Railway Network Management System - User Manual

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1. Introduction

1.1 Purpose

Railways represent one of the most efficient, safe, and environmentally friendly methods of transporting people and goods. This railway management system is designed to address the complex challenges of railway infrastructure management while providing an engaging simulation experience.

The system serves two primary purposes:

1. **Professional Management Tool**
    - Support basic functionalities of managing a railway system
    - Enable effective resource management
    - Facilitate network planning and optimization
    - Provide statistical analysis tools

2. **Educational Simulation**
    - Inspired by the classic RailRoad Tycoon game
    - Offers hands-on experience with railway management
    - Demonstrates the complexity of railway operations
    - Provides an entertaining learning environment

1.2 System Overview

The system is built around two core components that work together to provide a complete railway management experience:

1. **Map and Scenario Editor**
    - Create and customize maps with specific dimensions
    - Place industries and cities strategically
    - Define scenarios with historical contexts
    - Configure economic and operational parameters
    - Set up cargo generation and transformation rules

2. **Railway Network Simulator**
    - Build and manage railway stations
    - Connect stations with railway lines
    - Manage train operations and routes
    - Handle cargo transportation
    - Monitor network performance
    - Generate real-time statistics

Key Features:

- Realistic cargo generation based on cities and industries

- Dynamic station management and upgrades
- Historical progression of technology
- Economic simulation of railway operations
- Topological network analysis tools

1.3 Glossary

Software Engineering Terms

Term (EN)	*Termo* (PT)	*Description* (EN)
Acceptance Criteria (AC)	**Critérios de Aceitação**	Conditions that a user story must meet to be considered complete.
Agile SCRUM	**Agile SCRUM**	An iterative and incremental framework for managing teamwork, used in this project for sprint-based development.
Asymptotic Behavior	**Comportamento Assintótico**	The performance characteristic of an algorithm as the input size approaches infinity.
Backlog	**Backlog**	A prioritized list of tasks or user stories to be completed in a project.
Best-Fitting Curve	**Curva de Melhor Ajuste**	A mathematical curve that best represents the relationship between variables in observed data.
Boxplot	**Diagrama de Caixa**	A standardized way to display data distribution based on quartiles, highlighting outliers.
Business Rules Validation	**Validação de Regras de Negócio**	Ensuring that all business rules are respected when recording and updating data.
CamelCase	**CamelCase**	A naming convention where words are joined without spaces and capitalized, e.g., `myVariableName` .
Confidence Level	**Nível de Confiança**	A statistical measure of the probability that a parameter falls within a specified range of values.
Correlation	**Correlação**	A statistical measure indicating the extent to which two variables are related.
Dependent Variable	**Variável Dependente**	A variable whose value depends on that of another variable (e.g., revenue depending on

Term (EN)	*Termo* (PT)	*Description* (EN)
		cargo amount).
File Persistence	**Persistência em Ficheiro**	Storing data in files to maintain its state between program executions.
GraphStream	**GraphStream**	Tool used to visualize graph structures (e.g. railway networks) in Java.
Graphviz	**Graphviz**	Tool used to visualize graph structures (e.g. railway networks) in Python.
Independent Variable	**Variável Independente**	A variable whose variation does not depend on another variable (e.g., cargo type).
Input/Output Operations	**Operações de Entrada/Saída**	Methods responsible for handling user input and system output, typically excluded from unit tests.
Iterative and Incremental Development	**Desenvolvimento Iterativo e Incremental**	A development process where the project is broken into small iterations, each adding functionality incrementally.
Histogram	**Histograma**	A graphical representation of data distribution using bars, where each bar groups data into intervals (bins).
JaCoCo	**JaCoCo**	A Java code coverage tool used to generate reports on unit test coverage.
Java	**Java**	The programming language in which the application must be developed.
JavaFX	**JavaFX**	A platform for creating desktop applications with a graphical user interface in Java.
Javadoc	**Javadoc**	A tool used for generating API documentation from Java source code comments.
JUnit 5	**JUnit 5**	A framework for writing and executing unit tests in Java.
Jupyter Notebook	**Jupyter Notebook**	An interactive development environment for Python, used for statistical analysis and documentation.
Key Performance Indicators (KPIs)	**Indicadores-Chave de Desempenho (KPIs)**	Metrics used to evaluate the efficiency and profitability of railway operations (e.g. station

Term (EN)	*Termo* (PT)	*Description* (EN)
		profits).
LaTeX	**LaTeX**	A document preparation system used for formatting detailed descriptions and statistical analyses in the Jupyter Notebook.
Linear Regression Model	**Modelo de Regressão Linear**	A statistical model that examines the linear relationship between a dependent variable and one or more independent variables.
Markdown Format	**Formato Markdown**	A lightweight markup language for documentation.
Minimal Viable Product (MVP)	**Produto Mínimo Viável (MVP)**	The most basic version of a product that can be released to meet initial requirements.
Non-functional Requirements	**Requisitos Não Funcionais**	Constraints and quality attributes that a system must adhere to, such as performance, security, and maintainability.
Object-Oriented (OO) Practices	**Práticas de Programação Orientada a Objetos (OO)**	Design principles that promote modularity, encapsulation, and reusability in software development.
Object Serialization	**Serialização de Objetos**	A process that converts objects into a format that can be stored and reconstructed later, ensuring data persistence between successive runs.
Primitive Operations	**Operações Primitivas**	Basic operations (e.g. loops) implemented without relying on external library functions.
Product Owner	**Product Owner**	The person representing the organization developing the game, responsible for defining requirements.
Pseudocode	**Pseudocódigo**	A notation resembling a simplified programming language, used to describe algorithms in a human-readable form.
Python	**Python**	A programming language used for statistical analysis.
Scrum Board	**Quadro Scrum**	A visual tool used to track progress of tasks in a sprint (e.g., Backlog, ToDo, In Process, Testing, Done).

Term (EN)	*Termo* (PT)	*Description* (EN)
Scrum Master	**Scrum Master**	A team role responsible for ensuring the team follows Agile practices during a sprint.
Serialization	**Serialização**	The process of converting an object into a format that can be stored or transmitted and reconstructed later.
Shortest Path Algorithm	**Algoritmo do Caminho Mais Curto**	An algorithm that finds the path between two vertices in a graph with the minimum sum of edge weights.
Software Analysis and Design	**Análise e Conceção de Software**	The process of identifying software requirements and structuring the system to meet them effectively.
Statistical Analysis	**Análise Estatística**	Methods to analyze data.
SVG Format	**Formato SVG**	A vector graphics format used for storing images and diagrams in software development.
System Users	**Utilizadores do Sistema**	Refers to different users who interact with the system, including Editors and Players.
Test-Driven Development (TDD)	**Desenvolvimento Guiado por Testes (TDD)**	A development approach where tests are written before the code they validate.
Time Complexity	**Complexidade Temporal**	A measure of how the execution time of an algorithm increases with the size of the input.
Unit Tests	**Testes Unitários**	Tests that validate the functionality of individual methods in a program, typically implemented using JUnit 5.
User Story (US)	**História de Utilizador (US)**	A short description of a feature from the perspective of a user, often including acceptance criteria.
Worst-Case Analysis	**Análise de Pior Caso**	The evaluation of an algorithm's performance under the most unfavorable input conditions.

Railway Simulation Terms

Term (EN)	*Termo* (PT)	*Description* (EN)
Arrival Event	**Evento de Chegada**	A simulation event that occurs when a train arrives at a station, tracking metrics like traveled distance, duration, revenue, and fuel expenses.
Building	**Edifício**	A structure at a station that provides services like communication, storage, or administration.
Building Evolution	**Evolução de Edifício**	The process of upgrading a station building to a more advanced version, with associated costs and effects.
Cargo	**Carga**	Goods or passengers transported by trains. It includes raw materials, mail, passengers and products.
Cargo Generation Event	**Evento de Geração de Carga**	A simulation event that creates new cargo at a specific location, with properties like amount, type, and storage station.
Cargo Mode	**Modo de Carga**	The method of loading cargo onto a train, which can be FULL (train departs when fully loaded), HALF (departs when half loaded), or AVAILABLE (departs with available cargo).
Cargo Type	**Tipo de Carga**	The classification of cargo transported by trains, such as passengers, mail, coal, iron ore, steel, etc.
Carriage	**Carruagem**	A rail vehicle used to transport cargo, such as passengers, mail, coal, or steel.
City	**Cidade**	An urban area on the map that generates and consumes cargo like passengers, mail, and final products.
Demand	**Procura**	The need for specific cargo types at a station, which affects the delivery payment rates (ranging from 1-9).
Departure Event	**Evento de Partida**	A simulation event that occurs when a train leaves a station, tracking the loaded cargo and next destination.
Depot	**Depósito**	A small railway station with a short economic radius, mainly used for train maintenance (50k, 3x3 radius).
Diesel Locomotive	**Locomotiva a Diesel**	A type of locomotive powered by diesel fuel, more efficient than steam locomotives.
Economic Radius	**Raio Económico**	The area around a station where industries and cities contribute to its supply and demand.

Term (EN)	*Termo* (PT)	*Description* (EN)
Editor	**Editor**	A person who can create maps and scenarios that can be provided in a bundle with the game or sold separately.
Electric Locomotive	**Locomotiva Elétrica**	A train engine that requires electrified railway lines to operate.
Electrified Railway Line	**Linha Ferroviária Electrificada**	A railway line equipped with electrical power to support electric locomotives.
Expenses	**Despesas**	Costs associated with railway operations, including track maintenance, train maintenance, and fuel.
Farm	**Quinta**	A primary sector industry that produces agricultural resources like cereals, wool, or coffee.
Final Product	**Produto Final**	A processed good, such as textiles, food, or automobiles, consumed by cities.
Financial Results	**Resultados Financeiros**	The annual summary of expenses and revenues for the railway network.
Fuel Cost	**Custo de Combustível**	The expense related to powering locomotives, based on distance traveled.
Historical Restrictions	**Restrições Históricas**	Simulation constraints defining which historical events will be happening during the scenario.
House Blocks	**Blocos Habitacionais**	Residential units in a city that generate and consume cargo (passengers, mail, goods). Their quantity affects the city's economic activity in the simulation.
Industry	**Indústria**	A facility that produces, processes, or exports cargo.
Industry Sector	**Sector Industrial**	A classification of industries based on their economic role, defining their cargo generation and consumption patterns.
Locomotive	**Locomotiva**	The engine of a train that provides traction. It can be powered by steam, diesel, or electricity.
Locomotive Type	**Tipo de Locomotiva**	The classification of locomotives based on their propulsion system, such as steam, diesel, or electric.
Mail	**Correio**	A type of cargo representing postal services transported between cities.

Term (EN)	*Termo* (PT)	*Description* (EN)
Maintenance Route	**Rota de Manutenção**	A path that passes once by each railway line for maintenance purposes.
Map	**Mapa**	The virtual representation of the railway world, where cities, industries, and stations are placed.
Mine	**Mina**	A primary sector industry that, depending on its type, can extract coal, iron, bauxite, etc., which can be transported to steel mills.
Mixed Industry	**Indústria Mista**	An industry like a port that can import/export and transform cargo.
Offer	**Oferta**	The available cargo at a station for transport, generated by industries and cities in its economic radius.
Outlier Profits	**Lucros Atípicos**	Profits significantly higher/lower than the average.
Passenger Traffic	**Tráfego de Passageiros**	The volume of passengers arriving at stations.
Passengers	**Passageiros**	People transported by trains between cities.
Player	**Jogador**	A person who wants to play a game; in advanced versions, a scenario can be played by multiple players simultaneously.
Point of Route	**Ponto de Rota**	A specific location in a route where cargo operations (loading/unloading) can occur, associated with a station.
Port	**Porto**	A mixed industry that handles cargo import and export, and can transform resources.
Primary Sector Industry	**Indústria do Sector Primário**	An industry that generates raw resources like coal, iron ore, or cereals.
Railway	**Caminho de Ferro**	A transportation system using trains on tracks to move cargo and passengers.
Railway Connectivity	**Conectividade Ferroviária**	The topological representation of stations and lines, including electrified routes.
Railway Line	**Linha Ferroviária**	A track connecting two railway stations, allowing trains to travel between them.
Resource	**Recurso**	A type of raw material extracted or produced by primary sector industries.

Term (EN)	*Termo* (PT)	*Description* (EN)
Revenue	**Receita**	Income generated from cargo deliveries, affected by demand levels and distance.
Route	**Rota**	A predefined path for a train, including stations where cargo is loaded/unloaded.
Scenario	**Cenário**	A predefined game configuration with a specific time period, technological constraints, and historical events.
Shortest Route	**Rota Mais Curta**	The path between two stations with the minimum total distance, potentially passing through specific intermediate stations.
Simulation	**Simulação**	The active state of the railway system where trains move and cargo is generated according to rules.
Simulation Report	**Relatório de Simulação**	A comprehensive summary of a simulation run, including financial metrics, duration, and overall performance indicators.
Station	**Estação**	A facility where trains stop to load and unload cargo.
Station Building Slot	**Espaço de Construção na Estação**	A designated area within a station for constructing buildings.
Station Type	**Tipo de Estação**	A classification of stations (e.g., depot, terminal) that defines their economic radius, cost, and capabilities.
Steam Locomotive	**Locomotiva a Vapor**	A type of locomotive powered by coal and steam, commonly used in early railway history.
Technological Restrictions	**Restrições Tecnológicas**	Constraints in a scenario defining which locomotives or industries are available.
Terminal	**Terminal**	A large railway station with a wide economic radius (200k, 5x5 radius).
Time Restrictions	**Restrições Temporais**	Constraints in a scenario defining the period in which the simulation takes place.
Track Maintenance	**Manutenção de Vias**	The cost associated with maintaining railway lines, based on their length.
Track Type	**Tipo de Linha**	Classification of railway lines, including single, double, single electrified, and double electrified.

Term (EN)	*Termo* (PT)	*Description* (EN)
Train	**Comboio**	A vehicle composed of a locomotive and carriages, used to transport cargo and passengers.
Train Maintenance	**Manutenção de Comboios**	The cost associated with maintaining locomotives, based on their properties.
Train Schedule	**Horário do Comboio**	The timetable that defines when a train departs and arrives at each station on its route.
Train Type	**Tipo de Comboio**	The classification of trains based on their locomotive type, such as steam, diesel, or electric.
Transforming Industry	**Indústria Transformadora**	An industry that processes raw materials into final products, such as a steel mill or automobile factory.
Upgrade	**Melhoria**	An addition to a station (e.g., telegraph, hotel) that enhances its functionality or performance.
Wear and Tear	**Desgaste**	The gradual deterioration of railway lines and trains over time, requiring maintenance.

2. Getting Started

2.1 Main Menu

```
--- MAIN MENU -------------------------
  1 - Do Login
  2 - Know the Development Team
  0 - Cancel

Type your option:
```

The main menu provides access to:

1. Login System
2. Development Team Information
3. Role-specific menus (after login):
    - Player Menu
    - Editor Menu

Session Management:

- Progress is saved automatically

- You can log out at any time
- Current session information is maintained while logged in

2.2 Login System

```
--- LOGIN UI ----------------------------

Enter UserId/Email: editor@railway.app

Enter Password: editor123
```

The system provides a secure authentication system with role-based access control. Users can access different features based on their assigned roles.

Login Process

1. From the main menu, select "Do Login"
2. Enter your credentials:
    - User ID/Email
    - Password
3. You have 3 attempts to log in successfully
4. Upon successful login, you'll be prompted to select your role if you have multiple roles assigned

Available Roles

1. **Player Role**
    - Access to game simulation features
    - Build and manage railway networks
    - Manage trains and cargo operations

2. **Editor Role**
    - Create and modify maps
    - Design scenarios
    - Configure game parameters

Session Management

- The system maintains your session while you're logged in
- You can log out at any time to end your session
- Your progress is saved automatically during the session

3. Editor Features

```
--- EDITOR MENU -------------------------
  1 - Create Map
  2 - List Maps
  3 - Edit Map
  4 - Save Map
  5 - Load Map
  6 - Create Scenario
  7 - View Scenario Layout
  8 - Save Scenario
  9 - Load Scenario
  0 - Cancel

Type your option:
```

3.1 Map Creation

- Create new maps with custom dimensions
- Set map name following valid file name conventions
- Requirements:
  - Dimensions must be positive integers
  - Name must be valid

```
--- Create Map ---

Enter map name: Portugal

Enter map width: 20

Enter map height: 60

Enter map scale (e.g., 1 for 1 km per cell of the map): 1

Map details:
Name: Portugal
Width: 20
Height: 60
Scale: 1 kms per cell


Do you want to create this map? (y/n)
y

Map created successfully!
Map details:
Name: Portugal
Size: 20x60
Scale: 1 kms per cell
```

3.2 Edit Map

```
=== Edit Map ===

Available Maps:
1. iberian_peninsula
2. france
3. Portugal
4. italy

0. Return to previous menu

Select a map to edit (number):
```

- First it will ask to choose the map to Edit:

```
Edit Map Options:
1. Add Industry
2. Add City
0. Return to Main Menu

Select an option:
```

- Then it will show a preview of the map:

```
Map loaded successfully!
Map: Portugal
Size: 20x60

Legend:
C - City
I - Industry
S - Station
. - Empty cell

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
```

3.2.1 Industry Management

- Add industries to specific positions on the map
- Select from available industry types
- Define industry positions using X,Y coordinates

```
Available Industries:
1. coal_mine - Mine (Primary)
2. iron_mine - Mine (Primary)
3. farm - Farm (Primary)
4. steel_mill - Steel Mill (Transforming)
5. seaport - Port (Port)

Select an industry to add (number): 3

Enter industry details:
Name ID: exampleName
X coordinate (0-19): 1
Y coordinate (0-59): 7

Confirm industry details:
Name ID: exampleName
Position: (1,7)

Confirm? (y/n): y

Industry added successfully!

Industry Details:
Name ID: exampleName
Type: Farm
Sector: Primary
Position: (1,7)
Production Rate: 1.0
```

- Define Map scale (in kms)

3.2.2 City Management

- Add cities to the map with custom names
- Configure house blocks:
  - Manual placement
  - Automatic distribution using normal distribution
- Requirements:

    - City names cannot contain special characters or digits
    - House blocks must be a positive number

```
=== Add City ===

Enter city name: Coimbra
Enter X coordinate: 10
Enter Y coordinate: 10
Enter number of house blocks: 4

Do you want to assign blocks manually? (y/n): n

City Summary:
Name: Coimbra
Position: (10,10)
Number of house blocks: 4

Confirm city creation? (y/n): y

City created successfully!

City Details:
Name: Coimbra
Position: (10,10)
Number of house blocks: 4
Traffic rate: 0.0
```

3.3 Scenario Creation

- Create scenarios for existing maps
- Configure port behaviors:
    - Import/export cargo settings
    - Cargo transformation rules
- Set available locomotive types:
    - Steam
    - Diesel
    - Electric
- Configure industry generation factors

- First it asks to choose a map:

```
=== Create Scenario ===

Available Maps:
1. iberian_peninsula
2. france
3. Portugal
4. italy

Select a map (number):
```

- Then ask for Name and Time Period, and Available Industries:

```
=== Create Scenario ===

Available Maps:
1. iberian_peninsula
2. france
3. Portugal
4. italy

Select a map (number): 3

Enter scenario name: Iberian_1900-2000

Enter start year (yyyy): 1900

Enter end year (yyyy): 2000

Available Industries:
1. exampleName (Farm)

Select industries (comma-separated numbers, e.g., 1,3,5): 1
```

- Then configure each Port:

```
Configuring port: porto_port

Select cargoes to import:
1. Coal
2. Iron Ore
3. Steel
4. Wood
5. Passengers
6. Mail
7. Food
8. Oil
9. Fuel

Select cargoes to import (comma-separated numbers, or press Enter to skip): 1,2,7

Select cargoes to export:

Select cargoes to export (comma-separated numbers, or press Enter to skip): 2,3

Select cargoes to transform:

Select cargoes to transform (comma-separated numbers, or press Enter to skip): 1

Enter traffic rate for cities (1.0 is normal): 1
```

- Then ask for Available Locomotive Types:

```
Available Locomotive Types:
1. Steam
2. Diesel
3. Electric

Select locomotive types (comma-separated numbers, e.g., 1,2,3): 1
```

- Finally, it show the Scenario summary and asks confirmation:

```
Select locomotive types (comma-separated numbers, e.g., 1,2,3): 1

Scenario Summary:
Name: Iberian_1900-2000
Map: Portugal
Period: 1900 to 2000

Selected Industries:
- exampleName (Farm - Primary)

Generation Frequency Factor: 0.0
City Traffic Rate: 1.0

Selected Locomotive Types:
- Steam


Do you want to create this scenario? (y/n)
```

3.4 View Scenario Layout

- Asks for the Scenario Layout will be showed:

```
=== View Scenario Layout ===

Available scenarios for iberian_peninsula:
1. Iberian Early Industrial
2. Iberian Inter-War
0. Return to previous menu

Type your option:
Invalid option. Please try again: 1
```

```
Legend:
C - City
I - Industry
S - Station
. - Empty cell

S . . . . . .
. C . . I . . . . . .   (City: porto) (Industry: asturias_mine)
. . S . . . . . . . .
. . . S . . . . . I .   (Industry: barcelona_port)
. I . . . . . . . . .   (Industry: porto_port)
. . . . . . . C . . .   (City: madrid)
. . . . . . . . . . .
. . . . . . . . . . .
. . . . . . . . . . .


Scenario Summary:
Date Range: 1900 to 1920

Cities (2):
- madrid
- porto

Industries (3):
- porto_port (Port)
- barcelona_port (Port)
- asturias_mine (Mine)
```

4. Player Features

4.1. Map & Scenario Selection

Functionality Overview:

- Select a Map and a Scenario to play

Console Interface

- **The Player must select the first option in the Player Menu:**

```
--- PLAYER MENU -------------------------
  1 - Select Map and Scenario
  2 - Logout
  0 - Cancel

Type your option:
```

- **Then it needs to select the Map and Scenario:**

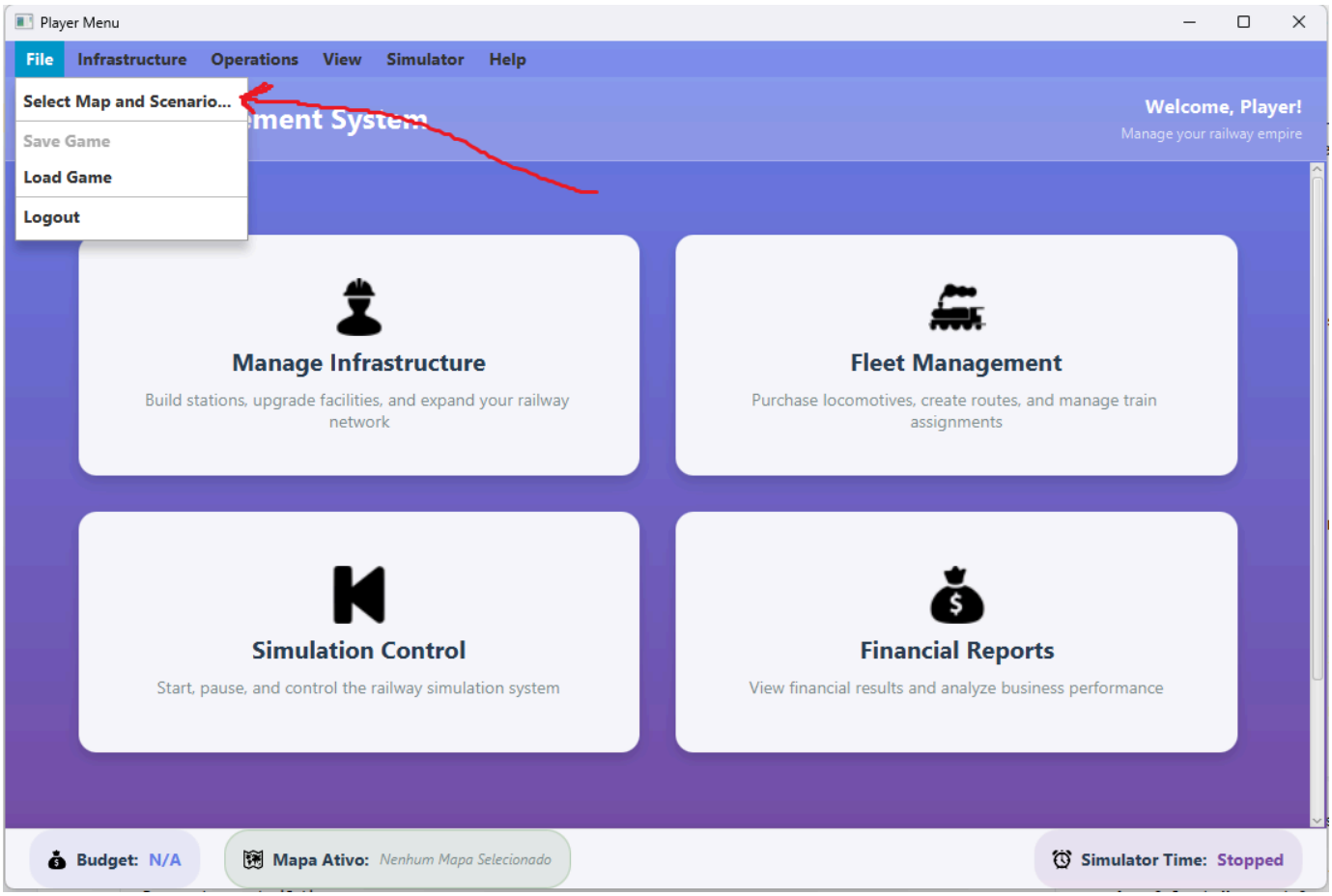
```
=== Map Selection ===

Available maps:
1. iberian_peninsula
2. france
3. italy
0. Return to previous menu

Type your option:

Available scenarios for iberian_peninsula:
1. Iberian Early Industrial
2. Iberian Inter-War
0. Return to previous menu

Type your option:
```

- **Then the Player menu for the simulation will show:**

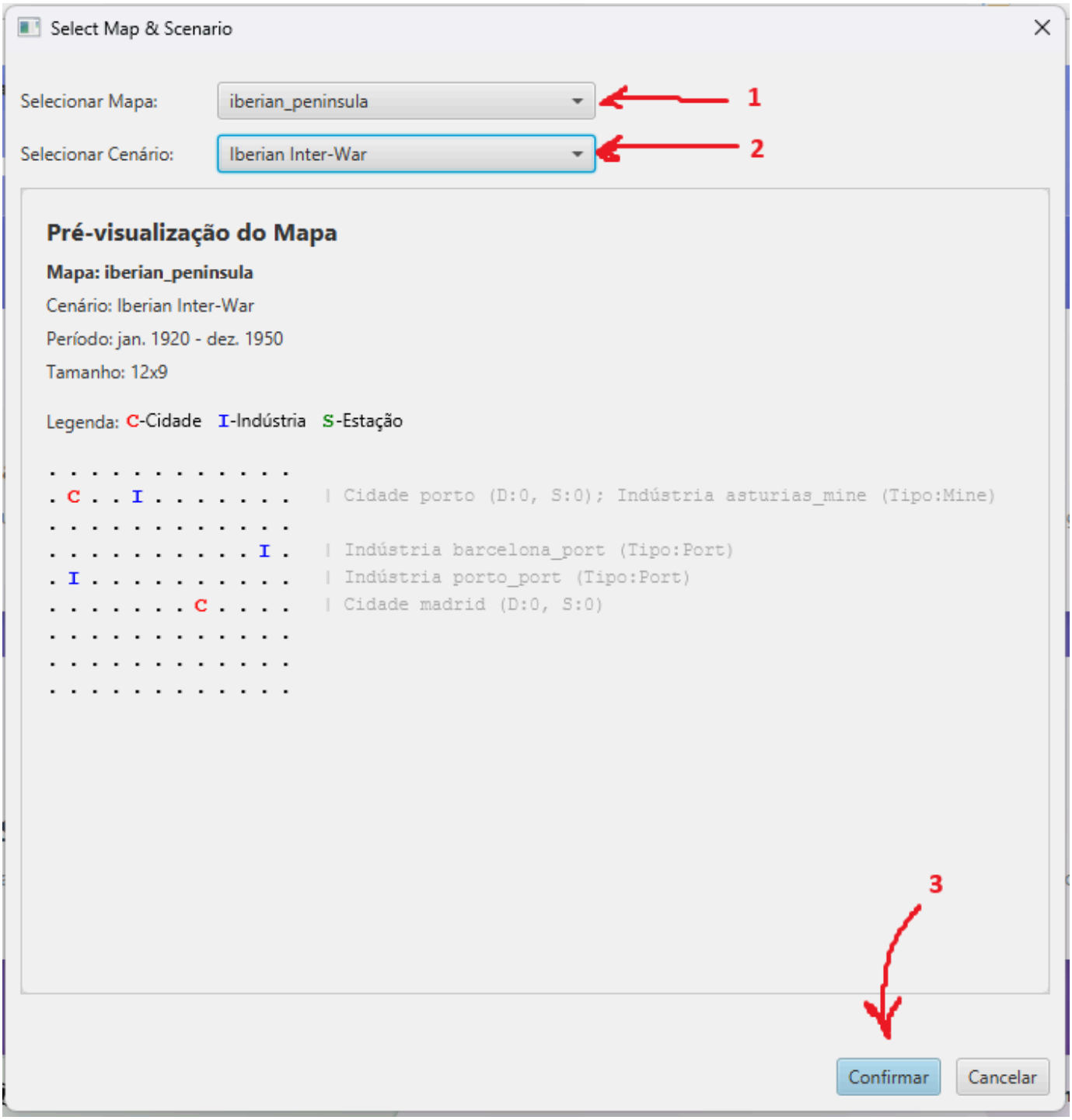
```
--- PLAYER MENU ------------------------
  1 - Select Map and Scenario
  2 - Buy Locomotive
  3 - View Locomotives
  4 - List Trains
  5 - Build Station
  6 - Build Railway Line
  7 - Create Route
  8 - Assign Train to Route
  9 - Run Simulator
  10 - View Current Map
  11 - View Budget
  12 - View Stations
  13 - View Network Statistics
  14 - Logout
  0 - Cancel

Type your option:
```

Graphical Interface

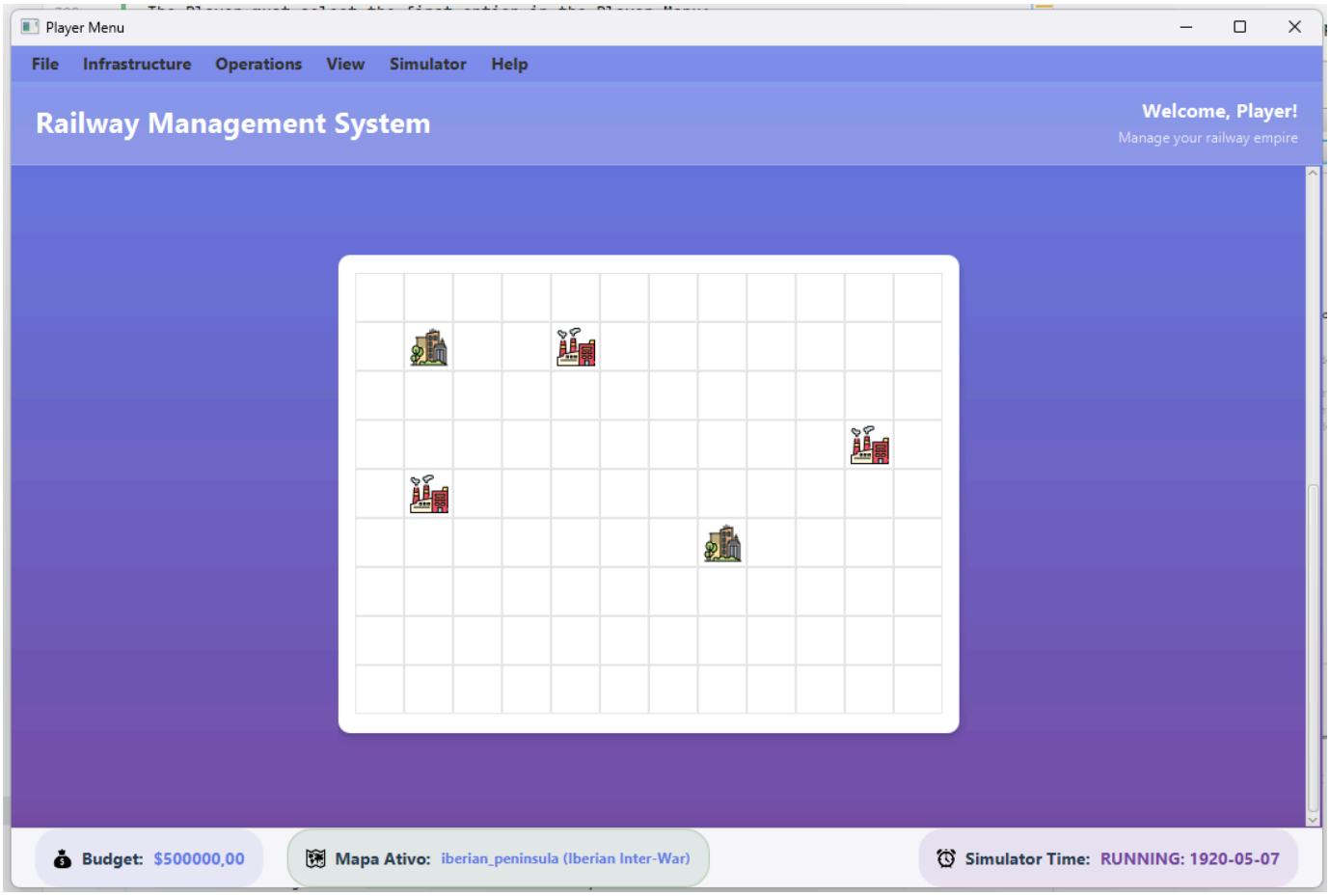
- **The Player must navigate to the Top Left corner and select FILE > Select Map and Scenario:**



- **Then it needs to select the Map and Scenario, and then confirm:**



- **Then the Map/Scenario layout will appear:**



4.2. Station Management

Functionality Overview:

- Build different station types:
  - Depot
  - Station
  - Terminal
- Automatic name generation based on closest city
- Station center configuration:
  - Depot/Terminal: Geometric center
  - Station: Player-defined (NE, SE, NW, SW)
- Prevent overbuilding

Console Interface

- **The Player must select all information of the station:**

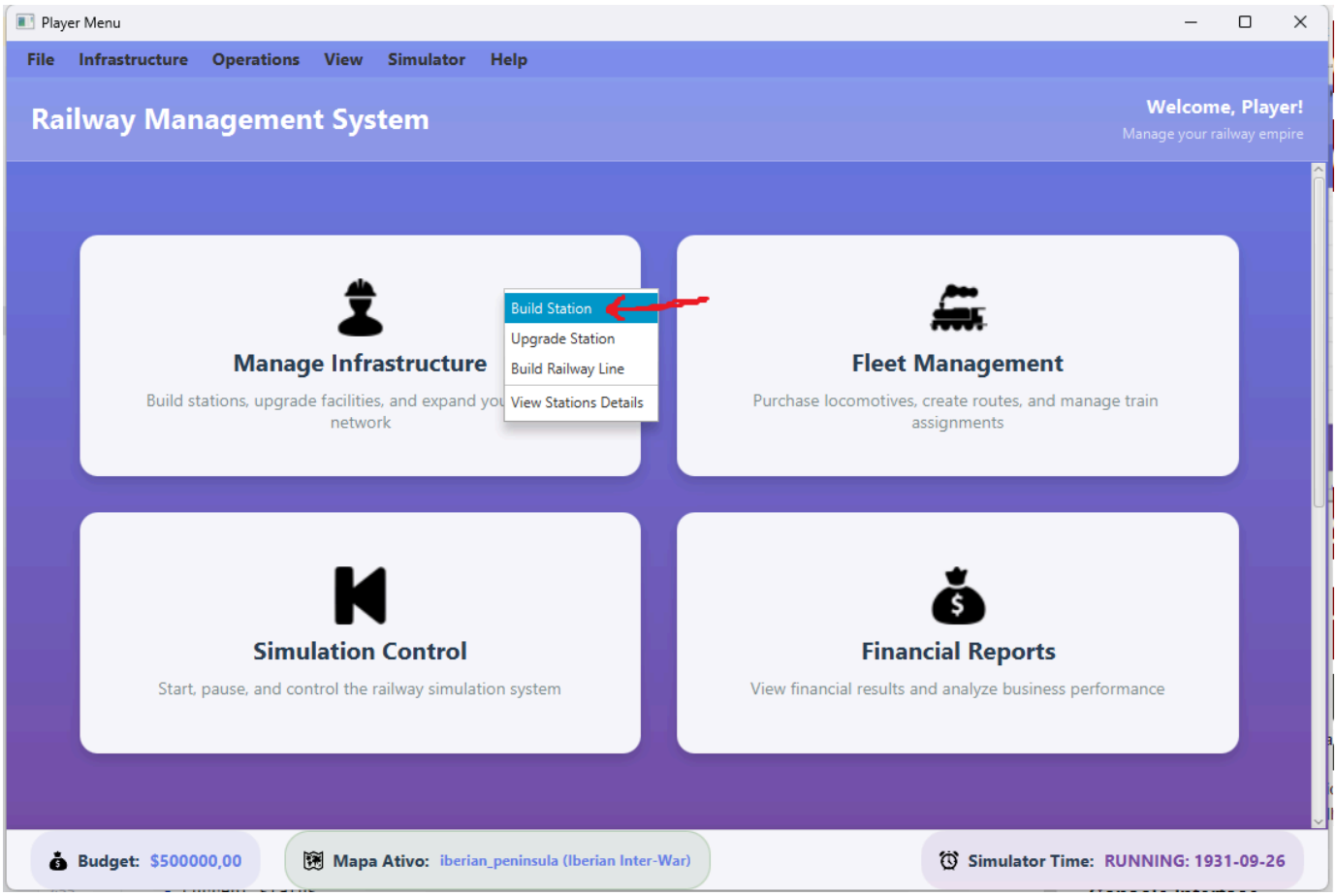
```
=== Build Station ===

Available station types:
DEPOT (Cost: 50000,00, Radius: 3)
STATION (Cost: 100000,00, Radius: 4)
TERMINAL (Cost: 200000,00, Radius: 5)

Type your option: 1

Enter station position:

X coordinate: 2

Y coordinate: 2
Suggested station name: "porto DEPOT"
Do you want to use this name? (y/n): y
```

- **Then all the Station information will be displayed, and the Player needs to confirm:**

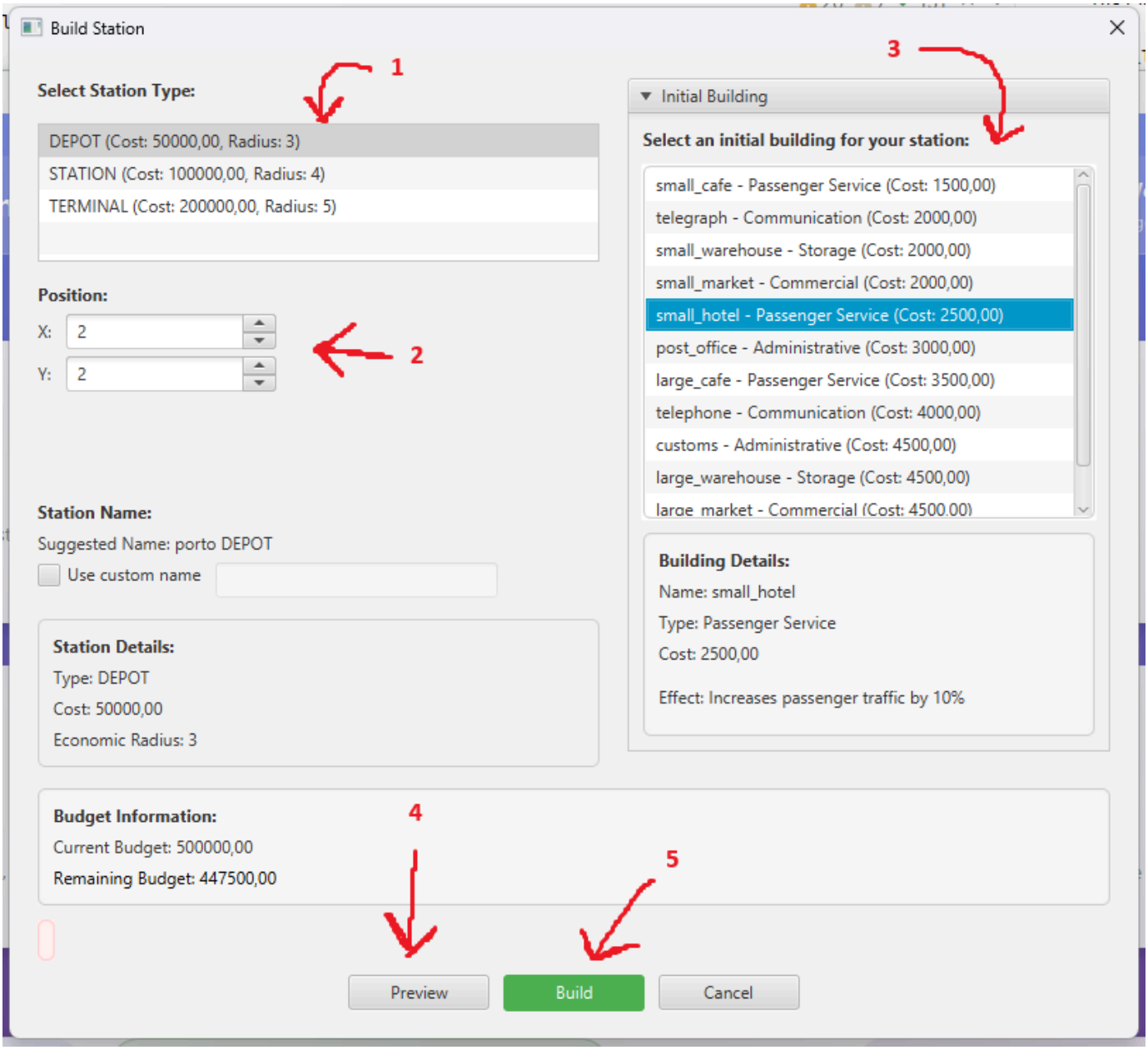
```
Station Details:
Name: porto DEPOT
Type: DEPOT
Cost: 50000,00
Economic Radius: 3
Current Budget: 500000,00
Remaining Budget After Build: 450000,00


Do you want to build this station?
y
Station built successfully!
New Budget: 448000,00
Current Budget: 448000,00
```

Graphical Interface

- **The Player must navigate and click in the Manage Infrastructure > Build Station:**



- **Then the Player must fill all the Station data, click on preview, and finally build:**



4.3 View Stations and Upgrades

Functionality Overview:

- Add buildings and improvements to stations
- Time-based availability of upgrades
- Manage equipment compatibility:
  - Mutually exclusive options
  - Replacement/removal of outdated technology
- View complete station list
- Access detailed station information:
  - Existing buildings
  - Cargo demand/supply

- Current status

Console Interface

- **First it will ask to choose station:**

```
=== Station List ===

Available stations:
--------------------
1. porto DEPOT (Type: DEPOT)
   Supply: Passengers from porto (5), Mail from porto (5)
   Demand: None


Select a station to view details:
  1 - porto DEPOT
  0 - Cancel

Type your option:
```

- **Then it will show station detail, and ask for selection:**

```
=== Station Details ===
Name: porto DEPOT
Type: DEPOT
Position: (2, 2)
Storage Capacity: 100/100 units
Building Slots: 2

Served Cities:
- porto

Available Cargo (Supply):
- passengers: 50 units
- mail: 50 units

Requested Cargo (Demand):
None

=== Station Actions for porto DEPOT ===

Choose an action:
  1 - Upgrade Station
  2 - Return to Station List
  0 - Cancel

Type your option:
```

- **Then it will ask for which upgrade the player wants, and upgrade data:**

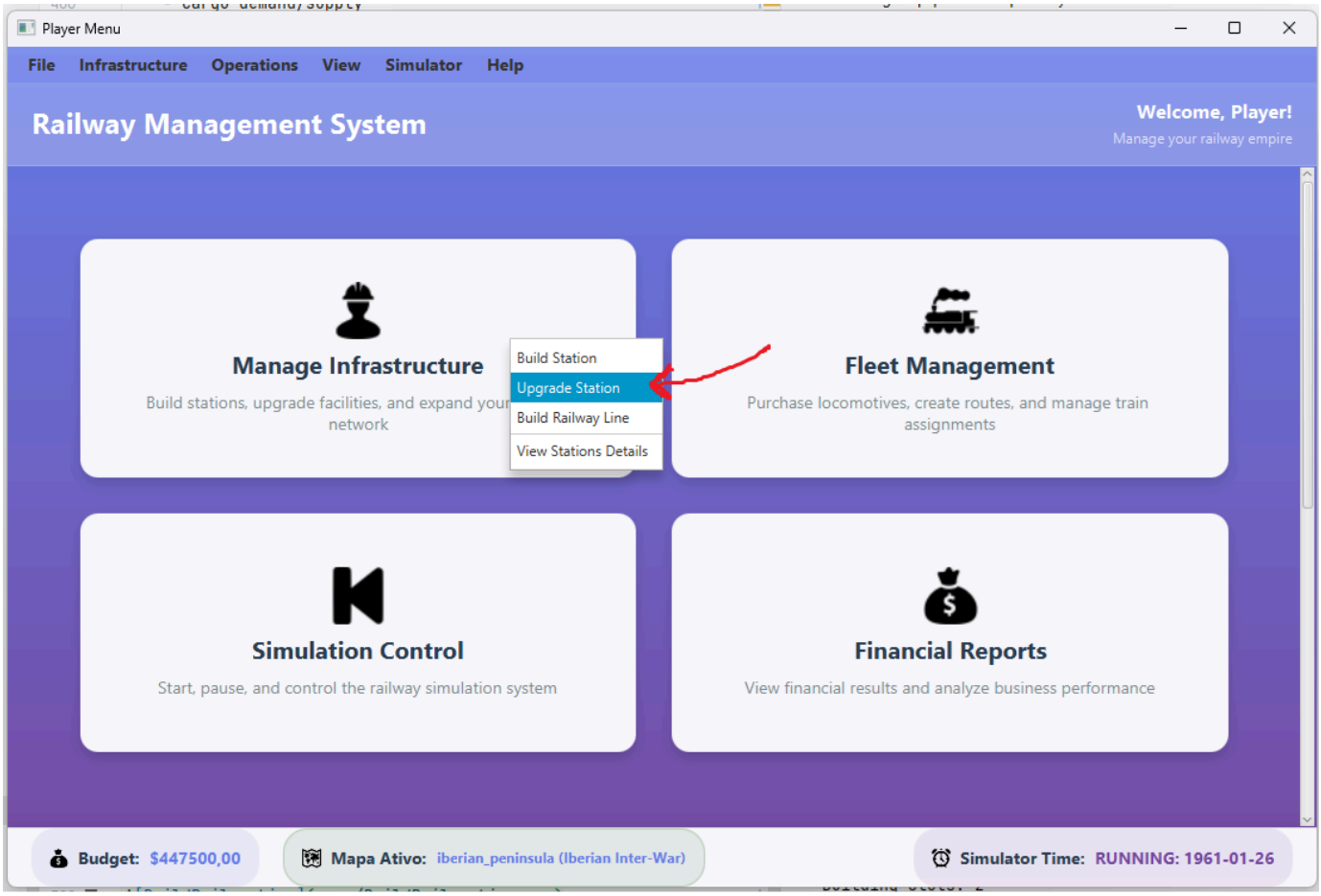
```
=== Upgrade Station: porto DEPOT ===

=== Station Information ===
Name: porto DEPOT
Type: DEPOT
Position: (2, 2)
Storage Capacity: 100
Building Slots: 1/2

Current Buildings:
-----------------
- small_warehouse (Type: Storage)
  Effect: Increases cargo storage capacity by 20%
  Can evolve to: large_warehouse (Cost: 2500,00)

What would you like to do?
  1 - Install New Building
  2 - Evolve Existing Building
  0 - Cancel

Type your option: 1
```

- **Then it will ask confirmation:**

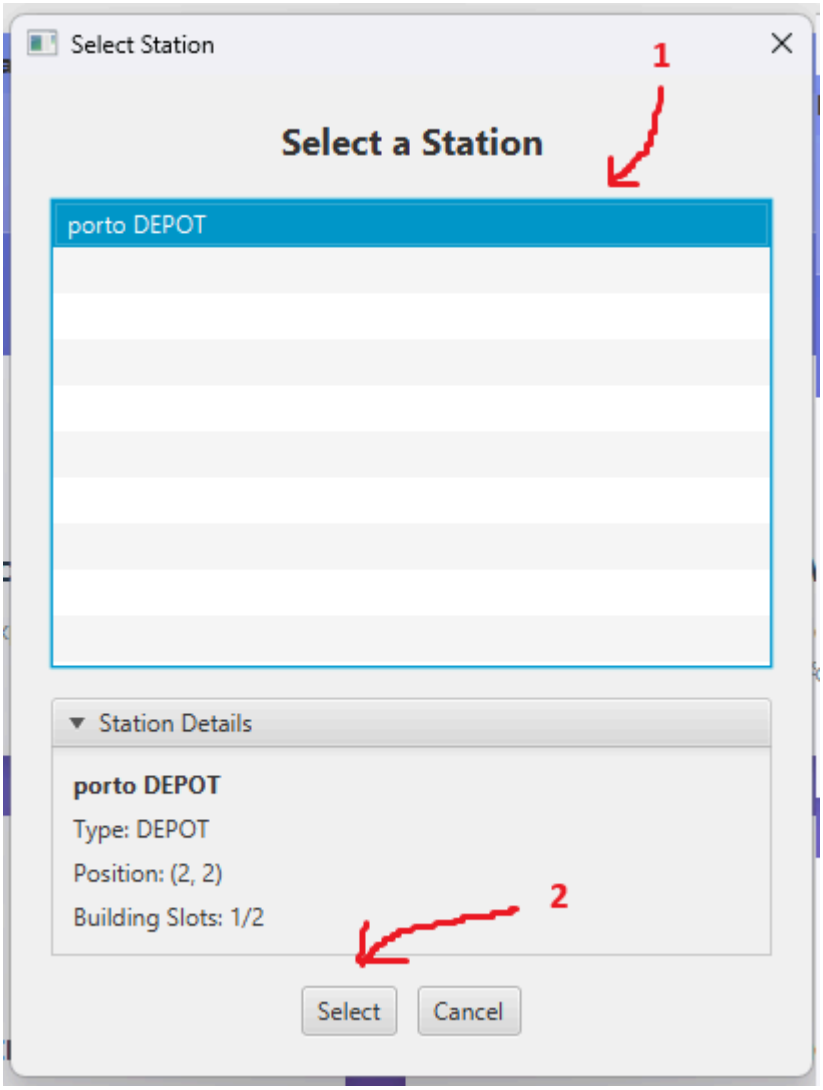
```
=== Building Information ===
Name: telegraph
Type: Communication
Available from: 1900
Cost: 2000,00
Effect: Improves train coordination by 10%
Can evolve to: telephone (Cost: 2000,00)


Do you want to install this building?
y

Building successfully installed!
```

Graphical Interface

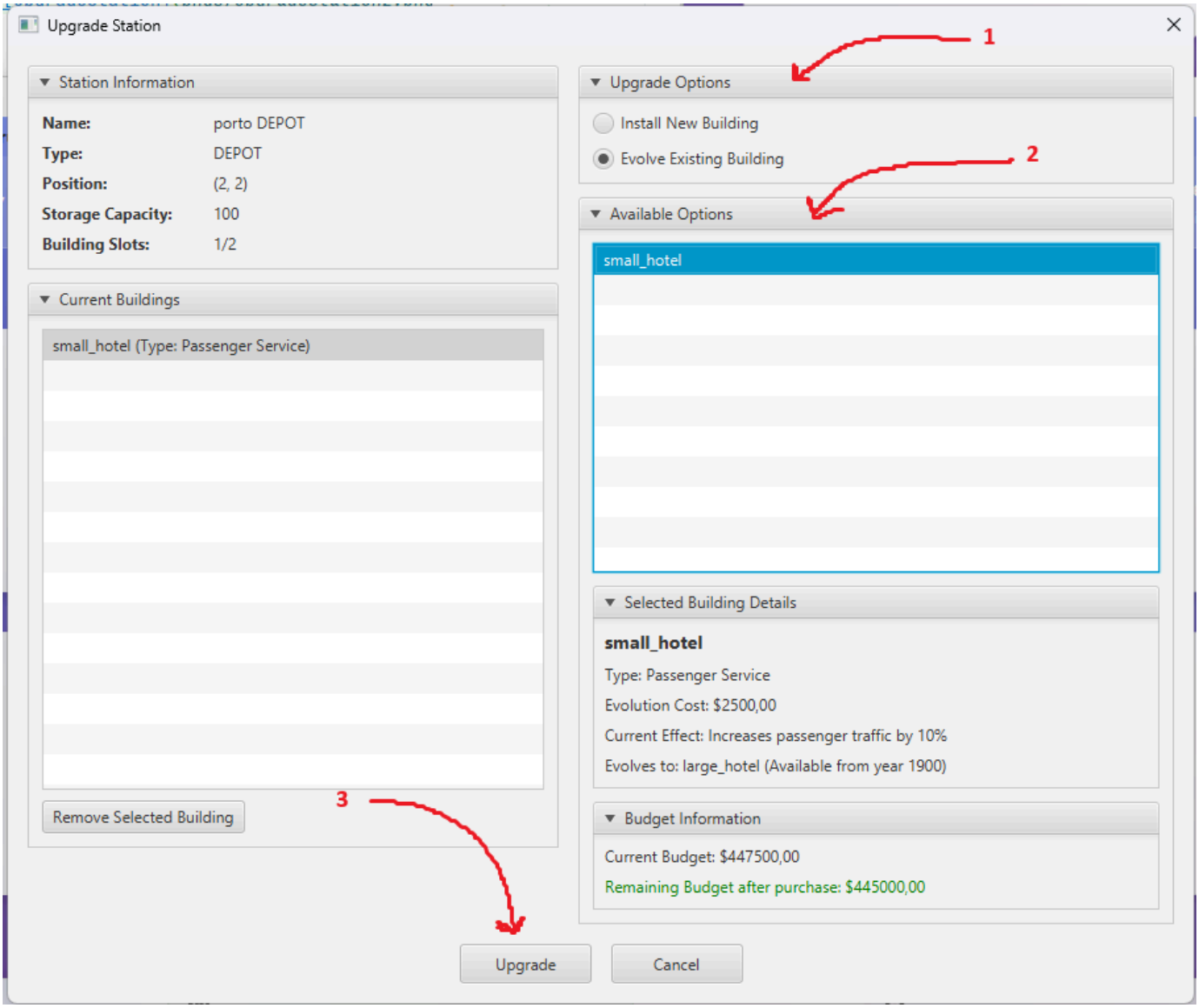
- **The Player must navigate and click in the Manage Infrastructure > Upgrade Station:**



- Then it needs to select the station to upgrade:



- **Player then needs to choose the upgrade, and select one available option, to be able to upgrade the station:**



4.4 Railway Line Construction

Functionality Overview:

- Connect stations with railway lines
-
- Select stations from registered station list

Console Interface

- **First aks the stations to connect:**

```
Type your option: 6
### Build Railway Line ###
Select the first station:
1. porto DEPOT
2. madrid STATION

Enter the station number: 1
Select the second station:
2. madrid STATION

Enter the station number: 2
```

- **Then asks data and confirmation:**

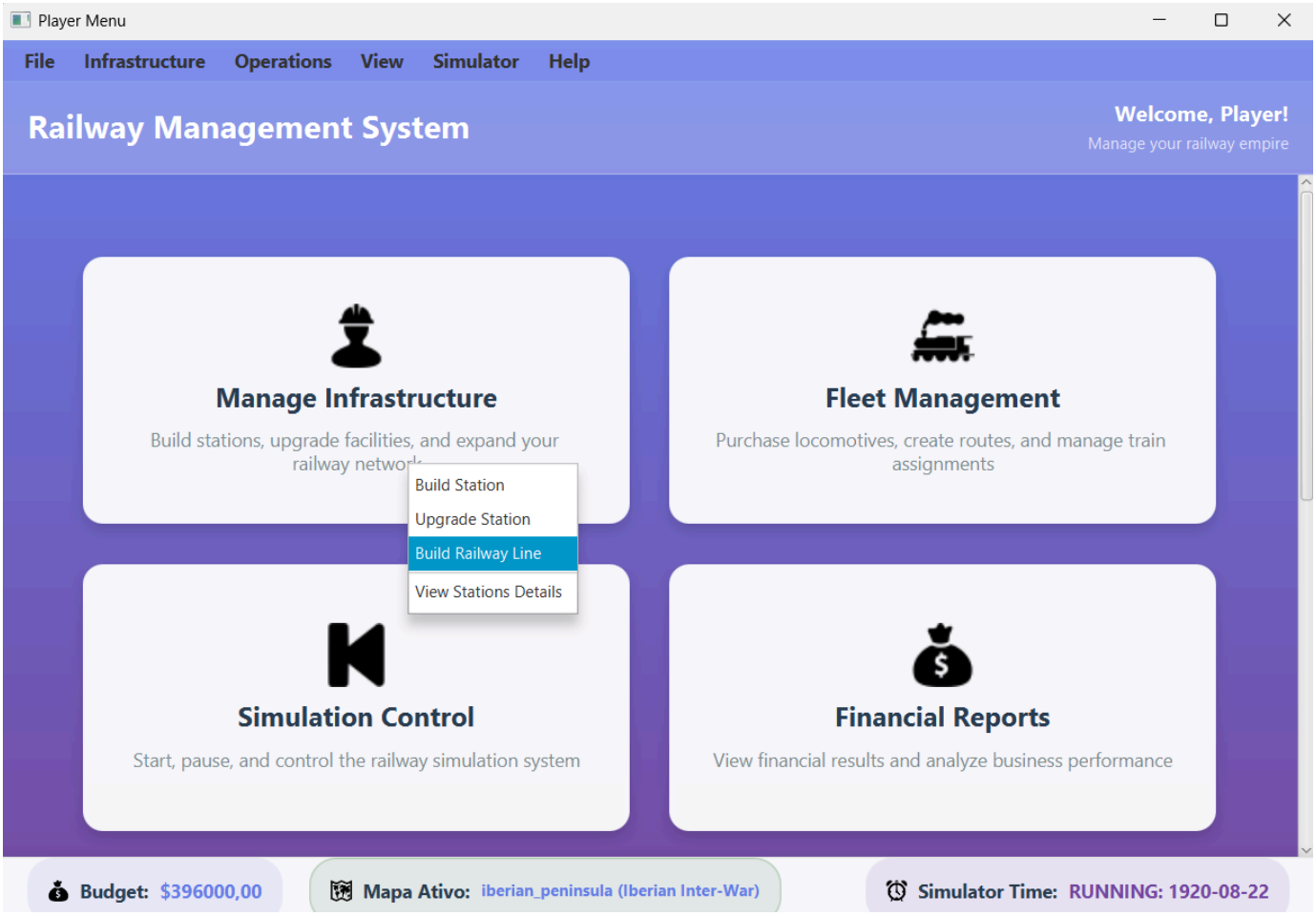
```
Is the railway line a double track? (y/n) y
Is the railway line electrified? (y/n) y
Estimated construction cost: $5250,00
Your current budget: $344000,00
Do you want to build this railway line? (y/n): y
Railway line built successfully!
New budget: $338750,00
Current Budget: 338750,00
```

- **Map with RailwayLine:**

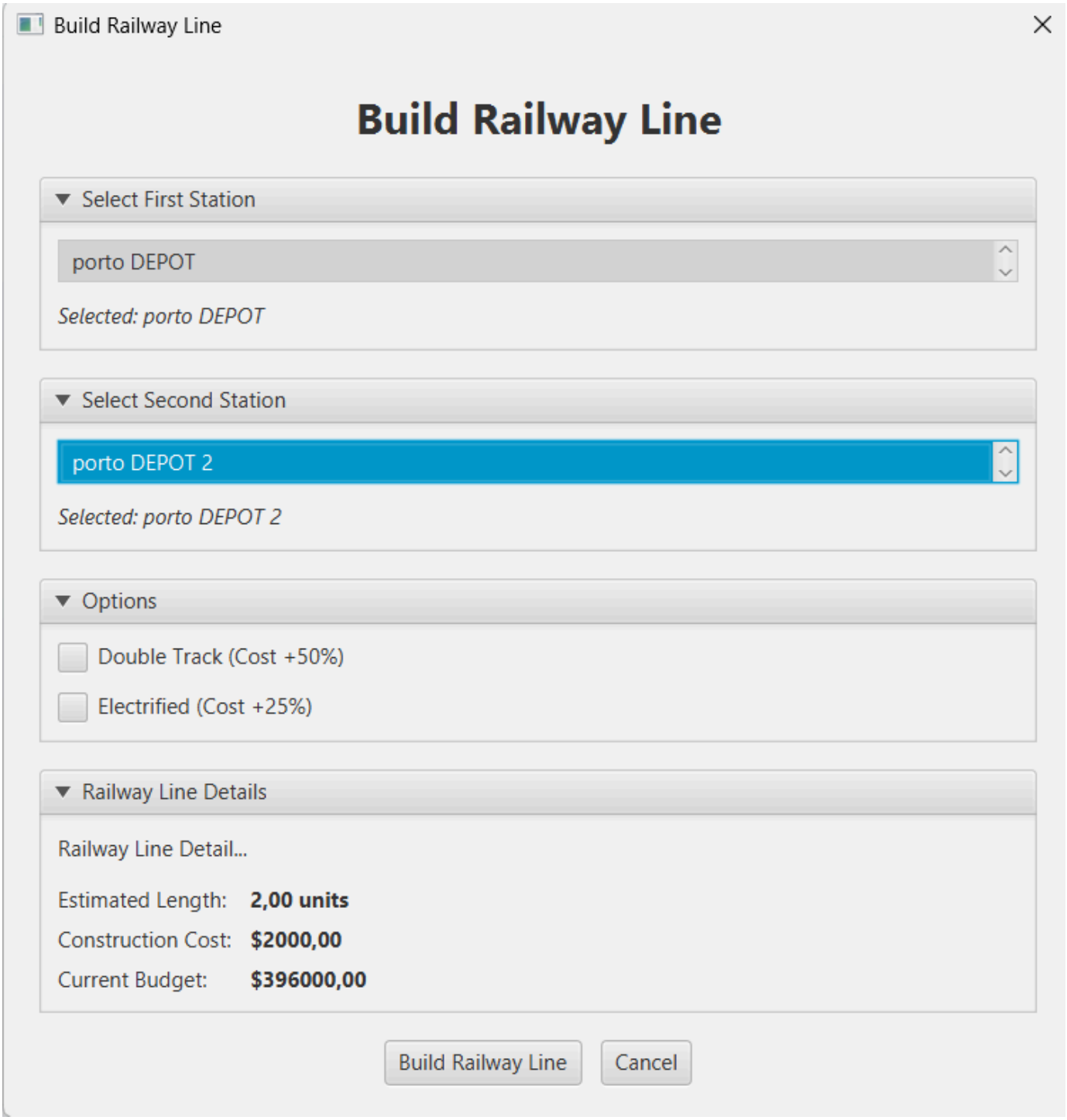
```
Type your option: 10
  0 1 2 3 4 5 6 7 8 9 0 1
 0 . . . . . . . . . . . .
 1 . C . . I . . . . . . .   (City: porto) (Industry: asturias_mine)
 2 . . S . . . . . . . . .   (Station at 2,2)
 3 . . . = . . . . . . I .   (Industry: barcelona_port)
 4 . I . . S . . . . . . .   (Industry: porto_port) (Station at 4,4)
 5 . . . . . . . C . . . .   (City: madrid)
 6 . . . . . . . . . . . .
 7 . . . . . . . . . . . .
 8 . . . . . . . . . . . .

Railway Lines:
porto DEPOT -> madrid STATION (Length: 2,83)

Legend:
C - City
S - Station
I - Industry
= - Railway Line
Current Budget: 338750,00
```

Graphical Interface

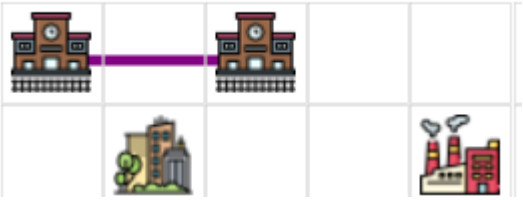
- **Player then needs to choose to build a railway line**



- Then it will ask to select the stations to connect



- **Then it will display it in the map**



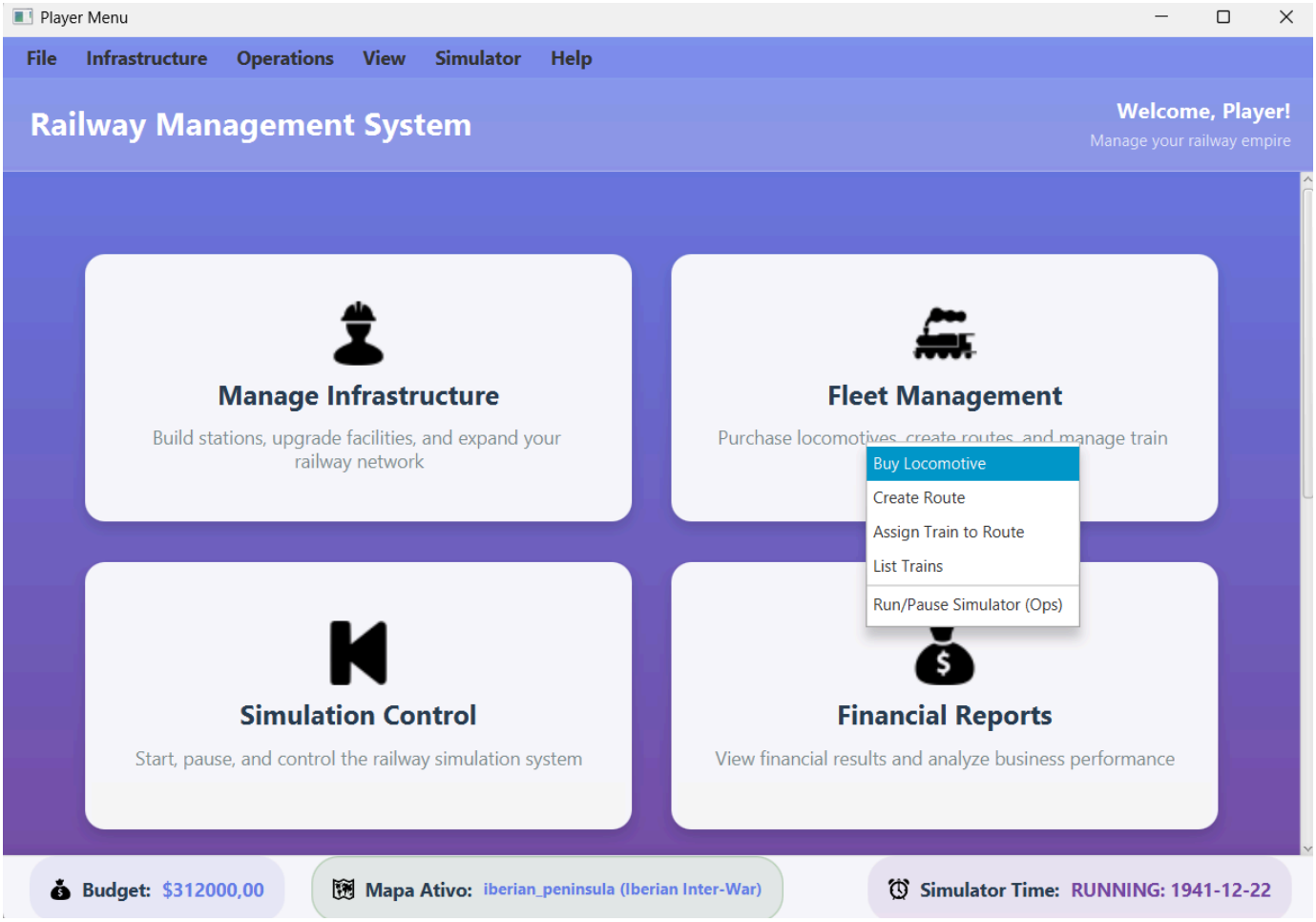
4.5 Locomotive Management

- Purchase new locomotives
- Select from scenario-available options
- Consider current date restrictions

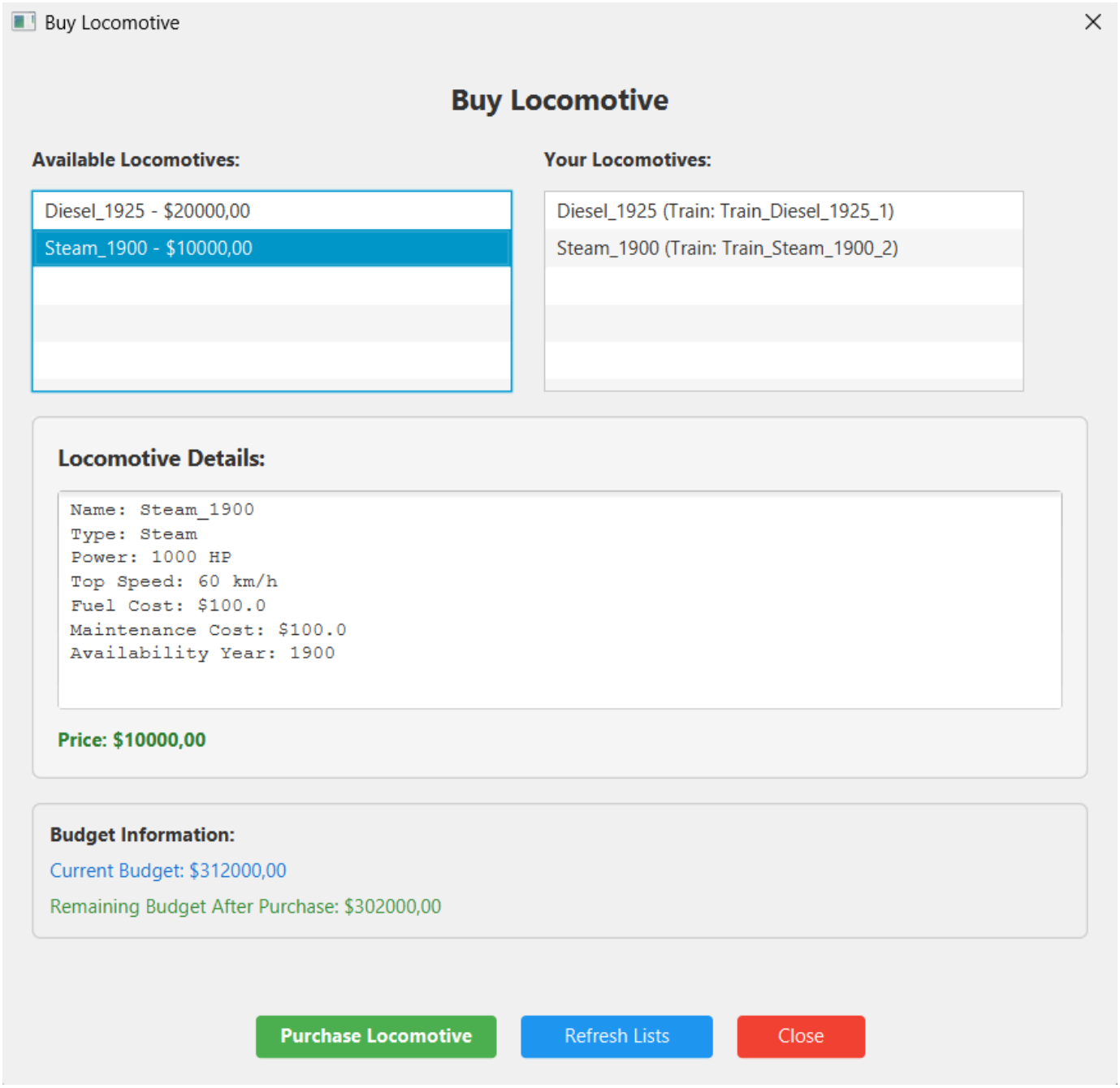
```
=== Buy a Locomotive ===

Available locomotives:
1. Steam_1900 - Type: Steam - Price: 10000,00 - Max Speed: 60 - Power: 1000
2. Diesel_1925 - Type: Diesel - Price: 20000,00 - Max Speed: 80 - Power: 1500

Type your option: 1

Locomotive Details:
Name: Steam_1900
Type: Steam
Power: 1000
Max Speed: 60 km/h
Fuel Cost: 100.0
Maintenance Cost: 100.0 per year
Price: 10000.0
```

Graphical Interface

- **Player then needs to choose to buy a locomotive**



- Then it will ask to select the locomotive to buy



4.6 Train Route Management

- Assign trains to routes
- Configure cargo pickup at stations
- Set station sequence

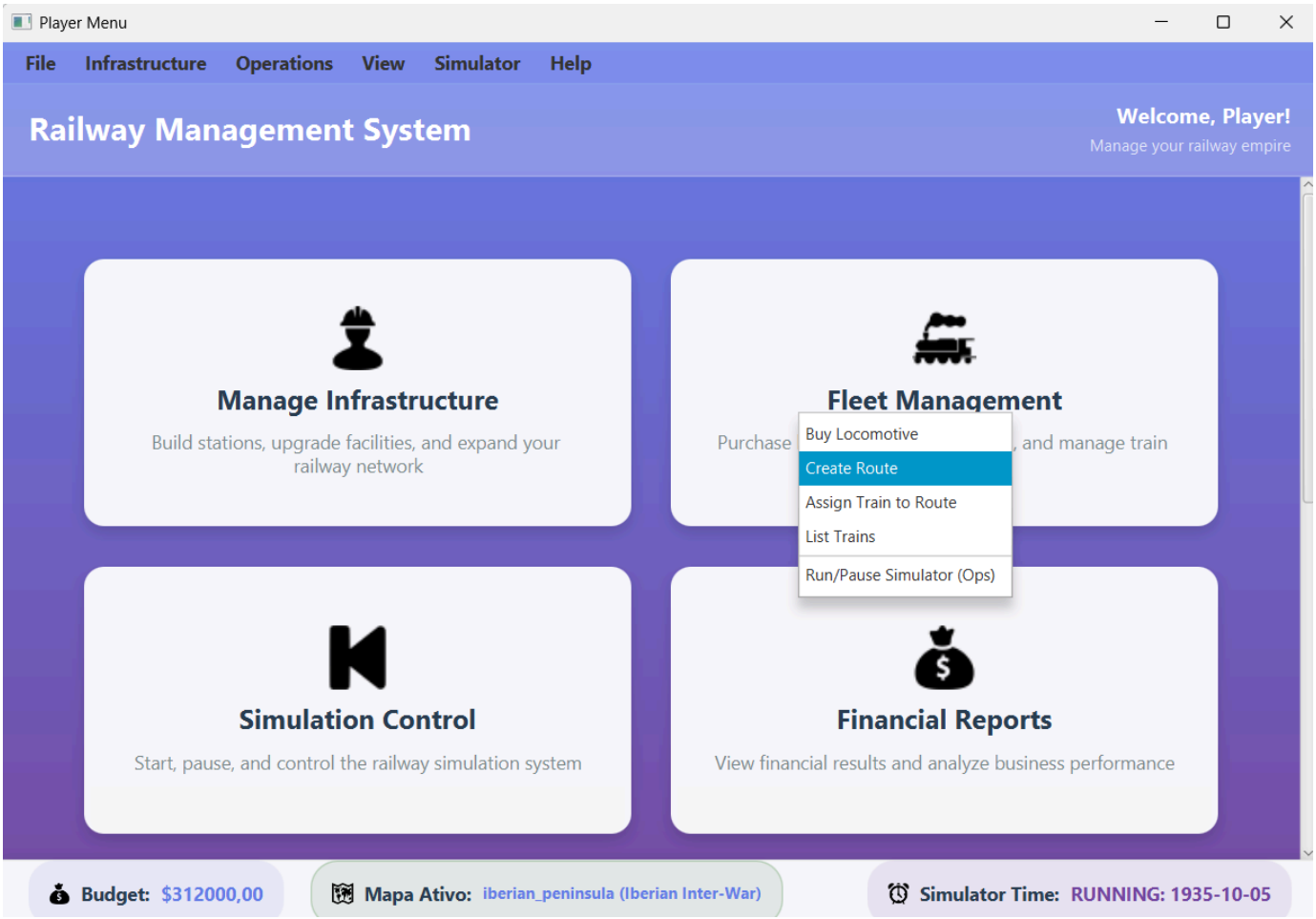
```
=== Create New Route ===


Available stations:
1 - porto DEPOT
2 - porto DEPOT 2
3 - porto DEPOT 3

Select the starting station (1-3, 0 to cancel):

Enter station number1
```

```
╔═══════════════════════════════════════════════════════════════╗
║                      CARGO MODE SELECTION                     ║
╠═══════════════════════════════════════════════════════════════╣
║ Station: porto DEPOT                                          ║
╠═══════════════════════════════════════════════════════════════╣
║ 1. FULL                                                       ║
║    The train will wait at this station until all carriages    ║
║    are fully loaded before departing                          ║
╠═══════════════════════════════════════════════════════════════╣
║ 2. HALF                                                       ║
║    The train will depart from this station as soon as at      ║
║    least 50% of its carriages are loaded                      ║
╠═══════════════════════════════════════════════════════════════╣
║ 3. AVAILABLE                                                  ║
║    The train will depart from this station with whatever      ║
║    cargo is currently available, regardless of capacity       ║
╚═══════════════════════════════════════════════════════════════╝
```

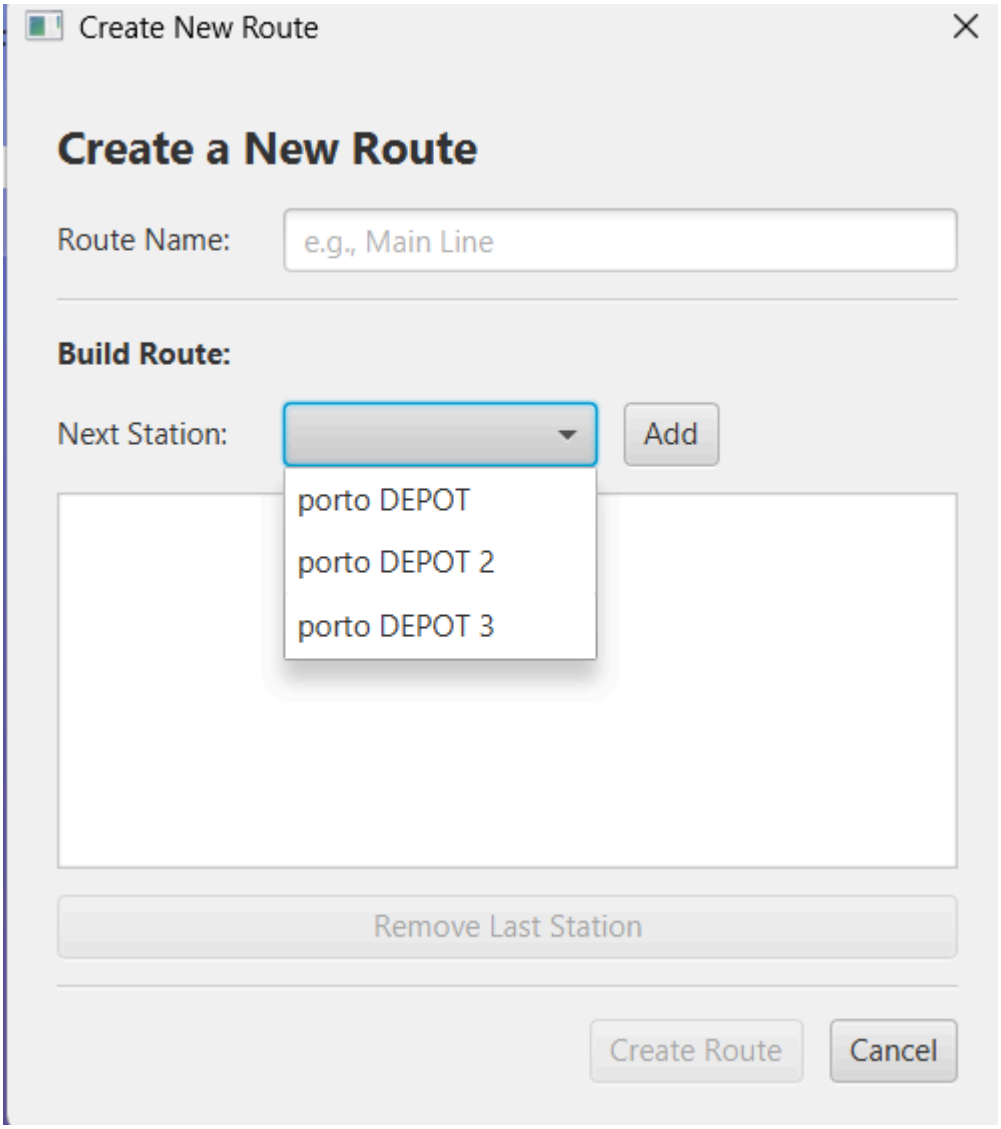
```
Enter your choice (1-3)1

╔═══════════════════════════════════════════════════════════════════════╗
║                        CURRENT ROUTE STATUS                           ║
╠═══════════════════════════════════════════════════════════════════════╣
║ 1. porto DEPOT                          | FULL                        ║
╚═══════════════════════════════════════════════════════════════════════╝

No more connected stations available.

Enter route nameporto-madrid

Failed to create route.
Current Budget: 334000,00
```

Graphical Interface

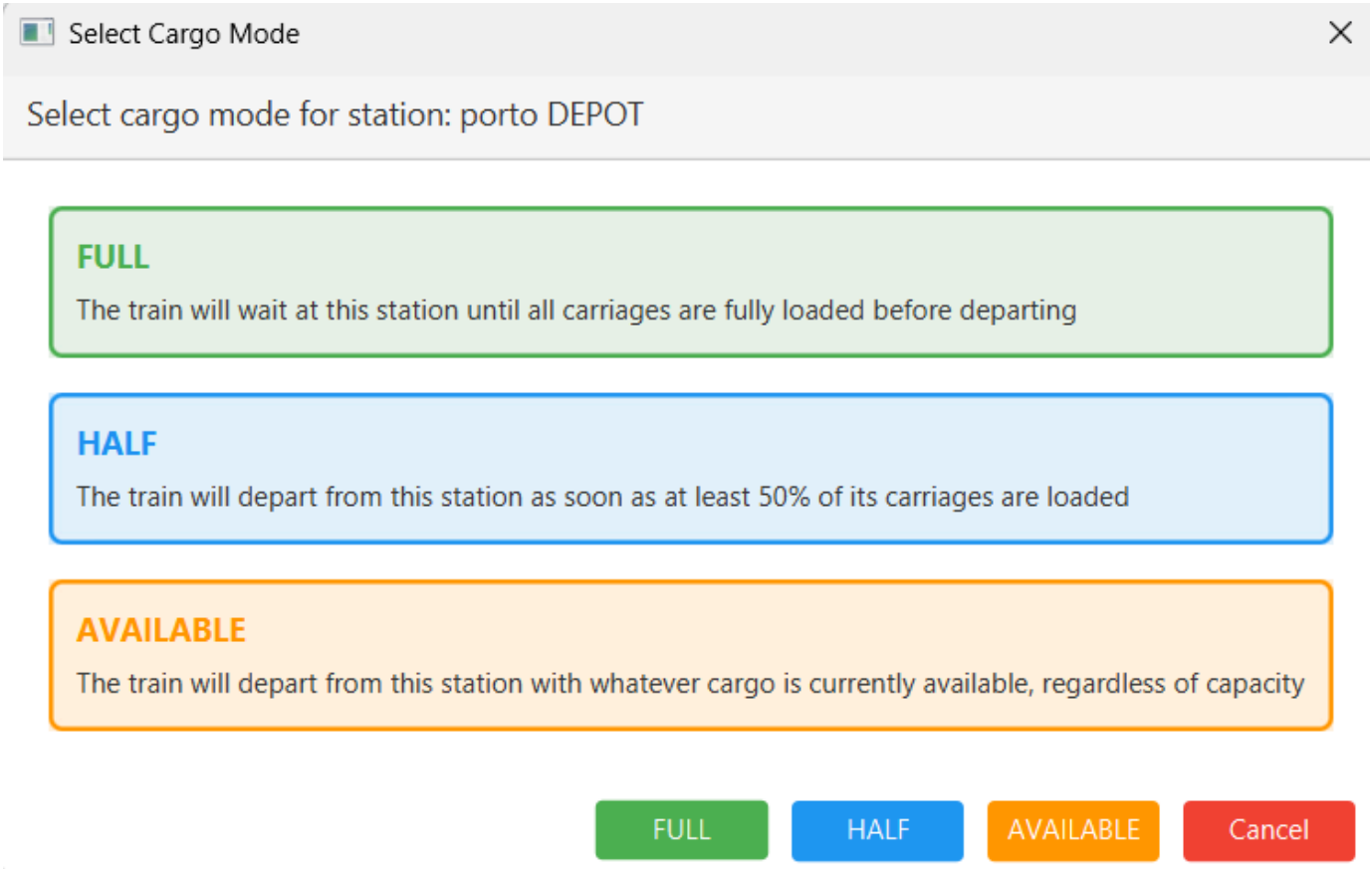
- **Player then needs to choose to create a route**



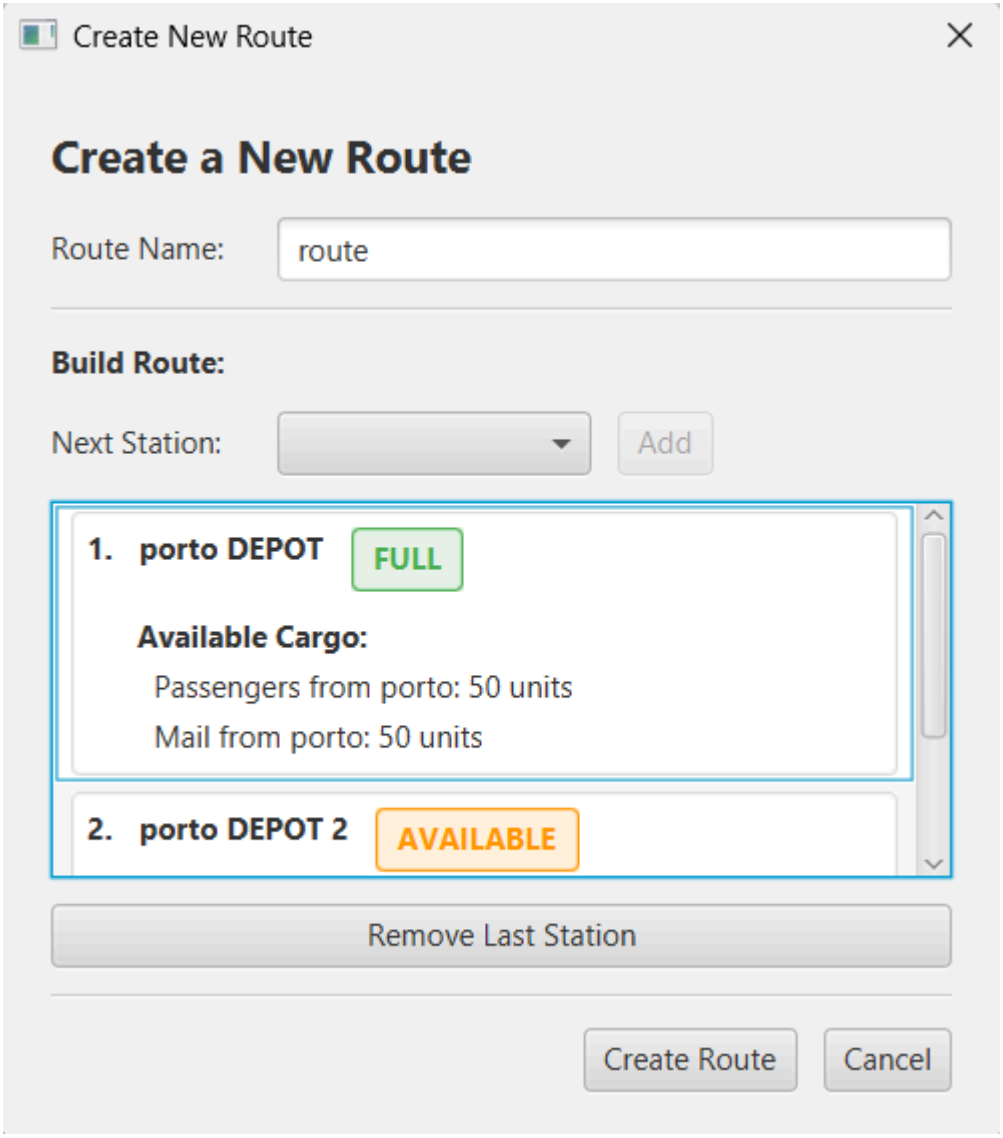
- Then it will ask to select the stations to connect



- **Then it will be prompt to select the cargo mode for each**



- **Finally, it will show the route summary and ask for confirmation**

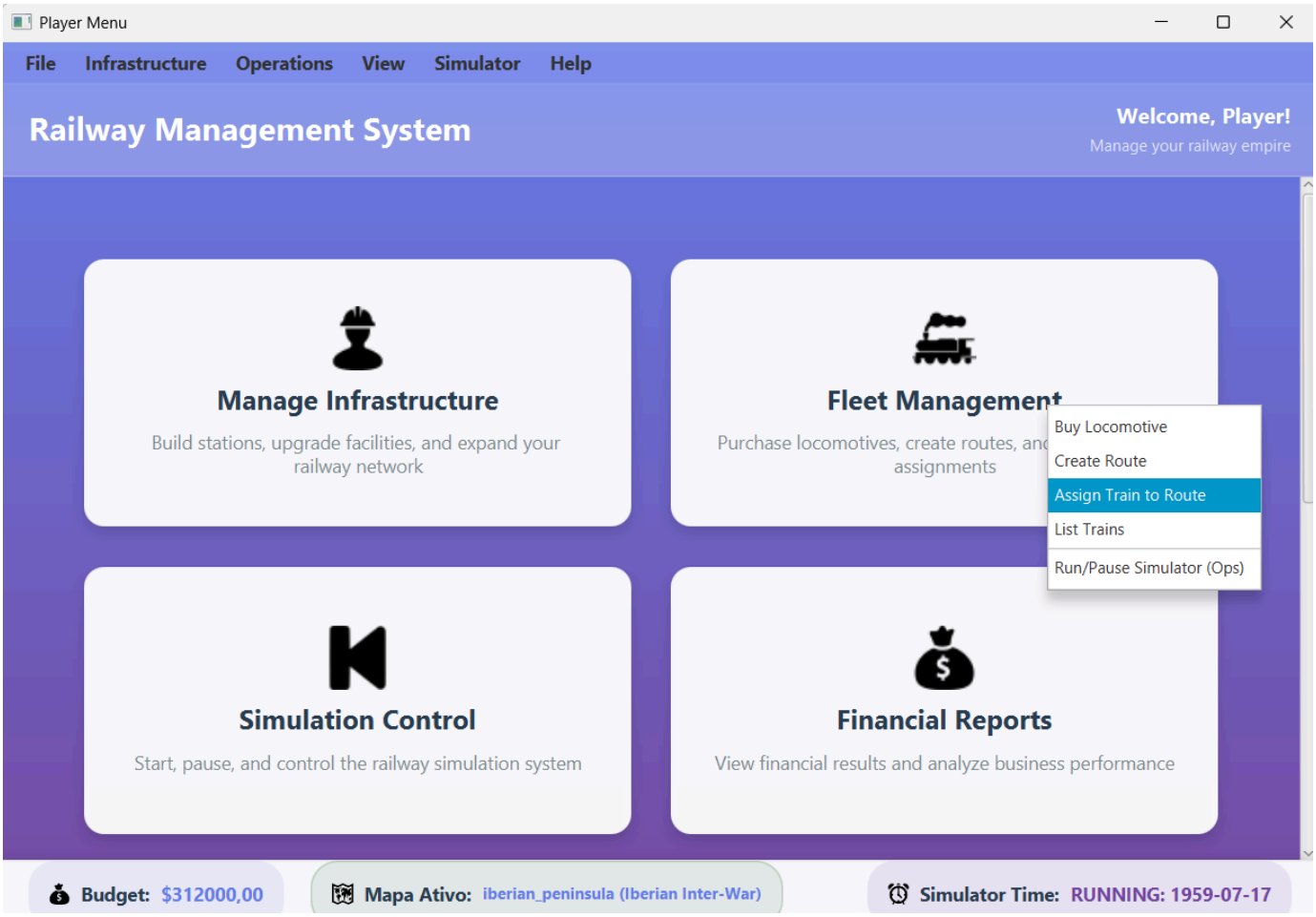


4.7 Train Assignment

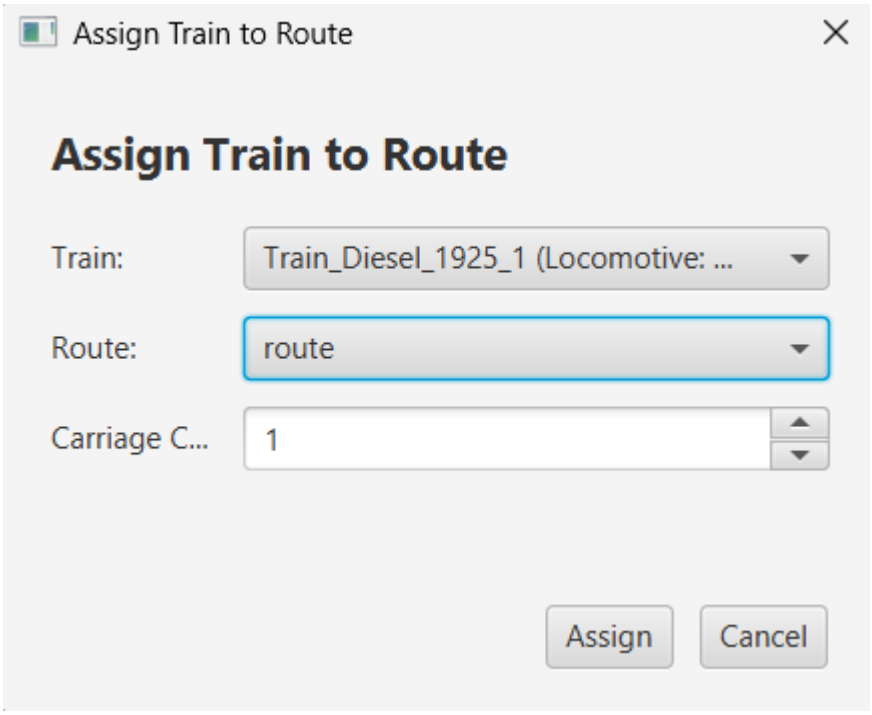
- Assign a purchased locomotive to an existing route

Graphical Interface

- **Player then needs to choose to assign a locomotive to a route**



- Then it will ask to select the locomotive and the route



4.8 Train List

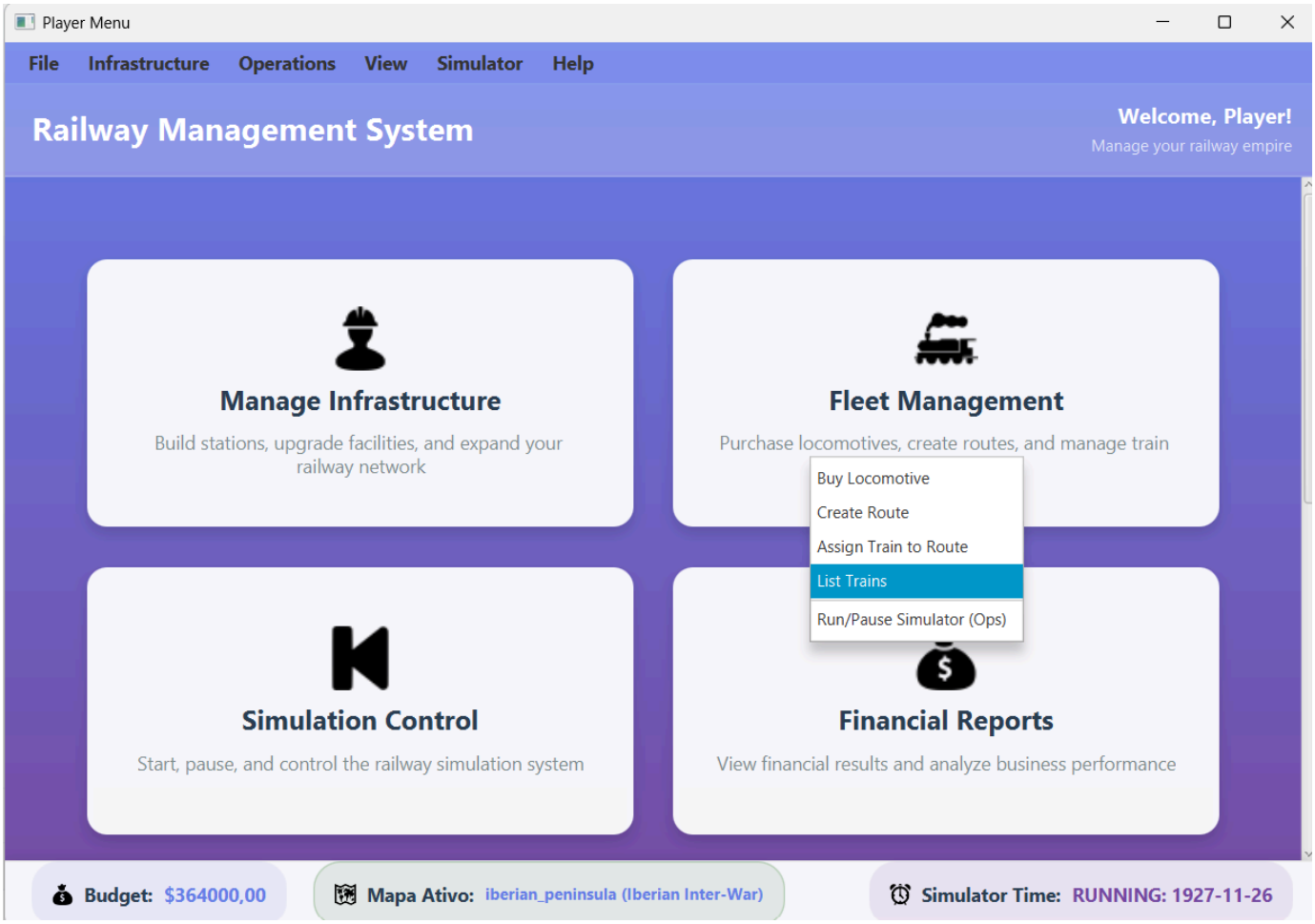
- View all trains grouped by locomotive type

- Sort alphabetically within groups
- Display:
  - Locomotive details
  - Current cargo status

```
=== Steam Locomotives (1) ===
No.  | Name                | Power    | Max Speed  | Fuel Cost  | Maintenance     | Route
-------------------------------------------------------------------------------------------
1    | Steam_1900          | 1000     | 60         | 100,00     | 100,00          | None

Total locomotives: 1
```

Graphical Interface

- **Player then needs to choose to view the train list**



- **Then it will show the list of trains, grouped by locomotive type**

5. Simulator Features (To be implemented)

5.1 Cargo Generation

- Automatic cargo generation at stations
- Based on:
  - Connected cities
  - Served industries
- Start/pause functionality

5.2 Network Statistics

- Analyze network performance
- Track cargo movement
- Monitor station efficiency