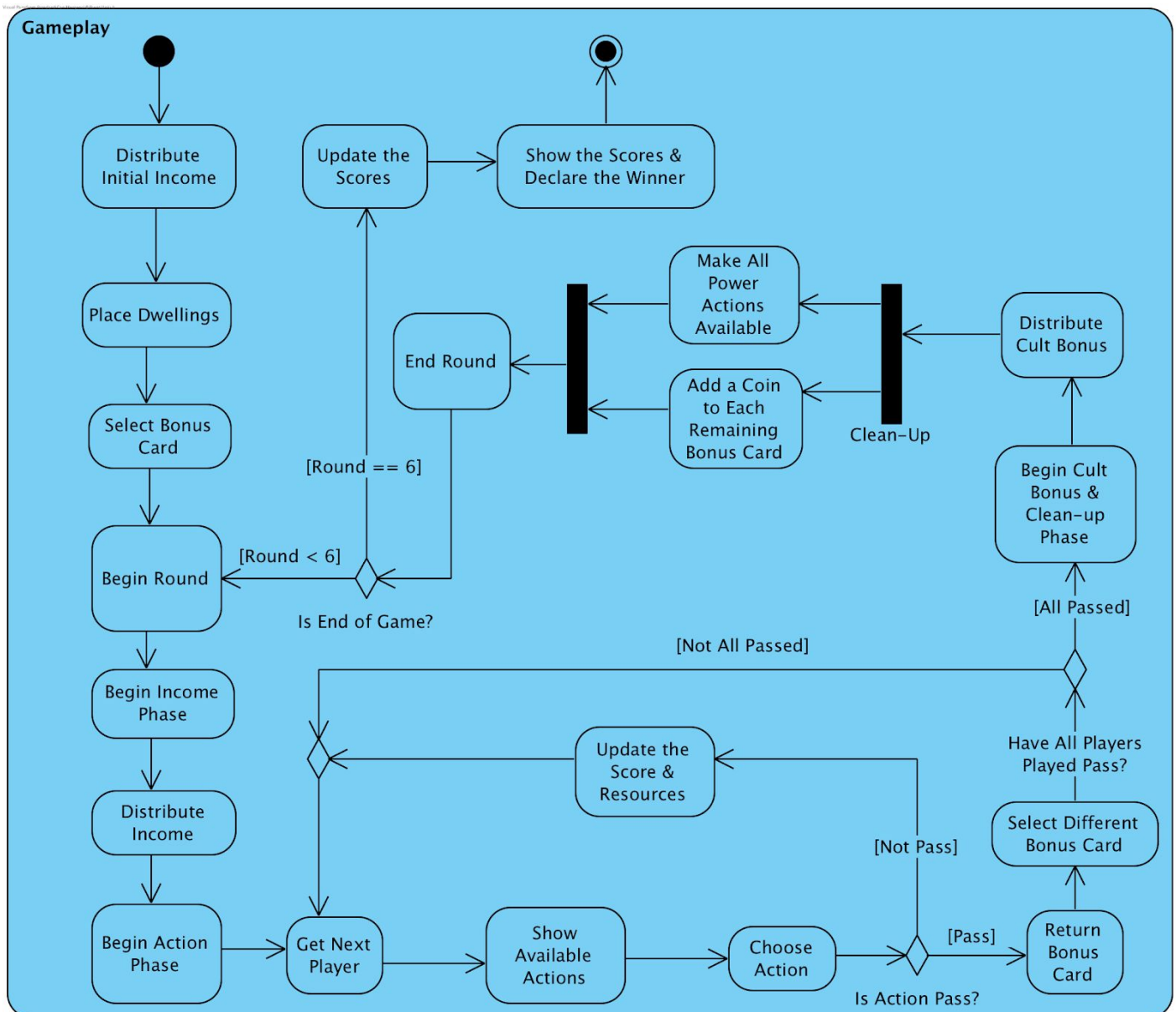
The game starts with the distribution of income to each player, based on their faction. Then, beginning with the starting player each player places a single dwelling on the faction board in turns, twice. Finally to round up the setup of the game, each player chooses a bonus card. This concludes the setup 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. 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. Score and resources of each player is updated after they take an action different from the 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 by showing the score of each player and declaring the winner. If the 6th round has not been reached yet, the next round begins with its income phase.

State Machine Diagram
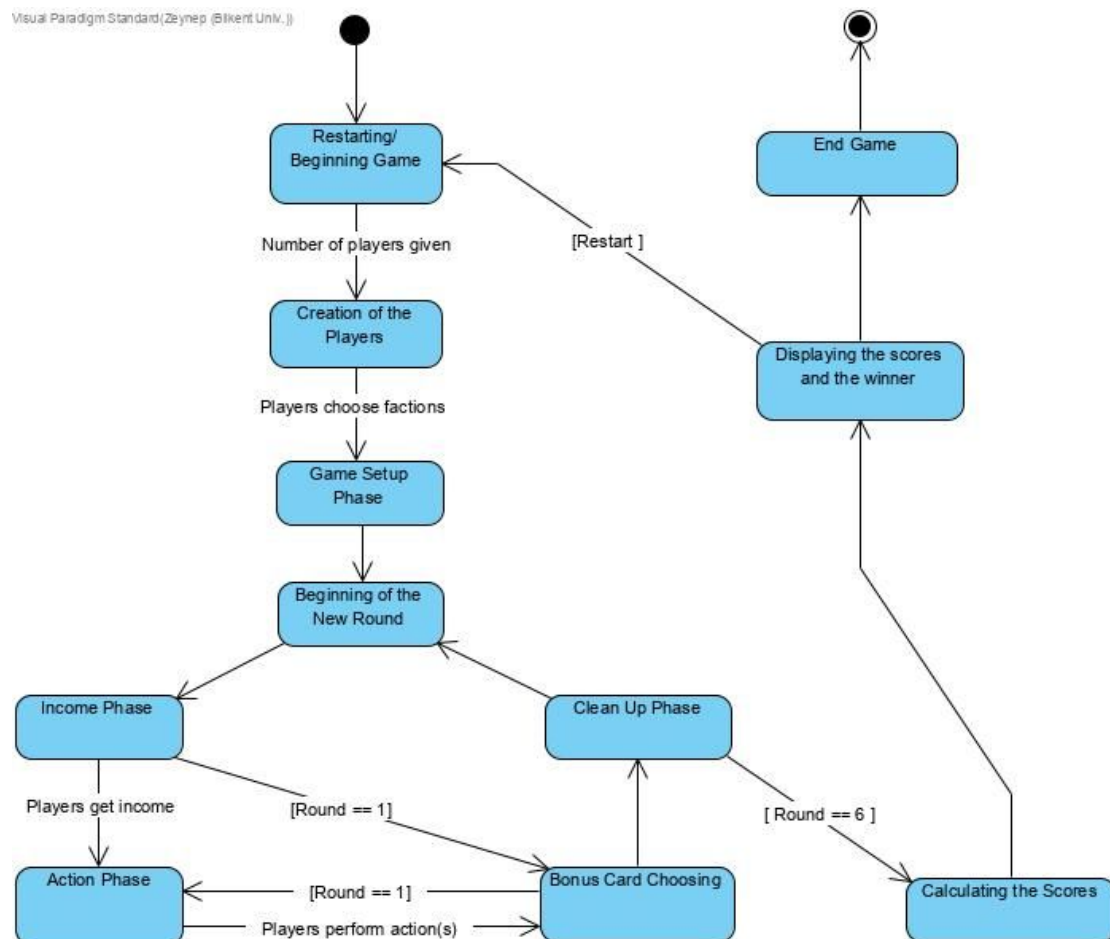
When the game is started or restarted, the program waits for the number of players to be given by the user. Once the number of players is determined, the program moves to the state of creating players. After each player chooses a faction to play, the game setup phase begins. The details of what happens 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.After the Beginning of the New Round, program executes the phase 1 which is called Income Phase. In this state the program waits for each player to get their income. Depending on the value of the round, the program either moves to the Bonus Card Choosing state (only happens in round one), or the phase two state which is the Action Phase in which it waits for each player to perform action(s). After each player has finally performed the pass action, players choose their new bonus cards at Bonus Card Choosing state. After all players performed pass action and chose their bonus cards, the Clean Up phase began. After phase three, if the round number is not six, the program executes a new round by moving to the Beginning of the New Round. If in phase three state (Clean Up Phase) 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.

Sequence Diagrams
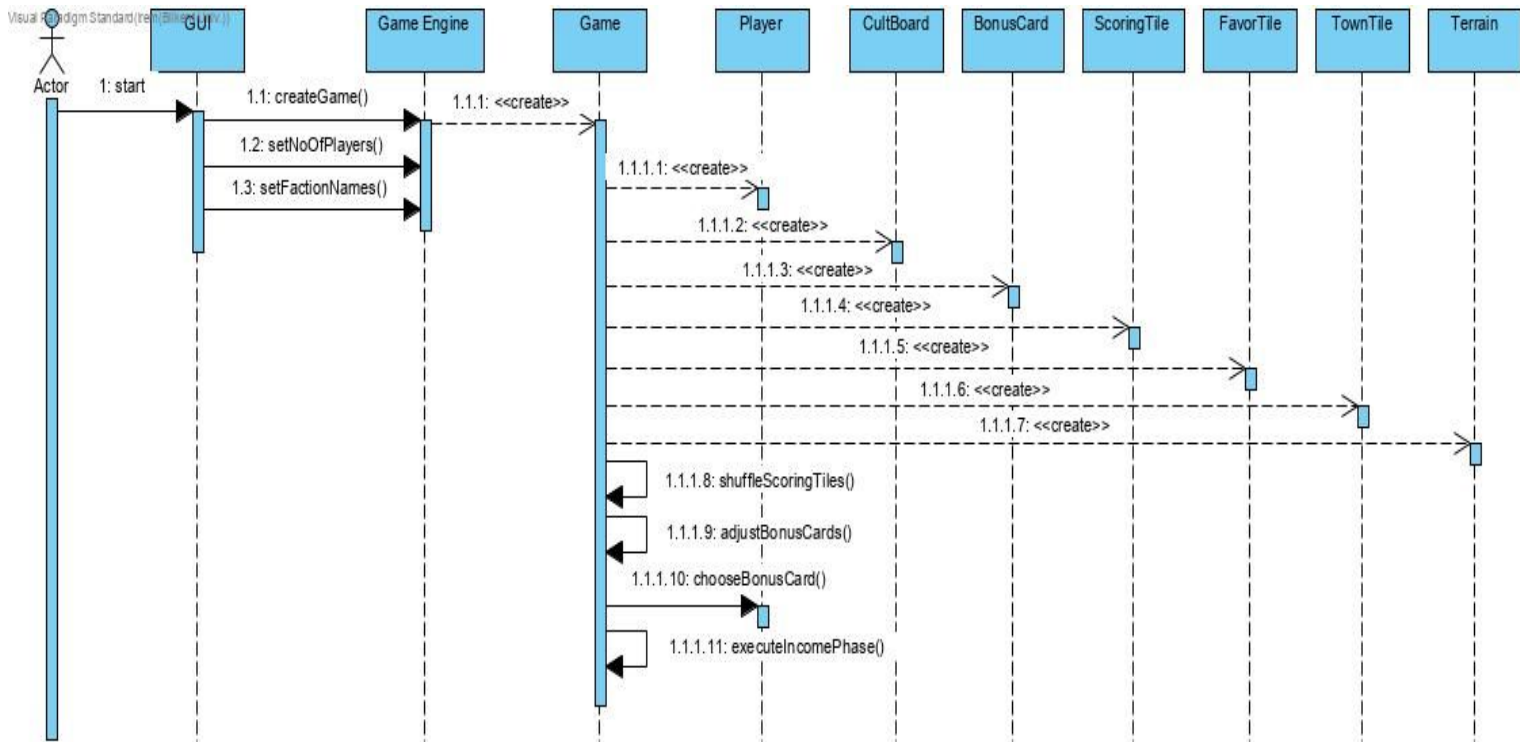
Initializing Game

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 objects 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.
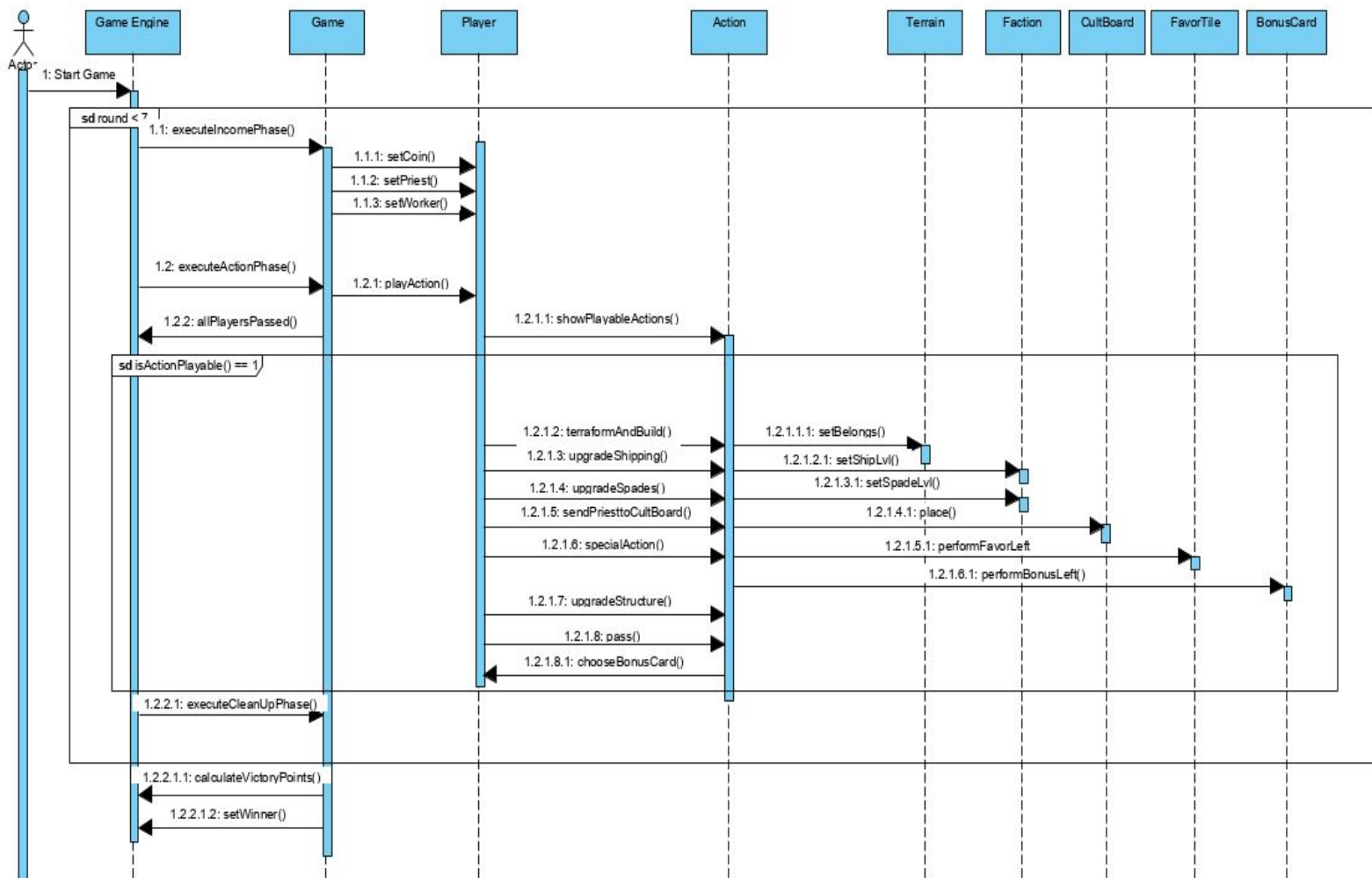
Rounds

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, the Player object is going to be used for setting its worker, coin and priests. After the incomes are set, the 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. The 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 declare the winner of the game.

Class Model

GameEngine
-game : Game
-noOfPlayers : int
-faction : Faction[]
-players : Player [noOfPlayers]
+createGame() : void
+pauseGame() : void
+continueGame() : void
+endGame() : void
+calculateScores() : int[]
+declareWinner(scores : int[]) : Player
+saveGame()
+loadGame()

CultBoard
-board : HashMap<String, int[]>
-airCultPriests : int[]
-fireCultPriests : int[]
-waterCultPriests : int[]
-earthCultPriests : int[]
+placePriest(priest : String, location : int)

ScoringTile
-id : int
-selected : bool
+performLeftBonus()
+performRightBonus()

Game
-round : int
-phase : int
-numberOfPlayers : int
-players : ArrayList<Player>
-terraLand : Terrain[][]
-scoringTiles : ScoringTile[6]
-allFavorTiles : FavorTile[]
-allTownTiles : TownTile[]
-allBonusCards : BonusCard[]
-usedPowerActions : ArrayList<Integer>
-possibleBridgeLocations : int[][]
+executeIncomePhase() : void
+executeActionPhase() : void
+executeCleanupPhase() : void
+shuffleScoringTiles()
+adjustBonusCards()
+allPlayersPassed() : bool
+modifyTerraland(terraLand : Terrain[][]) : void

TownTile
-id : int
-selected : bool
+performBonus() : void
+incrementVictoryPoint()

Terrain
-x : int
-y : int
-belongs : Player
-structureType : Structure
-type : TerrainType
+setBelongs(Player) : void
+setStructureType(Structure) : void

FavorTile
-id : int
-selected : bool
+performFavorLeft() : void
+performFavorRight() : void

<<enumeration>> Structure
DWELLING
TRADINGPOST
TEMPLE
SANCTUARY
STRONGHOLD

Player
-faction : Faction
-victoryPoints : int
-positionOnCultBoard : Map<String, int>
-bonusCard : BonusCard
-favorTiles : ArrayList<FavorTile>
-townTiles : ArrayList<TownTile>
-remainingBridges : int
-name : String
-id : int
-passed : boolean
-noOfStructures : int[]
-action : ActionHandler
+playAction(actionID : int) : void
+chooseBonusCard() : void

BonusCard
-id : int
-selected : bool
+performTopBonus() : void
+performBottomBonus() : void

ActionHandler
+terraformAndBuild() : void
+upgradeShipping() : void
+upgradeSpades() : void
+upgradeStructure() : void
+sendPriestToCultBoard() : void
+powerAction(id : int)
+specialAction(id : int)
+pass() : void
-canTerraformTerrain() : boolean
-terraformTerrain(terrain : Terrain)
-canBuildStructure(terrain : Terrain) : boolean
-buildStructure(structure : Structure)
-canUpgradeShipping() : boolean
-canUpgradeSpades() : boolean
-canUpgradeStructure() : boolean
-canSendPriestToCultBoard() : boolean
-hasEnoughPower() : boolean
-canPerformSpeacialAction() : boolean
+showPlayableActions() : void

Faction
-name : String
-homeTerrain : String
-spadeLevel : int
-spadeCost : int[]
-shippingLevel : int
-shippingCost : int[]
-powerbowl : int[]
-incomePerBuilding : Map<Structure, int>
-costPerBuilding : Map<Structure, int>
-spadeAttributeCost : int
-shippingUpgradeCost : int
-coin : int
-priest : int
-worker : int
+activateStrongholdAbility() : void
+setSpadeLevel(spadeLevel : int) : void
+performSpecialAbility() : void

Swarmlings
Mermaids
Darklings
Alchemists
Cultists

Withces
ChaosMagicians
Giants
Fakirs
Nomads
Halflings
Dwarves
Engineers
Auren

Required Classes:

GameEngine: This class manages the overall gameplay. It creates, pauses, saves and loads the game. Finally when the game is over, it calculates the scores of each player in the game and declares the winner of the game. The GUI will interact with the Game Engine class instead of the Game class whenever in need.

Game: This class represents the game and its components. It contains the players of the game, the Terraland, the Favor, Scoring and Town Tiles in addition to the Bonus Cards. It also contains the Cult Board. The goal of this class was to represent the

components that would be on the table, in the board game. It is also responsible for the flow of the game, as it executes the three main phases (Income, Action, Cleanup) with its functions.

Player: Represents a player of the game. It was necessary to hold the information about a player such as his position on the Cult Board tracks, the number of structures they have and the Faction that they chose. This class also have a method to perform actions in the Action Phase of the game, and to choose a Bonus Card in the Setup of the Game and after performing a "pass" action.

Faction: The Faction superclass as the parent of all factions. There are 14 different factions to be implemented as the child of this class. It also holds the assets of a player, such as their coins, workers, priests. It also keeps track of the power tokens in the powerbowls, which are also on the Faction Boards in the boardgame.
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

ActionHandler: The methods of this class must provide the player with all of the eight actions that they can possibly play. It will be used to display and execute the playable actions to the players.

BonusCard: This class represents a single Bonus Card. Like in the board game it has to be able to give the top and bottom bonuses to the player that chose the card. Each card has a unique bonus and there are nine bonus cards in Terra Mystica.

Favor Tile: This class represents a single Favor Tile. Each favor tile has unique left and right favors. There are twelve unique Favor Tiles that make up to twenty eight total Favor Tiles.

Town Tile: Represents a single Town Tile. Each Town Tile has its unique bonus. There are ten town tiles in total. This class should also be able increase the victory point of the Player by a specific amount.

Scoring Tile: Represents a single Scoring Tile. Each scoring tile has distinct left and right bonuses that are given in the Action Phase and the Cleanup Phase, respectively.

User Interface

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 the file must be downloaded for interaction to work properly.

NEW GAME ✖

Number of Players: 5 ⬍

Name:	Player 1	Choose Faction ▼
Name:	Player 2	Choose Faction ▼
Name:	Player 3	Choose Faction ▼
Name:	Player 4	Choose Faction ▼
Name:	Player 5	Choose Faction ▼

Start Game

SAVE GAME ✖

Select Location

📄 FirstGame.tm

Select Location:

Browse...

Enter name   Save

LOAD GAME

Select File

FirstGame.tm

Select a file:

Browse...

GAME MANUAL

TERRA MYSTICA

A GAME FOR 2-5 PLAYERS AGED 12 AND UP BY
HELGE OSTERTAG AND JENS DRÖGEMÜLLER

RULE BOOK

SETTINGS

Audio Settings

Video Settings

Main Menu

HISTORY   X

Finished Game Statistics

Game #1
    Number of Players: 2
    Player 1: Witches (56 points)
    Player 2: Nomads (72 points) - WINNER

Overall Statistics

Games Played: 2
Games Finished: 1

Average Victory Points Earned: 64

Quit

Are you sure?

| Yes | No |

GAME PAUSED

Resume Game

Save Game

Forfeit Game

Gameplay

Game Board

| Cult Board | Town Tiles | Bonus Cards | SpecialActions | Round Tiles | VictoryPoints |

	VP : 16		VP : 32		VP : 43
	Player 1		Player 2		Player 3
	Engineer		**Fakirs**		**Mermaids**
Worker : 5	Shipping : 2	Worker : 2	Shipping : 1	Worker : 7	Shipping : X
Coin : 16	Spade : 3	Coin : 5	Spade : 0	Coin : 3	Spade : 3
Bridge : 1		Bridge : 3		Brige : 0	
Priest : 2		Priest : 0		Priest : 1	

Cult Board
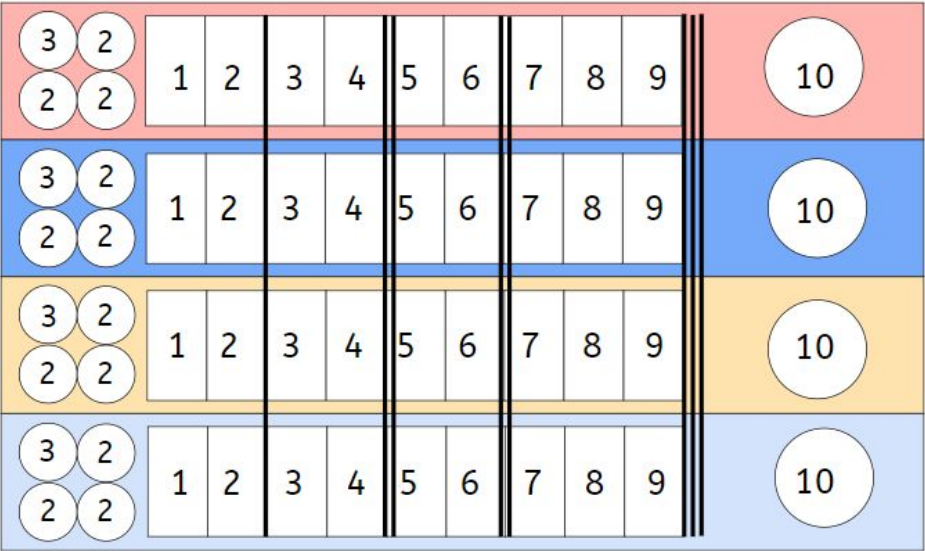
Improvement Summary

Document Format

- Indentation for each subheading was removed since it caused too much blank space in the document. Heading styles were reformatted so that they can be distinguished more easily from each other. Line spacing was reduced from 1.5 to 1.15 for normal text.

Extra Features

- Extra features section was added. It includes the features that normally were not included in the traditional gameplay but rather be included in this version.

Requirements

Nonfunctional Requirements

- Safety, fault tolerance, and performance were added as additional nonfunctional requirements.

System Models

Use Case Model

- Use case diagrams of the game and the system were separated. Use case diagram for the system "subject" shows how players interact with the s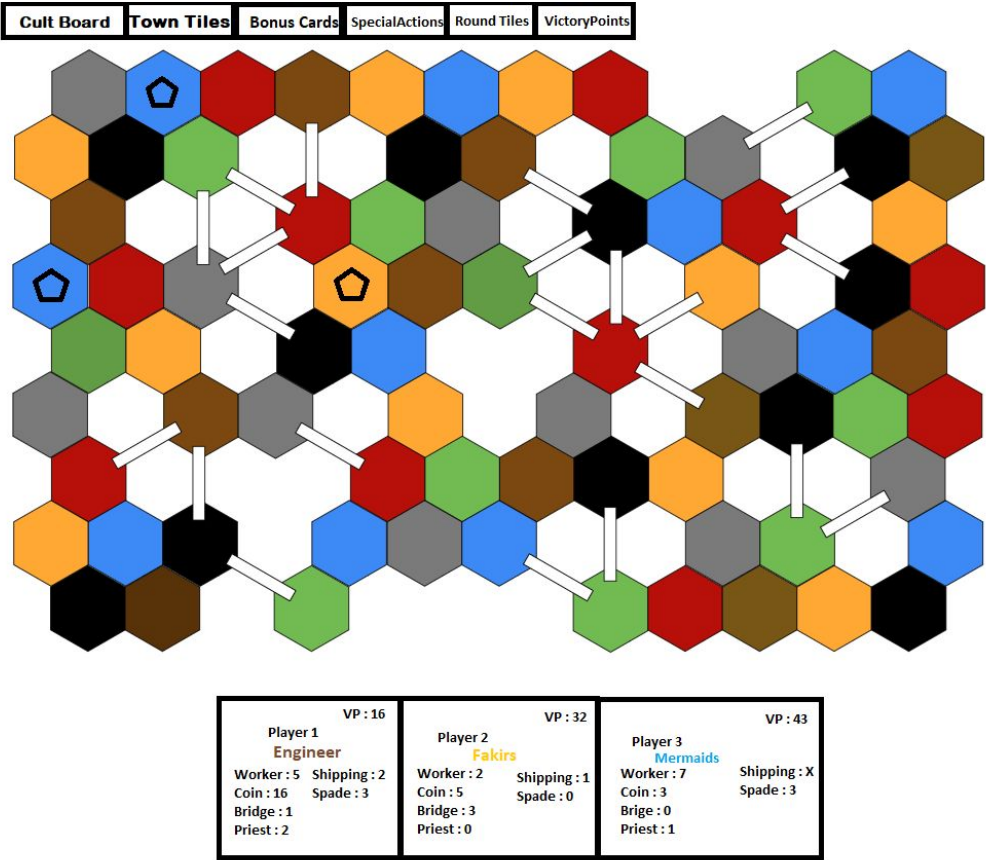ystem (e.g., playing a game, loading a game, displaying the game manual, etc.). Use case diagram for the game "subject" shows how players interact with the game during the gameplay (e.g., building structure, transforming terrain, etc.).
- "Play Single Player Game" and "Play Multiplayer Game" use cases were removed as there is not much time left to implement different game options. So, there will be only one game that can be played with multiple real players on the same computer.

Dynamic Models

Activity Diagram

- Activity Parameter Node "Game" and Object Node "Player" were removed from the activity diagram to increase the understandability of the diagram for the client.
- New action node was added after the "Is Action Pass?" decision node. It updates the resources and score of each player.
- Two new action nodes were added just before the Activity Final Node. First action is updating the score of each player. Second action is showing the scores of each player and declaring the winner at the end of the game.
- Highlighted activity diagrams were added to the Appendix Section for different scenarios.

State Machine Diagram

- Phase names in the diagram are updated such as "Phase 1" to "Income Phase" in order to make it a more understandable diagram for the client.
- The errors of the state names at the first iteration are corrected and more accurate names are given.
- The location of the Bonus Card Choosing state is corrected and executed after the Action Phase.

User Interface

- Menu Structure Mockups were updated to reflect the latest changes.

Class Model

- The methods that were more related to the solution domain, such as the constructors, accessor and mutator methods were removed.
- Number of Terrains, Favor Tiles, Scoring Tiles, Bonus Cards and Town Tiles were added to the diagram according to the feedback of the TA.
- Using Abbot's technique, the sentences Player **has** Favor Tile or Player **has** Town Tile indicate that there should be a composite relation between Player and Favor Tile, Town Tile, Bonus Card classes.
- In the first iteration, the descriptions of the classes included the details about the methods and their logic, which is in the scope of the design report. Therefore, the descriptions of the classes were updated into brief descriptions about their purpose and what it represents in the board game.

References

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Visual Paradigm. (2020). *Visual Paradigm Standard* (Version 16.1). Visual Paradigm International. https://www.visual-paradigm.com/editions/standard/

Ostertag, H., & Drögemüller J. (n.d.). *Terra Mystica Rule Book.* Feuerland Spiele. http://www.feuerland-spiele.de/dateien/Terra_Mystica_EN_1.0_.pdf

Object Management Group. (2017, December) OMG Unified Modeling Language. https://www.omg.org/spec/UML/2.5.1/PDF

Appendix

Highlighted Activity Diagrams

Action Phase with Passing

Gameplay

- Distribute Initial Income
- Place Dwellings
- Select Bonus Card
- Begin Round
- Begin Income Phase
- Distribute Income
- Begin Action Phase
- Get Next Player
- Show Available Actions
- Choose Action

Is Action Pass?
- [Pass] → Return Bonus Card → Select Different Bonus Card
- [Not Pass] → Update the Score & Resources

Have All Players Played Pass?
- [All Passed] → Begin Cult Bonus & Clean-up Phase → Distribute Cult Bonus
- [Not All Passed]

Clean-Up
- Make All Power Actions Available
- Add a Coin to Each Remaining Bonus Card

End Round

Is End of Game?
- [Round < 6]
- [Round == 6] → Update the Scores → Show the Scores & Declare the Winner

Action Phase without Passing

Gameplay

Distribute Initial Income

Place Dwellings

Select Bonus Card

Begin Round

Begin Income Phase

Distribute Income

Begin Action Phase

Get Next Player

Show Available Actions

Choose Action

Is Action Pass?

[Not Pass]

Update the Score & Resources

[Pass]

Return Bonus Card

Select Different Bonus Card

Have All Players Played Pass?

[Not All Passed]

[All Passed]

Begin Cult Bonus & Clean-up Phase

Distribute Cult Bonus

Clean-Up

Make All Power Actions Available

Add a Coin to Each Remaining Bonus Card

End Round

Is End of Game?

[Round < 6]

[Round == 6]

Update the Scores

Show the Scores & Declare the Winner

End of Round

Gameplay

Distribute Initial Income

Place Dwellings

Select Bonus Card

Begin Round

Begin Income Phase

Distribute Income

Begin Action Phase

Update the Scores

Show the Scores & Declare the Winner

Make All Power Actions Available

End Round

Add a Coin to Each Remaining Bonus Card

Clean-Up

Distribute Cult Bonus

Begin Cult Bonus & Clean-up Phase

[Round == 6]

[Round < 6]

Is End of Game?

[All Passed]

[Not All Passed]

Have All Players Played Pass?

Update the Score & Resources

Select Different Bonus Card

[Not Pass]

[Pass]

Return Bonus Card

Get Next Player

Show Available Actions

Choose Action

Is Action Pass?

End of Game

Gameplay

Distribute Initial Income

Place Dwellings

Select Bonus Card

Begin Round

Begin Income Phase

Distribute Income

Begin Action Phase

Update the Scores → Show the Scores & Declare the Winner

Make All Power Actions Available

End Round

Add a Coin to Each Remaining Bonus Card

Clean-Up

Distribute Cult Bonus

Begin Cult Bonus & Clean-up Phase

[Round == 6]

[Round < 6]

Is End of Game?

[All Passed]

[Not All Passed]

Have All Players Played Pass?

Select Different Bonus Card

Update the Score & Resources

[Not Pass]

Get Next Player → Show Available Actions → Choose Action

[Pass]

Return Bonus Card

Is Action Pass?