



---

## Development of the Portfolio Management Game

---

### Master Project

UNIVERSITY OF ZURICH - DEPARTMENT OF BANKING AND FINANCE

#### Authors:

ROLAND SCHLÄFLI - ROLANDSCHLAEFLI@GMAIL.COM

PASCAL ZEHNDER - PASCAL\_ZEHNDER@OUTLOOK.COM

#### Supervisor IFI:

PROF. DR. CHAT WACHARAMANOTHAM

#### Supervisors DBF:

DR. BENJAMIN WILDING, ANJA ZGRAGGEN

# **Contents**

<b>1. Motivation</b>	<b>1</b>
<b>2. Project Description</b>	<b>1</b>
<b>3. Methodology</b>	<b>1</b>
3.1. Requirements Engineering . . . . .	2
3.2. User Interviews . . . . .	2
3.3. Observation of Game Execution . . . . .	2
3.4. Design and Iterative Prototyping . . . . .	2
<b>4. Architecture</b>	<b>3</b>
4.1. Frontend . . . . .	3
4.2. API . . . . .	3
4.3. Model . . . . .	3
4.4. Continuous development . . . . .	3
<b>5. Market Model</b>	<b>3</b>
<b>6. Application Overview</b>	<b>3</b>
6.1. Administration . . . . .	3
6.1.1. Administrator login . . . . .	4
6.1.2. Game management . . . . .	4
6.2. Team View . . . . .	7
6.2.1. Login . . . . .	7
6.3. Period 0 decisions . . . . .	7
6.4. Other periods decisions . . . . .	8
6.4.1. TAA . . . . .	8
6.4.2. Depot Realization . . . . .	8
6.4.3. Business Administration . . . . .	8
<b>7. Future Development</b>	<b>9</b>
<b>A. Exemplary scenario</b>	<b>10</b>
<b>B. User Stories</b>	<b>10</b>

## 1. Motivation

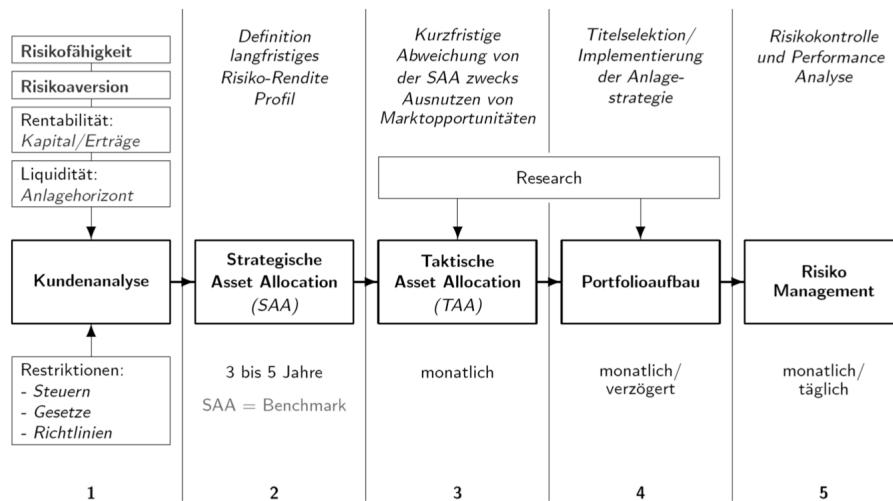
The Portfolio Management Game is a simulation thought to.....

Both members of the project team work at the Department of Banking and Finance UZH as web developers parallel to their studies achieving their Master's degree in Informatics. Both interested in developing applications from scratch and analyzing the procedure of financial processes. By re-developing the application the Department of Banking and Finance wants to achieve a sustainable simulation of a typical portfolio management process. The simulation should help the students within their learning process by focussing on practical decision making, building up on their theoretical knowledge.

## 2. Project Description

The "Portfolio Management Game" was initially developed in 2001 by an external company for the Department of Banking and Finance at the University of Zurich. This simulation of a portfolio manager was being used from the DBF over several years by multiple seminars of their department. A course named "Advanced Portfolio Seminar" has given insights to the portfolio management process for Master students by playing the game in between different rounds playing the game. For the final seminar of the "Executive Education" the game was being played for two days on Uetliberg with all the executive students.

The game has been deprecated by its implemented technologies and after each round the supervisors had to collect a USB-stick where all decisions of the students have been saved to. The supervisors had to collect this data for each group on a central device with administrative access (on a windows native application) to calculate the result of the teams decisions.



## 3. Methodology

Different tools helped us to understand a typical investment process to model the game best for a proper learning of the students. Those tools are described in this section.

### *3. Methodology*

#### **3.1. Requirements Engineering**

The typical requirements engineering builds the base of our engineering design process. By creating user stories we had a common basis to define the requirements together with our principals from the DBF. As usual when defining user stories we classified those stories into following three categories: Nice-to-have, Should-have, Must-have. Additionally they are structured into different functional or organizational parts. All the stories can be found in the appendix B.

#### **3.2. User Interviews**

By interviewing multiple individuals we got an insight into different practices during the investment process in different companies, such as Zürcher Kantonalbank and Credit Suisse. They have showed some screens of their internal applications which helped us to design the depot realization part of the students decisions.

#### **3.3. Observation of Game Execution**

The game observation was separated in following parts:

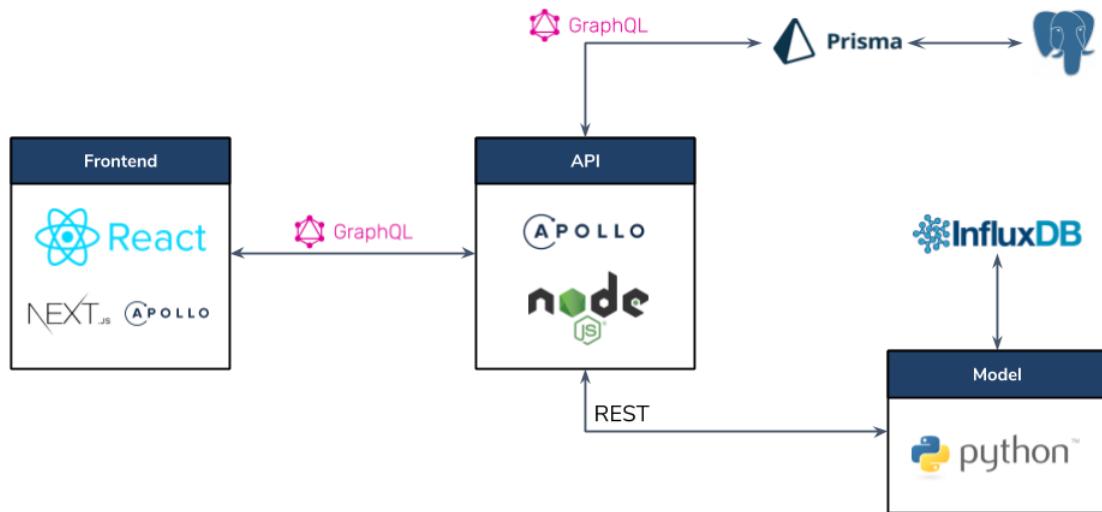
- Executive Education Students Observation during their final seminar at the Uetliberg
- Observation of different knowledge types in one room (Undergraduate studies, Graduate studies)
- Master Seminar: Advanced Portfolio Management Seminar

Multiple tools have been used by observing students playing the old game.

#### **3.4. Design and Iterative Prototyping**

Initially we designed some screens, using a sketching software, for the students process which includes the SAA, TAA, depot realization and business administration. As we realized that the game does not only consist of those screens we decided, due to time constraints, to start implementing screens by iterative prototyping.

## 4. Architecture



### 4.1. Frontend

We use the React Framework which is developed by Facebook. Based on NextJS.

### 4.2. API

Bla

### 4.3. Model

All calculations of the simulation are performed in a python-model which interacts with the time series data stored on an InfluxDB. A Restful service fetches the data from the model.

### 4.4. Continuous development

## 5. Market Model

## 6. Application Overview

For playing the game an administrator of a specified game and an infinite number of teams have to interact together for playing this simulation.

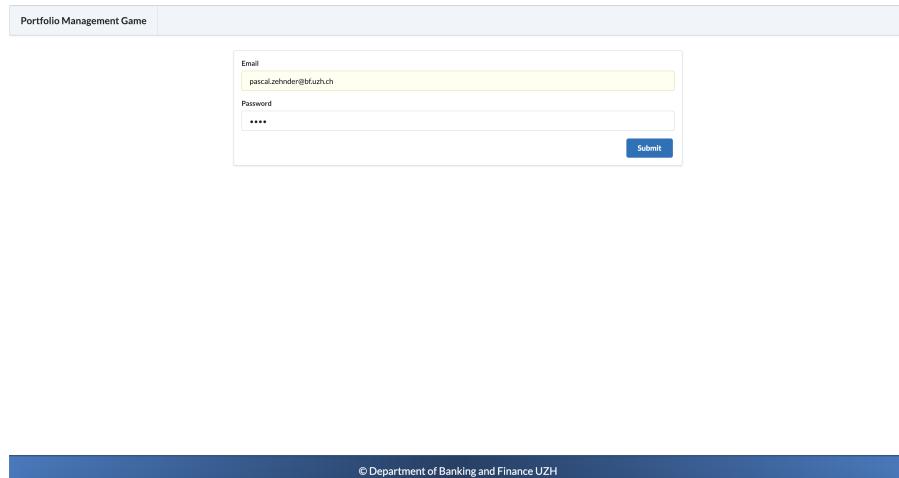
### 6.1. Administration

All administrative tasks will be described in this part.

## 6. Application Overview

### 6.1.1. Administrator login

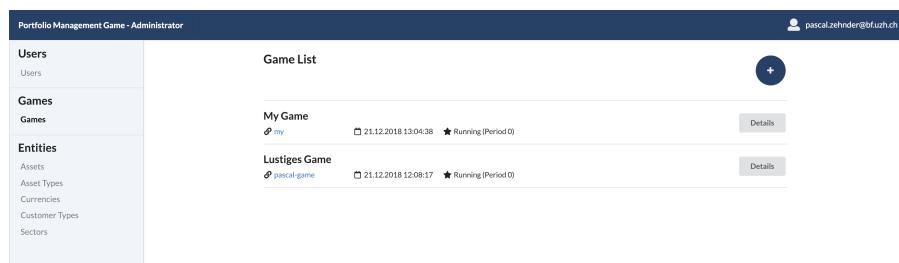
An administrator needs to have a login for having all administrative functionalities. Therefore he has to provide his credentials on the following screen which he reach by following the instructions on the start page.



The screenshot shows a login form titled "Portfolio Management Game". It contains fields for "Email" (pascal.zehnder@bfuzh.ch) and "Password" (\*\*\*\*), and a "Submit" button. Below the form is a copyright notice: "© Department of Banking and Finance UZH".

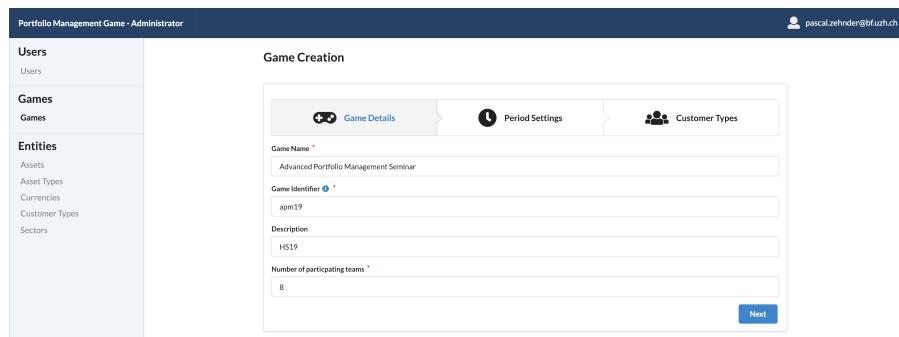
### 6.1.2. Game management

**Game overview** As landing page of the administrator the game overview exists. It serves as the control center of the game administration.



The screenshot shows the "Game List" section of the administrator interface. It displays two games: "My Game" (created by "my" on 21.12.2018 13:04:38) and "Lustiges Game" (created by "pascal-game" on 21.12.2018 12:08:17). Both are marked as "Running (Period 0)". A sidebar on the left lists "Users", "Games", and "Entities" categories.

**Game creation** For creating a game the administrator needs to define some parameters for playing a game which are structured into three tabs. By pressing on the "next"-button the administrator will be leaded through the form. Some tooltips help users to understand the purpose of the provided input. After submitting the creation of the game, the user will be redirected to the game overview.



The screenshot shows the "Game Creation" form. It consists of three tabs: "Game Details", "Period Settings", and "Customer Types". The "Game Details" tab is active and contains fields for "Game Name" (Advanced Portfolio Management Seminar), "Game Identifier" (apm19), "Description" (HS19), and "Number of participating teams" (8). A "Next" button is at the bottom right.

## 6.1. Administration

**Game detail** The game detail for each game may be accessed over the game overview list. In this page a user can initialize period, start periods, having an overview about the teams submission and many other features, which will be described in this part:

**Game initialization** As the game creation may be done in advance we have splitted the game creation from the game initialization, such that last adjustments of the game may be done just before the start of the game.

The screenshot shows the 'Game Details' section of the administration interface. It includes fields for 'Initial Customer Types' (set to 'Fixed Income'), 'Initial Customer Count' (set to '10000'), and a large green 'Initialize Game' button.

**Game start** By starting the game the students or teams are finally able to start with their period 0 decisions. Administrators are able to give them some help over messages which will be visible for the teams in their report section.

The screenshot shows the 'Game Identifier' (spmt19), 'Initial Customers' (10000), 'Simulation Type' (Historical), and 'Period Length' (30 days). It also displays the game timeline with three periods: Period 0 (SAA), Period 1, and Period 2. Below the timeline are sections for 'Economic Outlook' (Report) and 'Messages' (Add new message).

**Team overview** For providing access for all teams an administrator has an overview about the team logins, which are generated automatically when initializing the game.

The screenshot shows a table of team logins. There are 8 teams listed with their corresponding logins and passwords.

Team Name	Login	Password
Team 1	team1	Snd3l3qW
Team 2	team2	u2NNvD0X
Team 3	team3	9fFWwA74
Team 4	team4	hBPqpxMO
Team 5	team5	dsuWAmnD
Team 6	team6	YALRyRWE
Team 7	team7	hdITWxQJl
Team 8	team8	8DlvP1r4

**Running game** Overview about the submission state of all teams. The administrator is able to get an insight about the decisions of all submitted teams. The period can only be finished if all teams submitted and therefore the state of the teams has been green.

## 6. Application Overview

The screenshot shows the administrator interface for the Portfolio Management Game. On the left, a sidebar lists categories: Users, Games, Entities, and Teams. The main area displays game details: Game Identifier: apm19, Initial Customers: 10000, Simulation Type: Historical, Period Length: 30 days, and Start Date of Period 0: 2000-01-01. Below this is a timeline with three periods: Period 0 (SAA), Period 1, and Period 2. Under 'Teams', a list of teams is shown: Julius Bull (submitted 21.12.2018 17:49), Team 2, Team 3, Team 4, Students Kantonalbank (submitted 21.12.2018 17:51), Team 6, Team 7, and Team 8. A red 'Finish period' button is at the bottom right.

**Initializing period** After completion of period zero the administrator has to initialize a period in which the team decisions will be compared to the other teams decisions and evaluated. Additionally new customer types for the next period and other settings could be defined in this phase of the game.

The screenshot shows the administrator interface after initializing Period 1. The timeline now shows Period 0 (SAA) in green, and Period 1 and Period 2 in grey. A green 'Initialize period' button is visible at the bottom right.

**Period start** By completing the simulation, respectively evaluation of the previous period, a next period may be started. If the game is still paused the teams cannot access the decisions site. The administrator can define some optional messages which will be displayed in the teams report page. Some adjustments to the simulation results will be edited in this phase of the game.

The screenshot shows the administrator interface during Period 1. The timeline shows Period 0 (SAA) in green, and Period 1 and Period 2 in grey. The main area includes an 'Economic Outlook' section with a 'Report' link and a 'Messages' section. The 'Messages' section contains a form for adding guidance or misleading messages to the economic outlook of each team, with fields for 'Author' (CIO) and 'Content'. Buttons for 'Delete current message' and 'Add new message' are at the bottom, along with a 'Start Period' button.

## 6.2. Team View

### 6.2.1. Login

Student OR Teacher

apm19 Continue Login

© Department of Banking and Finance UZH

Team Login

team1

Password

\*\*\*\*\*

Submit

There could be some inconsistencies if your team makes their decisions on multiple devices. Ensure that only one logged in user finally decides about the teams choices. Reports may be viewed on multiple devices without any problems.

© Department of Banking and Finance UZH

## 6.3. Period 0 decisions

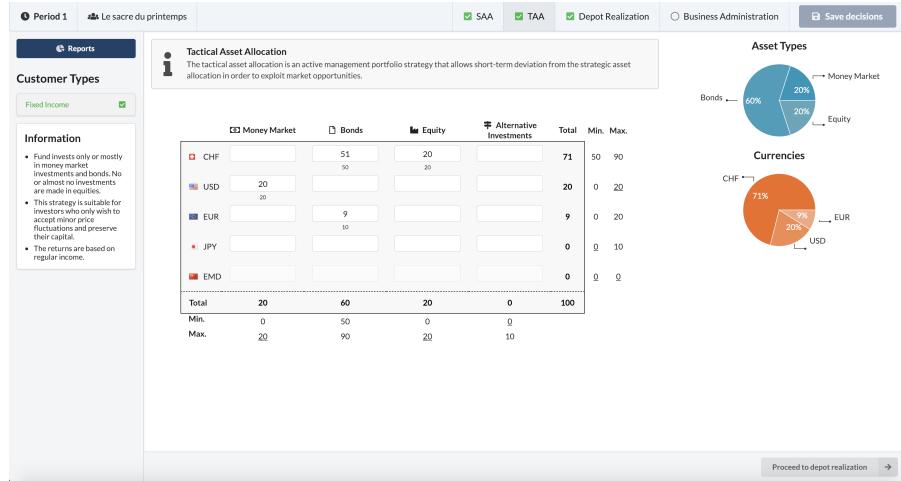
In period 0 which represents phase 1 of the game, the teams define their SAA for all customer types which are enabled by the administrator of the specific game. The teams need to fulfill the ranges for all dimensions to submit their decisions. Supportive graphs in form of pie charts help the teams to decide about the share of the two dimensions. Additionally the players can name their team on the top left corner of the screen.

	CHF	USD	EUR	JPY	EMD	Total	Min.	Max.
Money Market	10	30	20	0	0	60	50	90
Bonds	0	20	10	0	0	20	0	20
Equity	0	0	0	0	0	0	0	10
Alternative Investments	0	0	0	0	0	0	0	0
Total	20	60	20	0	0	100		
Min.	0	50	0	0	0			
Max.	20	90	20	10	0			

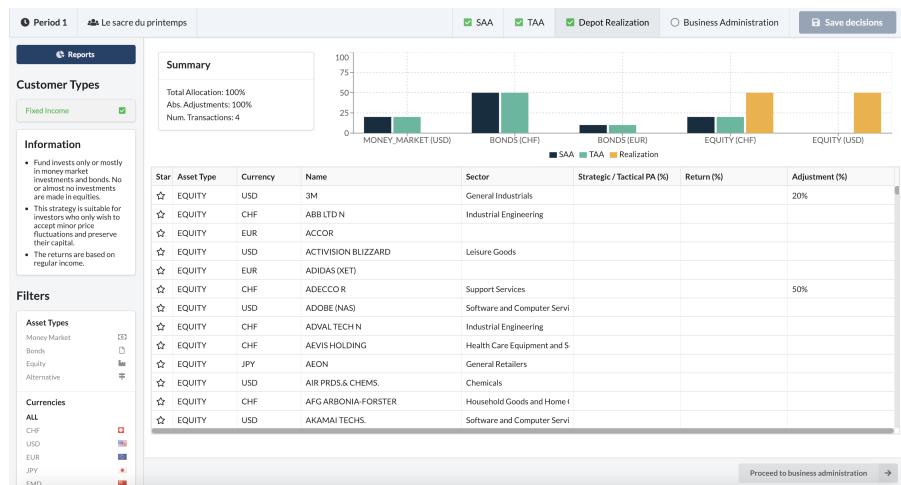
## 6. Application Overview

### 6.4. Other periods decisions

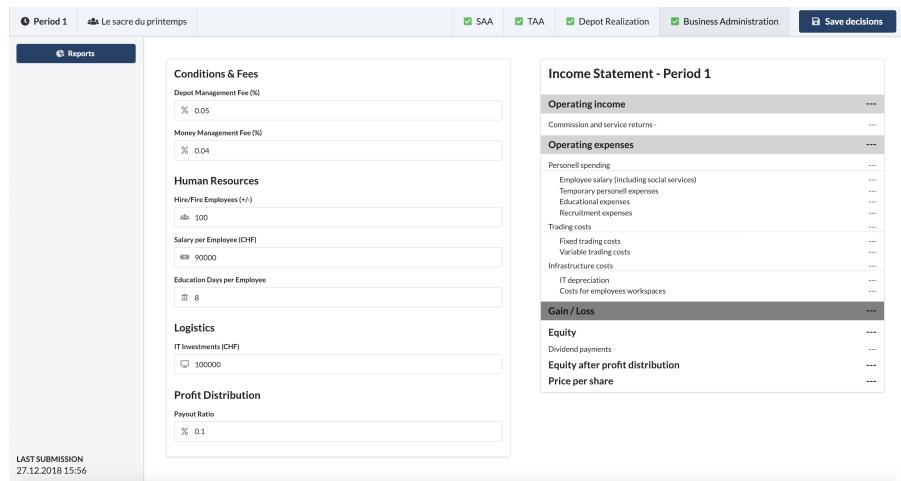
#### 6.4.1. TAA



#### 6.4.2. Depot Realization



#### 6.4.3. Business Administration



## **7. Future Development**

*B. User Stories*

**A. Exemplary scenario**

Followoing scenario should generalize an exemplary playing of the portflio management game:

**B. User Stories**

## General

<b>ID:</b> GE01	<b>Date:</b> 17.07.2018
<b>Name:</b> One login per team	
<b>Story:</b> As a game master, I want to be able to create one single login per participating team such that the participants are supported in their group work.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ Game masters can create team logins by creating a game</li> <li>✓ Teams can login with the credentials they received from the game master</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> GE02	<b>Date:</b> 13.08.2018
<b>Name:</b> Maintaining multiple logins with a single account	
<b>Story:</b> As a team of students, we would like to be able to sign in on multiple devices such that we can perform research and preparations independently.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ Multiple login sessions can be maintained with a single team account</li> <li>✓ Teams need to be appropriately informed about the possibility of inconsistencies due to multiple actions taken from different devices</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> GE03	<b>Date:</b> 13.08.2018
<b>Name:</b> Game master account creation	
<b>Story:</b> As the responsible person for the seminar I need to create different game master accounts such that multiple persons could overtake the lead of the game.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ A game master account can create new game master accounts</li> <li>✓ Multiple game master accounts may be created</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> GE04	<b>Date:</b> 16.10.2018
<b>Name:</b> Provisional hand-in of allocations	
<b>Story:</b> As a team of students, we would like to be able to save our current state	

provisionally, such that other members of the team can also see the current state on their device.

**Acceptance Criteria:**

- SAA, TAA, and Allocations can be imperatively saved to the database without needing to end the period
- After saving the state, other members of the team with the same active login can reload their application and see the new state

**Priority:** Must have

## Game Sessions

<b>ID:</b> SE01	<b>Date:</b> 13.08.2018
<b>Name:</b> Session creation	
<b>Story:</b> As a game master, I want to be able to create game sessions (multiple games) such that I can set up an execution of the game in advance.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ Game masters can initialize new game sessions</li> <li>✓ Teams can be created based on number of teams and assigned to any initialized game session</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> SE02	<b>Date:</b> 13.08.2018
<b>Name:</b> Customer profiles	
<b>Story:</b> As a game master, I would like to define and parametrize different customer profiles that students have to work with.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ The game master can define any number of customer profiles that students will need to account for</li> <li>✓ There are existing some predefined customer types</li> <li>✓ Each customer profile can be parameterized with regards to their acceptance ranges (upper and lower limits per customer profile)</li> <li>✓ Customer profiles can be enabled only after a certain number of rounds such that it is possible to start games with only one single type of customer (may be parametrized in advance)</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> SE03	<b>Date:</b> 13.08.2018
<b>Name:</b> Game execution	
<b>Story:</b> As a game master, I need to be able to explicitly start and continue sessions such that access is controlled and only available during the execution of the game.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ Initialized games can be started by the game master that created them (and only by them)</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> SE04	<b>Date:</b> 13.08.2018
<b>Name:</b> Session parametrization	
<b>Story:</b> As a game master, I want to be able to parametrize games such that I can introduce reasonable variance between different games and showcase different economic environments.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Sessions can be parameterized with respect to the execution of the game</li> <li><input type="checkbox"/> Sessions can be parameterized with respect to the simulation of stock market data (e.g., length and number of periods to simulate)</li> <li><input type="checkbox"/> Sessions can be parameterized with respect to the internal market model (i.e., its effective curves and indices)</li> <li><input type="checkbox"/> Sessions can be set to alternatively use periods of historical data instead of using the stock market simulation</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> SE05	<b>Date:</b> 13.08.2018
<b>Name:</b> Pausing and continuing sessions	
<b>Story:</b> As a game master, I would like to be able to pause and continue sessions in-between rounds, such that I can account for any unexpected events in a fair manner.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ Running sessions can be paused by the game master after a round is completed if all teams have submitted their decisions such that the students have some time pressure in the game</li> <li>✓ Paused sessions can be continued by the game master</li> <li>✓ After continuing a paused session, the next round can be started immediately</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> SE06	<b>Date:</b> 07.11.2018
<b>Name:</b> Parametrized Sessions - Scenarios	
<b>Story:</b> As a game master, I would like to choose from different predefined templates that represent different critical points in financial history	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Choose from multiple scenario templates within creation of the game</li> </ul>	
<b>Priority:</b> Nice to have	

<b>ID:</b> SE07	<b>Date:</b> 07.11.2018
<b>Name:</b> Add new customers	
<b>Story:</b> As a game master, I would like to have the possibility to add new customers for each Team after a period. This should be voluntary for each period.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"><li>✓ Game master can add a different number of new customers for each team</li><li><input type="checkbox"/> Game master can add a total summation of customers for every team</li></ul>	
<b>Priority:</b> Should have	

## Asset Allocation

<b>ID:</b> AP01	<b>Date:</b> 13.08.2018
<b>Name:</b> Defining a Strategic Asset Allocation (SAA)	
<b>Story:</b> As a team of participants, we need to be able to define an initial strategic asset allocation for the game based on the different types of customers that are available to us.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> An SAA can be defined before any of the game rounds are played (period 0)</li> <li><input type="checkbox"/> Once defined, the SAA provides a fixed point of reference for further rounds</li> <li><input type="checkbox"/> The SAA can be extended to new customer profiles if any are added later on</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> AP02	<b>Date:</b> 13.08.2018
<b>Name:</b> Defining a Tactical Asset Allocation (TAA)	
<b>Story:</b> As a team of participants, we need to be able to define our tactical asset allocation at the beginning of each round, so that we can adjust our long-term strategic plans.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> A new TAA can be specified for each round of the game and if the SAA is defined within boundaries for all categories</li> <li><input type="checkbox"/> While deciding on a TAA, the team is kept informed about their SAA and any ranges or game constraints they might not fulfill with their current allocation (e.g. max. 10% deviation from SAA)</li> <li><input type="checkbox"/> Deviation for TAA from SAA may be defined for each game with default of 10%</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> AP03	<b>Date:</b> 13.08.2018
<b>Name:</b> Portfolio realization	
<b>Story:</b> As a team of participants, we need to be able to allocate our funds to specific assets and markets, as we want to achieve the portfolio state we defined in our SAA and TAA.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Teams are able to distribute their funds on different asset categories based on their TAA decisions</li> <li><input type="checkbox"/> Teams can choose from different markets and currencies</li> <li><input type="checkbox"/> When investing in equity, teams can choose from different sectors of markets</li> <li><input type="checkbox"/> Teams are being appropriately informed about any constraints and ranges that</li> </ul>	

<p>need to be followed, as well as their self-defined SAA and TAA constraints</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Maximum deviation of a share should be defined when creating the game by the game master (e.g. max. 10% deviation per share in next round)</li> </ul>
<p><b>Priority:</b> Must have</p>

<b>ID:</b> AP04	<b>Date:</b> 13.08.2018
<b>Name:</b> Hedging foreign currencies	
<b>Story:</b> As a team of participants, we would like to be able to hedge our investments into foreign currencies such that we are not exposed to currency risks.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Investments in other currencies can be optionally hedged when realizing a depot</li> <li><input type="checkbox"/> Hedging incurs a reasonable cost</li> </ul>	
<b>Priority:</b> Should have	

<b>ID:</b> AP05	<b>Date:</b> 07.11.2018
<b>Name:</b> Define two phases for the game	
<b>Story:</b> As UI designer of the game we would like to define two phases of the game, whereas the first phase defines the initial SAA. In the second phase the teams can decide on their TAA, their depot realization and other business administration decisions.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Phase 1 enables the opportunity to define the initial SAA for each customer type</li> <li><input type="checkbox"/> In phase 2 the teams can decide on TAA, depot realization or other business administrative decisions</li> </ul>	
<b>Priority:</b> Must have	

## Business Administration

<b>ID:</b> BP01	<b>Date:</b> 13.08.2018
<b>Name:</b> Forecasting	
<b>Story:</b> As a team of participants, we would like to be able to generate forecasting reports based on our own estimates, such that we can evaluate our planned decisions without using additional tools (i.e., Excel).	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Teams can provide estimates for future parameters (e.g., customer counts)</li> <li><input type="checkbox"/> Based on their estimates and their input numbers, teams can generate a forecasting report that will show them some metrics about their decisions</li> </ul>	
<b>Priority:</b> Should have	

<b>ID:</b> BP02	<b>Date:</b> 13.08.2018
<b>Name:</b> Account balance	
<b>Story:</b> As a team of participants, we need to be able to see the balance of our accounts (i.e., assets under management), such that we can decide on how much money to spend in different expense categories.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> The necessary account balances are transparently visible to teams</li> <li><input type="checkbox"/> Expected investments for the current period are simulated in the account balance</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> BP03	<b>Date:</b> 13.08.2018
<b>Name:</b> Defining fees and conditions	
<b>Story:</b> As a team of participants, we need to be able to define the fees and conditions we offer to our customers, such that we can optimize our profits.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Fees and conditions can be defined for each customer type</li> <li><input type="checkbox"/> All-in pricing model can be chosen with a provided percentage</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> BP04	<b>Date:</b> 13.08.2018
-----------------	-------------------------

<b>Name:</b> Marketing, HR, and Logistics
<b>Story:</b> As developers of the simulation, we need to ensure that teams can distribute their money to different expense categories, such that we can appropriately simulate business-related expenses (like marketing, HR, and logistic).
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Teams can define their spend on marketing-related categories:           <ul style="list-style-type: none"> <li>- Marketing expenses for all different customer types</li> </ul> </li> <li><input type="checkbox"/> Teams can define their spend on HR-related categories:           <ul style="list-style-type: none"> <li>- Employments and suspensions of personal</li> <li>- Salary of employees (for each employee)</li> <li>- Bonus</li> <li>- Education days for an employees per year</li> </ul> </li> <li><input type="checkbox"/> Teams can define their spend on logistics-related categories:           <ul style="list-style-type: none"> <li>- Investments in IT</li> </ul> </li> </ul>
<b>Priority:</b> Must have

<b>ID:</b> BP05	<b>Date:</b> 13.08.2018
<b>Name:</b> Fluctuation	
<b>Story:</b> As a developer, we need to ensure that teams must account for fluctuation in their HR expenses, as we want to model a realistic business environment.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> The market model includes fluctuation coefficients</li> <li><input type="checkbox"/> Fluctuation is based on several factors:           <ul style="list-style-type: none"> <li>- Satisfaction of the employees</li> <li>- Workload of the employees</li> <li>- Salary / Bonus</li> </ul> </li> </ul>	
<b>Priority:</b> Must have	

## Evaluation / Simulation

<b>ID:</b> EV01	<b>Date:</b> 13.08.2018
<b>Name:</b> Team performance metrics	
<b>Story:</b> As a game master, I need to be able assess the performance of teams on several levels, including separate metrics and aggregate measures.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> After a completed round of play, different metrics are calculated for each team</li> <li><input type="checkbox"/> Some metrics build on a predefined effective curve and result in an “index”</li> <li><input type="checkbox"/> Other metrics assess the performance of teams with regards to their portfolios</li> <li><input type="checkbox"/> An overall measure aggregates the different metrics and allows a ranking of teams</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> EV02	<b>Date:</b> 13.08.2018
<b>Name:</b> Customer satisfaction index	
<b>Story:</b> As developers of the game, we want to build a customer satisfaction index that, based on several key input numbers, calculates the satisfaction of all different customer types for each team.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> The customer satisfaction index is specific to each type of customer</li> <li><input type="checkbox"/> The customer satisfaction index is calculated based on multiple factors: <ul style="list-style-type: none"> <li>- Performance of the portfolios of the respective customer type</li> <li>- Track record</li> <li>- Risk-adjusted Performance (Sharpe-Ratio, Information-Ratio, ...)</li> <li>- Management fees</li> <li>- Availability of bank employees for consulting (HR)</li> <li>- Matching SAA to customer profile</li> <li>- Matching actual allocation to SAA</li> </ul> </li> </ul>	
<b>Priority:</b> Must have	

# Reporting

<b>ID:</b> RE01	<b>Date:</b> 13.08.2018
<b>Name:</b> Reports for presentation	
<b>Story:</b> As a game master, I want to be able to present an automatically generated comparison (graphs and reports) of individual team performances, such that I can explain some of the typical mistakes and decisions that could have been made throughout the seminar or the lecture.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> After completion of any round, game masters can display a comparison report</li> <li><input type="checkbox"/> The comparison report includes sensible means of visualization: <ul style="list-style-type: none"> <li>- Graphs with ranking of all teams regarding different measures <ul style="list-style-type: none"> <li>- Netto-performance per customer type</li> <li>- Netto-performance cumulative per customer type over all periods</li> <li>- Tracking error per customer type</li> <li>- Customer satisfaction index per customer type</li> <li>- Customer count per customer type</li> <li>- Assets under management</li> <li>- Net-new money</li> <li>- Total earnings</li> <li>- Total expenses</li> <li>- Gain / Loss</li> <li>- Cost / Income ratio</li> <li>- All in conditions</li> <li>- Depotgebührensatz</li> <li>- Marketing-expenses</li> <li>- Infrastructure (IT-index)</li> <li>- Education-index</li> <li>- Human Resources - current count of employees</li> <li>- Temporary employees</li> <li>- Customer advisory services</li> <li>- Employee Satisfaction</li> <li>- Service quality index</li> <li>- Total index</li> <li>- Total index cumulative</li> </ul> </li> <li>- Benchmark using ideal SAA predefined by game master</li> </ul> </li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> RE02	<b>Date:</b> 13.08.2018
<b>Name:</b> After-period reports for individual teams	
<b>Story:</b> As a team of participants, we want to be able to access our past benchmarks and	

performance reports, such that we can decide about future actions in an informed way.

**Acceptance Criteria:**

- Teams can display their past reports at any time during the game
- No information is leaked about any of the other teams or the future of the game

**Priority:** Must have

**ID:** RE03

**Date:** 13.08.2018

**Name:** Economic outlook

**Story:** As a game master, I want to provide the participating teams with an automatically generated economic outlook (including forecasts) that I can customize with some sensible parameters, such that the students can take more informed decisions for the next period.

**Acceptance Criteria:**

- The system generates an economic outlook according to a predefined template
- Key numbers are taken from the parameters that have been defined for the simulation of the next period as well as from some randomization parameter
- The numbers in the economic outlook can be overridden manually before providing it to the participants

**Priority:** Must have

**ID:** RE04

**Date:** 13.08.2018

**Name:** View of the CIO

**Story:** As a game master, I would like to have the opportunity to provide a custom assessment and directions in my own wording that is provided to the students as the view of their bank's CIO (based on the economic outlook).

**Acceptance Criteria:**

- Game masters can provide custom plain text that is shown to the students under the premise of being from their own CIO
- The CIO assessment can include directions and guidelines as well as interpretations of the economic outlook

**Priority:** Should have

**ID:** RE05

**Date:** 13.08.2018

**Name:** Visualization of historical stock prices

**Story:** As a team of participants, we would like to get a historical overview of the stocks in our portfolio, such that we can make reasonable decisions about future investments.

**Acceptance Criteria:**

- Teams can access reports regarding the historical development of their stocks
- Teams can view all stocks, not just those they've chosen for their portfolio

**Priority:** Should have

**ID:** RE06

**Date:** 13.07.2018

**Name:** Performance attribution

**Story:** As a team of participants, we need to have a comprehensive report about the performance attribution of our assets, such that we can decide about further investments.

**Acceptance Criteria:**

- After each period, teams can access reports with their full performance attribution over past periods

**Priority:** Must have

# Development

<b>ID:</b> DE01	<b>Date:</b> 12.07.2018
<b>Name:</b> Infrastructure	
<b>Story:</b> As a developer, I need to build my application on an extendable and scalable infrastructure, such that it will be easily maintainable in the future.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ The infrastructure is easily extendable by additional services (Docker)</li> <li>✓ Multiple services can be included into the system</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> DE02	<b>Date:</b> 13.08.2018
<b>Name:</b> Continuous integration and deployment	
<b>Story:</b> As a developer, I want to have an environment that is continuously integrated and deployed, such that I can always rely on having current feedback and fast failures.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ On merges into the master branch, the application is continuously deployed to a staging environment, where it can be tested</li> <li><input type="checkbox"/> On tagging of releases, the application is deployed to the production environment</li> <li>✓ The CI pipeline includes a full test suite for the API of the application</li> </ul>	
<b>Priority:</b> Must have	

<b>ID:</b> DE03	<b>Date:</b> 13.08.2018
<b>Name:</b> Code versioning and maintenance	
<b>Story:</b> As a developer, I need to have access to reliable repositories for the application code, such that I can easily collaborate with others on the project and new developers could understand the code.	
<b>Acceptance Criteria:</b> <ul style="list-style-type: none"> <li>✓ The application services are stored in separate, modular repositories</li> <li>✓ The repositories are managed by submitting merge requests that contain at least a short (but complete) description of the changes</li> <li>✓ The application backend contains a full integration test suite as well as independent unit tests for each service</li> <li><input type="checkbox"/> New developers understand the architecture of modular repositories by creating understandable readme files</li> </ul>	

**Priority:** Must have

**ID:** DE04

**Date:** 13.08.2018

**Name:** Local game execution

**Story:** As a game master, I need to be able to easily run the application on my local device, such that it can still be used even in case of network and/or other failures.

**Acceptance Criteria:**

- Application can be started on any local device with sufficient performance
- Backup datasets can be previously downloaded such that it is not necessary to load the entire stock market database onto the local device
- The application can be started by using simple scripts without extensive IT affinity

**Priority:** Should have