Ocean Inc. Project Report

An Industrial Management Game
Set in the Ocean.

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I Project Description

1 Project Overview

Ocean Inc. is a 3D-isometric industrial building and management game that takes place on an ocean. The player must expand their factories, build oil rigs, dispose of waste, and generate wealth to grow an industrial empire. Meanwhile, the sea level rises due to accelerated global warming from carbon emissions. The Ocean will become heavily polluted as well which could affect resource deposits. At this point, the objective of the game changes once the player has caused enough damage to the Earth's oceans. The player must mitigate or remediate the damage, otherwise the environmental effects will destroy their factories and practically render the game unplayable. This would be considered the "losing" state of the game.

This game will be available exclusively for PC platforms, such as Steam or Epic Games Launcher.

2 The Purpose of the Project

By making an educational but fun game for everyone to use. The game will bring awareness to the sea level rising and rapidly generating industrial-sourced pollution in the ocean. This project is being carried out because we want to bring awareness of the rising sea levels and the rapidly melting glaciers that has been happening for decades. The objective is to bring people together and to try to help fund organizations that are taking on this objective. Nonetheless, it's also being created to be a fun educational game for adults and the youth. Some motivation would be to create a game and be able to educate people about how the industrial revolution has affected the climate. We will know when goals have been reached when users download the game and interact with it because it will show that users are interested in the rising sea levels and are learning about it. The goal from the business perspective is to make as much money as possible which will be achieved by the initial purchase of the digital copy and any DLC content we add. Furthermore, if the game is being played and users purchase items in-game then we will be able to measure that.

3 The Scope of the Work

The "work" addressed by the proposed product, *Ocean Ink*, involves the development of an interactive, data-driven simulation game that educates players on the environmental impacts of industrialization, specifically on ocean ecosystems. This product is focused on creating engaging, educational experiences that merge industrial management gameplay with real-world environmental data, aiming to raise awareness about pollution and climate change.

3a The Current Situation

In analyzing the existing landscape of industrial management and environmental simulation games like *SimCity*, *Cities: Skylines*, and *Anno 2070*, it is clear that while these games address pollution and urban growth, they do so in a broad, often simplified context. Manual processes in these games typically involve the player making decisions

about resource allocation, waste management, and expansion, with limited integration of real-world environmental data. Automated processes in these titles handle pollution mechanics and environmental consequences based on predefined rules and player choices, but without dynamic feedback loops that reflect accurate, real-time environmental data. *Ocean Ink* seeks to replace and enhance these processes by offering a more precise, data-driven simulation, incorporating real-world climate data and ecological models to provide an authentic experience. By transitioning from static pollution mechanics to a dynamic, real-world simulation, *Ocean Ink* will create a more immersive, educational experience, allowing players to see the tangible effects of industrial actions on ocean ecosystems. Business analysts might have already conducted this investigation as part of the business case, identifying gaps in the existing products that *Ocean Ink* aims to fill by offering a more nuanced, scientifically accurate gameplay experience.

The motivation behind *Ocean Ink* is to improve upon the simplified environmental systems in games like *SimCity*, *Cities: Skylines*, and *Anno 2070*. In these games, players manually manage industrial growth, while automated processes simulate pollution based on fixed rules. By studying these systems and how players interact with them, *Ocean Ink* aims to fill gaps, such as the lack of real-world data and dynamic environmental feedback. Integrating actual climate data and more responsive environmental mechanics will offer a deeper, more educational experience, showing the true impact of industrial actions on ocean ecosystems.

3b The Context of the Work

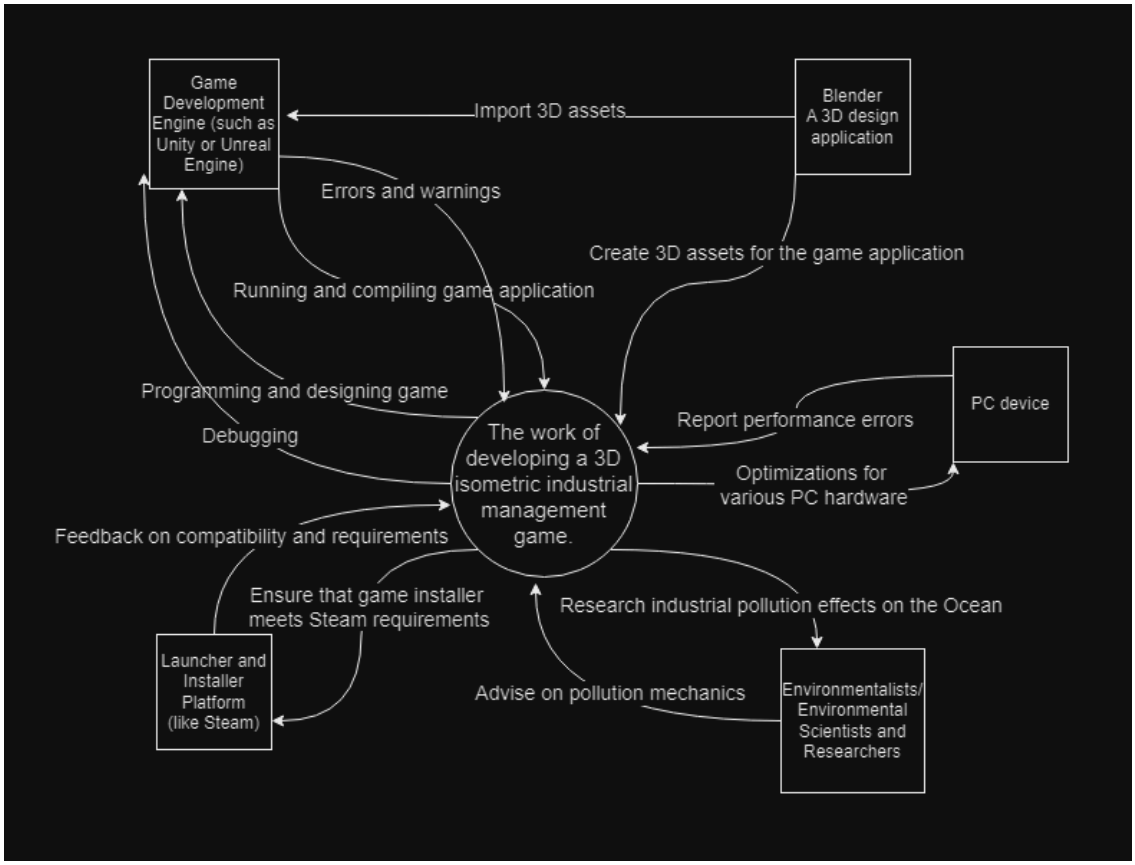

Figure 1

3c Work Partitioning

Business Event List

Event Name	*Input and Output*	*Summary*
1. Ocean Level Station transmits reading	*Ocean Level Sensor Data (in). Updated Ocean Level Reports (out)*	*Collects and analyzes real-time data on sea levels, providing critical information for assessing the impact of industrial activities and informing future business decisions.*
2. Ocean Pollution Reading Station	*Pollution Sensor Data (in). Pollution Level Reports (out).*	*Monitors various pollutants in the water, helping players understand the consequences of their industrial actions and prioritize remediation efforts.*

3. Building More Oil Rigs	*Resource Availability Data, Economic Forecasts (in). Oil Production Reports, Environmental Impact Assessments(out)*	*Players can expand their operations by building additional oil rigs. This decision will affect resource management and environmental health, necessitating careful analysis of potential impacts.*
4. Disposition of waste of business.	*Waste Generation Reports, Local Regulations (In). Waste Management Solutions, Compliance Reports (out).*	*Involves determining how to dispose of generated waste responsibly. Players must navigate regulations and potential fines while aiming to minimize environmental harm.*
5. Cleaning Up Ocean Waset	*Ocean Pollution Reports (in). Cleanup Success Reports, Environmental Health Improvements (out)*	*Initiate cleanup operations to reduce ocean waste, which not only mitigates pollution but also enhances their reputation and fosters marine biodiversity.*
6. Adding more operational buildings	*Infrastructure Capacity Data (in). Operational Efficiency Reports, Resource Allocation Updates (out).*	*Expanding operational buildings improves productivity. Players need to balance expansion with environmental considerations to avoid negative impacts on the ecosystem.*
7. Creating partnerships with other businesses.	*Market Analysis Reports, Business Collaboration Proposals (in). Partnership Agreements, Resource Sharing Plans(out)*	*Forming partnerships can enhance resource efficiency and reduce environmental impacts. Players must assess potential benefits and risks associated with each partnership.*
8. Hiring more personal	*Workforce Demand Analysis (in). Staff Allocation Reports,*	*As the business grows, hiring more personnel is crucial for maintaining efficiency. This decision*

	Operational Efficiency Metrics (out)	*requires evaluating the potential environmental impact of increased industrial activity.*
9. Upgrading current tools.	*Equipment Performance Data (in). Upgraded Tool Efficiency Reports, Environmental Impact Assessments (out).*	*Upgrading tools can enhance productivity and reduce environmental impact. Players must weigh the costs against the benefits of improved operations.*
10. Marine Wildlife Population Report	*Environmental Impact Assessments(in). Wildlife Health Reports, Conservation Recommendations (out)*	*This report provides players with insights into marine life populations, prompting them to consider conservation strategies to protect affected species amid industrial expansion.*
11. Implementing Green Technology Upgrades	*Technology Assessment Reports (in). Energy Efficiency Metrics, Reduced Pollution Levels (out).*	*Players can invest in green technology to improve sustainability. This event requires assessing current technologies and the potential long-term benefits for both the business and the environment.*

3d Competing Products

At the moment, there are no games on the market that are trying to achieve what we are doing. Games that are similar, though, are the ones I mentioned earlier in the section, such as *SimCity*, *Cities: Skylines*, and *Anno 2070*. Our game is different, though, because it specifically focuses on growing an industrial business and the direct negative effects it has on the ocean. While those games touch on pollution and urban development, *Ocean Ink* delves deeper into environmental consequences, using real-world climate data to simulate the impact of industrial actions on marine ecosystems and highlighting the critical need for environmental remediation.

4 The Scope of the Product

The main objective of this game is to balance industrial growth with environmental responsibility. Players will have the opportunity to monitor pollution levels while

making strategic decisions to grow their business. If pollution levels become too high, players can take action to mitigate environmental damage. Conversely, if their business needs expansion, players will have opportunities to invest in growth. The key challenge is to find the right balance between growing an industrial empire and minimizing harm to the planet.

4a Scenario Diagram(s)

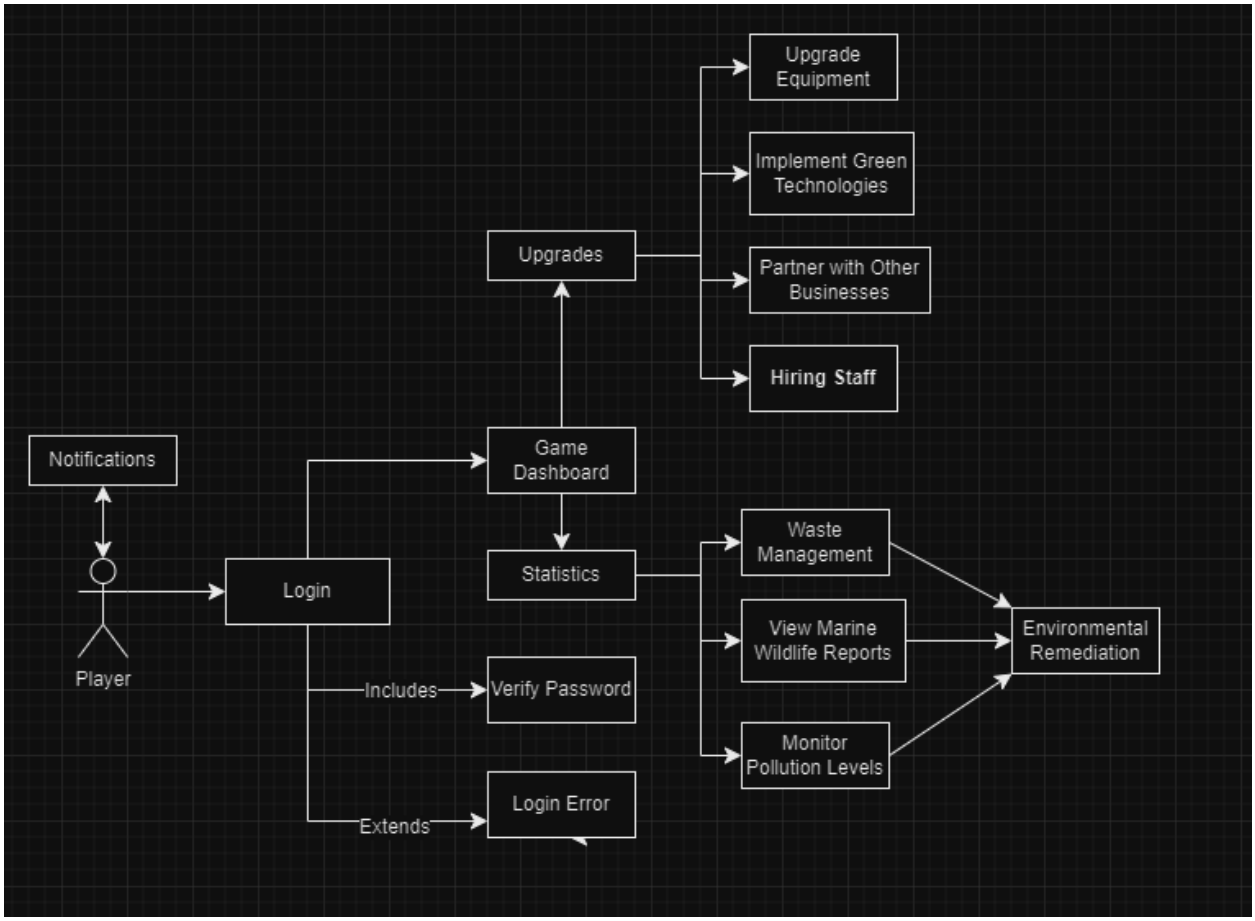

Figure 2

4b Product Scenario List

Scenario Name	Actors
1. Login	User
a. Verify password	Developer
b. Login error	User/Developer
2. Notifications	Developer
3. Upgrades	User
4. Upgrade Equipment	User
5. Implement Green Technologies	User
6. Partner with Other Businesses	User
7. Hiring Staff	User

8. Waste Management User
9. View Wildlife Reports User
10. Monitor Pollution Levels User
11. Environmental Remediation User

4c Individual Product Scenarios

- Login: This feature allows users to securely access their game accounts. Players will enter their credentials, including a username and password, to verify their identity. A successful login will grant access to their saved game progress, achievements, and customization options. If users encounter any issues, such as incorrect passwords or account lockouts, they will receive appropriate error messages and guidance for recovery.
- Notifications: This feature informs players about important updates, events, and alerts related to their industrial activities and environmental conditions. Notifications can include changes in pollution levels, wildlife population reports, successful upgrades, or urgent environmental issues requiring attention. Additionally, players receive reminders for tasks, such as waste management or partnership opportunities. By delivering timely information, this feature helps players make informed decisions and stay engaged with the game's dynamic challenges.
- Upgrades: This tab allows users to manage and improve various aspects of their industrial empire. When players open the Upgrades tab, they will see a list of potential upgrades available for their factories, equipment, and other resources. These upgrades might focus on enhancing productivity, reducing environmental impact, or implementing new technologies.
- Upgrade Equipment: This feature allows users to enhance their existing equipment, provided they have accumulated sufficient funds. Players can browse through available upgrades for their machinery and tools, which can improve operational efficiency, increase production output, or reduce environmental impact.
- Implement Green Technologies: This feature enables users to invest in sustainable technologies aimed at reducing their business's environmental footprint. Once players have the necessary resources, they can adopt eco-friendly solutions such as renewable energy sources, waste reduction systems, or pollution control measures.
- Partner With Other Businesses: This feature allows players to collaborate with other virtual businesses in the game. By forming partnerships, users can share resources, expand their market reach, and reduce operational costs. Collaborations may also open up opportunities for joint ventures in environmentally friendly technologies, waste management solutions, or other mutually beneficial projects.
- Hiring Staff: This option enables players to recruit additional personnel to improve the efficiency and productivity of their business. As the industrial empire grows, expanding the workforce becomes crucial to manage new operations, maintain equipment, and oversee environmental remediation efforts.
- Waste Management: This feature allows players to manage the disposal of waste generated by their industrial activities. Players must decide how to handle different types of waste—whether to invest in environmentally friendly disposal

methods, such as recycling or waste treatment, or opt for cheaper but more harmful options.

- View Wildlife Reports: This feature allows players to monitor the health and population levels of marine wildlife affected by their industrial activities. Players will receive detailed reports on various species, highlighting the impact of pollution, habitat destruction, and other environmental factors.
- Monitor Pollution Levels: This feature gives players real-time data on the pollution their industrial activities are generating in the ocean. Players can track various types of pollutants, such as chemical waste, oil spills, or plastic, through a pollution meter. The pollution levels will fluctuate based on their decisions related to production, waste management, and environmental policies.
- Environmental Remediation: This feature enables players to take action to repair the environmental damage caused by their industrial activities. Players can invest in various remediation strategies, such as cleaning up ocean pollution and restoring marine habitats. The effectiveness of these efforts will depend on the severity of the damage and the chosen method of remediation.

5 Stakeholders

5a The Client

The clients for the game would be game development companies or environmental organizations that are aiming and thinking that making an educational and engaging game like this would be a great way to educate people about the industrial impact on the oceans. The client needs to be interested in making a great product that raises awareness about climate change.

5b The Customer

The customers of the game would be multiple types of people. The first type of people would be schools that want to educate their students in a fun and interactive way about this specific topic, the second would be just ordinary people who like playing games and either want to play a fun management/simulation game for fun or educational purposes.

5c Hands-On Users of the Product

The Hands-On users of this application would be the students in the school who will be using the educational app, and other users would be ordinary people of any age who want to play the experience to learn or have fun.

The users role would be to build and grow their industries and while that is happening their factories will be producing pollution which they would then learn about and learn about how to deal with it to prevent the sea level from rising and hurting the wildlife and prevent too much pollution from occurring to be able to keep playing the game and learning.

It will be used by any age group of people, for people who are 18+ people who want to learn about pollution of the ocean from different industries, and for younger kids still in school who will use it as an educational tool.

5d Maintenance Users and Service Technicians

Different people who provide maintenance would include game developers, technical support teams, ocean pollution researchers, and possibly modders who want to update the game or extend its features.

These users will ensure that the game works, receive new content, and make sure that all the information of the game stays up to date and accurate to make sure that the different effects in the game match real life for each industry.

5e Other Stakeholders

Sponsor: Environmental organizations funding the project to raise awareness about ocean pollution.

Testers: Game testers who will ensure the product is both fun and educational, including different people who already play and enjoy educational games as well as students from different schools who will give suggestions on how to improve the game to make it more enjoyable to learn.

System designers: Responsible for creating an intuitive and well-designed user interface.

Marketing experts: Will ensure the game reaches the intended audience, such as people who enjoy simulation and education games, environmentally conscious people, and schools.

Domain experts: Climate change scientists will provide expertise on the game's environmental effects, messages, and gameplay.

These stakeholders will ensure the game is accurate, educational, and fun so that all people who play the game will enjoy their time while also learning.

5f User Participation

Before the game fully releases there will be people who play educational games, normal games, students from schools, and environmental experts who will play the game and give feedback on things that can be improved. This feedback will be used to make the game balanced between enjoyability and learning.

Beta testing would likely last for a few months until a high amount of feedback is received and the changes to be made.

5g Priorities Assigned to Users

Key users would be kids who are in school from middle to high school, as well as people who enjoy playing games and care about the environment.

Secondary users would be people who are not playing the game to learn but want to play a game that involves strategy and simulation. This will at the same time still be educational because the user would need to learn about the game and the pollution from industries to be able to progress through the game.

6 Mandated Constraints

6a Solution Constraints

Description: The final product will be a game developed to be played on a personal computer/laptop.

Rationale: Computers/Laptops and computer labs are located in mostly all schools and homes so it would be playable by people anywhere they are.

Fit Criteria: The game must not need a lot of power to run, meaning that it will be playable on almost all computers or laptops no matter how powerful it is.

Description: The game should be educational and entertaining.

Rationale: The game should be able to be a fun game for the users while also educating them on the importance of pollution in the ocean.

Fit Criteria: The user would need to play the game and pay attention to all of the important information that affects the gameplay and pollution.

6b Implementation Environment of the Current System

The product will be a game that will be accessible on any computer. It will be available for download on “Steam” which is a digital distribution platform and storefront for video games. It will be accessible for both Windows and Apple computers.

6c Partner or Collaborative Applications

The product will need collaboration with ocean pollution and industrial pollution experts to be able to collect accurate information to be used in the game as an educational tool. The product would also want to collaborate with many schools to be able to get the schools to use the game as an educational tool in schools for certain classes.

6d Off-the-Shelf Software

Content: To be able to create the game it would need Unity or Unreal Engine to be able to create the 3D graphics, physics simulation, and gameplay mechanics. A

database will be needed to manage the player's game state, player data, and progress. Other tools like Blender and Adobe will be used for 3D modeling for the game.

Motivation: Existed tools like these would allow well-designed and rapid prototyping of different mechanics of the game to test for accuracy and gameplay of all of the features.

Examples: Unity offers extensive documentation and a large asset store, making it easy to find resources. Databases such as MongoDB allow for flexibility and easy integration with the game's backend.

Considerations: Game design requirements and commercial off-the-shelf software may conflict in different ways such as the software not allowing a certain level of needed customization for the game. Identifying the needs of the game and software as soon as possible will help decide whether the game needs to have a specific feature or use a different solution or software.

6e Anticipated Workplace Environment

The game will be accessible using wifi through the Steam game launcher. The user would be located in a place that has wifi connectivity and has access to a computer or laptop to be able to access and play the game.

6f Schedule Constraints

There is no specific schedule but the sooner the game is ready for beta testing the better. As soon as the game is in a playable state it will be released to schools and people who want to beta test the game and give feedback on what can be improved both for educational and entertainment purposes. This will let the game be able to be fully created as soon as possible and released to the public in a working state.

6g Budget Constraints

Content: The project budget would be around $500 thousand dollars, this budget would include development, marketing, and research costs needed for the project. The development would include game design, programming, and asset design and creation. The research will include research on the different effects of pollution on oceans from industrial buildings.

Motivation: These are essential to developing the game to make it look good, fun, and interesting to play, as well as having real facts and data from real life to make it an educational experience.

The budget should be properly allocated to different parts of the project to make sure that the right amount of development, marketing, and research is done to complete the project.

7 Naming Conventions and Definitions

7a Definitions of Key Terms

Factories: Buildings that the player can build which will either make them money or gather resources along with producing pollution.

Playable Area: The space where the player can build factories.

Build Menu: A menu that contains the different factories available to build.

Pollution Meter: A meter that displays how much pollution the factory is producing.

Upgrades: Factories can be upgraded in different ways to increase productivity or reduce pollution.

Pollution Rate: Rate of pollution produced by a factory. {Pollution unit per day}

Resouces: The money and materials available to a player.

7b UML and Other Notation Used in This Document

This document typically follows the Version 2.0 OMG UML standard, as described by Fowler in UML Distilled, Third Edition, Boston: Pearson Education, 2004. Exceptions may be noted in specific cases.

7c Data Dictionary for Any Included Models

pollution meter amount = {factory1 pollution rate + factory2 pollution rate + factoryN pollution rate…} x {days passed}

Determining Pollution Rate: Depends on the factory type and the amount of waste it produces.

8 Relevant Facts and Assumptions

8a Facts

- Census data from websites like NASA will be pulled in order to try to make the game as realistic as possible.
- Climate data will be collected in order to make industry factories show real effects in the game.
- Sea-level and glacier images will be used in order to show real-life effects in the game.
- Census data will be collected from Government organizations to see how the climate has been affected by industry factories.

8b Assumptions

- Players will be able to assume their industrial actions have consequences.
- Assuming that the development team has all the tools it needs and will be managing the game for bug fixes, feedback, and updates.
- Users will assume it will work on their PC.
- The development team will assume the user has no knowledge of climate change and factories' effects on climate change.
- It will be assumed that there will be a partnership with environmental organizations in order to try to make the game as realistic and educational as possible.
- It will be assumed that micro-transactions will be made in-game for cosmetics.
- There will be no changes due to environmental effects that should impact the development.
- Software tools that are expected to be available will be Unity or Unreal engine for the game development and somewhere to store the code like Github. Furthermore, in order to create tasks and manage activity JIRA.
- We are expecting to use the product in order to educate and make a profitable game to bring awareness to climate change's effect on Oceans.
- Any business changes we will be able to deal with are any copyright issues because this is very different from products out in the market.

II Requirements

1 Product Use Cases

1a Use Case Diagrams

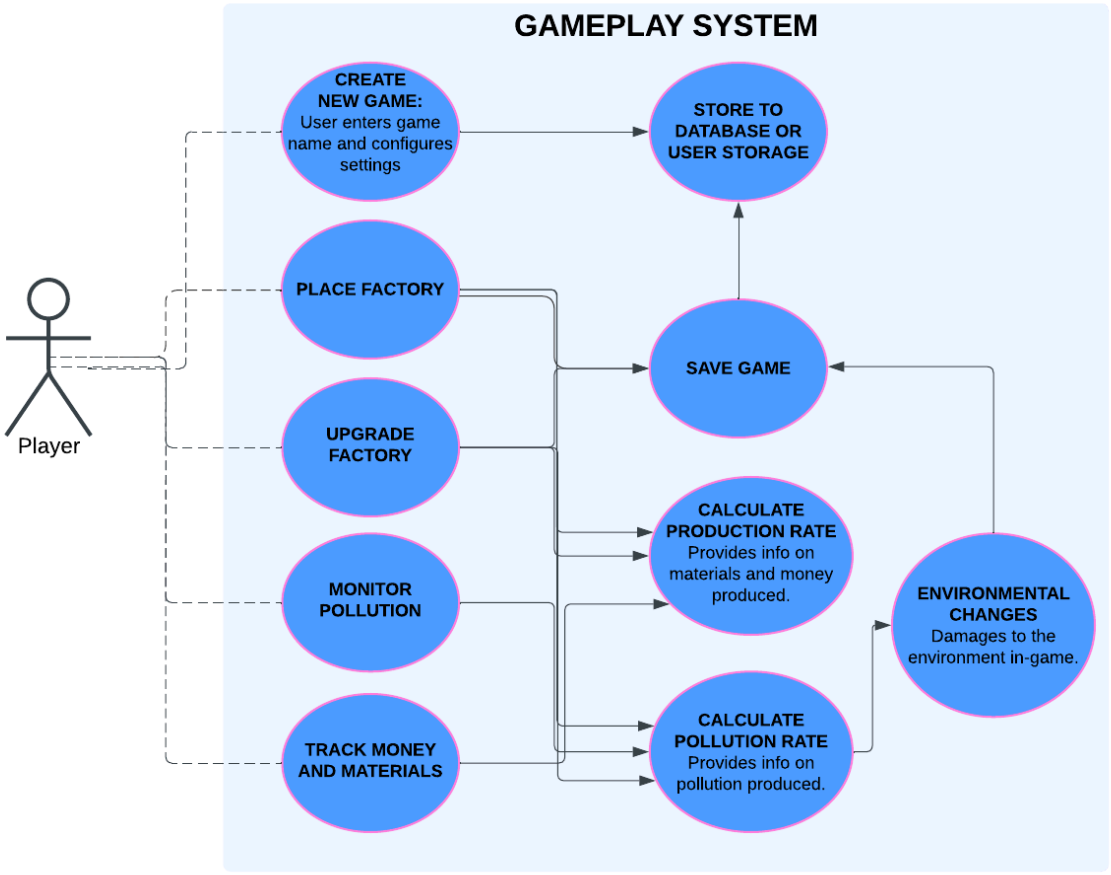

Figure 1 - Gameplay Use Case Diagram

1b Product Use Case List

- A player creates a new game and types in a name for it so it can be saved to their local storage or in the server database.
- A player places a factory in-game to increase the production rate of money and materials. The game must save and recalculate the pollution and production rate.
- A player upgrades a factory in-game to increase the production rate of money and materials. The game must save and recalculate the pollution and production rate.
- A player monitors pollution to understand how much pollution their industrial area is producing.

- A player tracks their money and materials they have at their disposal to spend on upgrades and buying more factories.

1c Individual Product Use Cases

Use case ID:#001 Name: Create New Game pre-conditions: Game application is installed properly and launched on the user's device. post-conditions: New game is created and ready to be played on. Initiated by: Player Triggering Event: User selects "New Game" option in main menu. Additional Actors: System database/storage
Sequence of Events: 1. User installs game and launches it. 2. User loads into the main menu. 3. User selects "New Game" button on main menu. 4. The game prompts the user to enter a name for the new game. 5. User enters a name and the game initialization begins. 6. Once the game is created, the system saves the game to storage.
Alternatives: User loads into a game that already exists in storage. Exceptions: Errors can occur on game launch, initialization, and saving to storage.

Use case ID:#002 Name: Place Factory

pre-conditions: Game application is installed properly and launched on the user's device. A saved game is loaded.

post-conditions: A new factory is placed and working.

Initiated by: Player

Triggering Event: User selects a factory option and places it in the area of play.

Additional Actors: System database/storage

Sequence of Events:

1. User installs game and launches it.
2. User loads into or creates a new saved game.
3. User selects a factory from the build menu, then dragging it into the area of play.
4. The system calculates the new production and pollution rate.
5. The system saves the game to storage.

Alternatives: The game is already loaded and launched, so the user places another factory.

Exceptions: Errors can occur on game launch, initialization, saving to storage, and in calculating rates.

Use case ID:#003 Name: Upgrade Factory

pre-conditions: Game application is installed properly and launched on the user's device. A saved game is loaded. At least one factory exists in the user's game.

post-conditions: A factory is upgraded and working.

Initiated by: Player

Triggering Event: User selects a factory and chooses an upgrade.

Additional Actors: System database/storage

Sequence of Events:

1. User installs game and launches it.
2. User loads into or creates a new saved game.
3. User selects a factory in the area of play.
4. User selects an upgrade in the upgrade menu shown upon selecting a factory.
5. The system calculates the new production and pollution rate.
6. The system saves the game to storage.

Alternatives: The player doesn't have a factory yet, so they must place a factory first.

Exceptions: Errors can occur on game launch, initialization, saving to storage, and in calculating rates.

Use case ID:#004 Name: Tracking materials, money, and/or pollution pre-conditions: Game application is installed properly and launched on the user's device. A saved game is loaded. post-conditions: N/A Initiated by: User Triggering Event: Game loads. Additional Actors: N/A
Sequence of Events: 1. User installs game and launches it. 2. User loads into or creates a new saved game. 3. System calculates and displays total of money, materials, and pollution produced. 4. User may check these values to understand progress and affordances.
Alternatives: Pollution total may trigger environmental events. Exceptions: Errors can occur on game launch, initialization, and calculating rates/totals.

2 Functional Requirements

#005 - Initializing a new saved game.

Description: The game application system must initialize a new game for the user to play on.

Rationale: The game is just not possible to play if there's no game save being created in the first place.

Fit Criterion: Does the user need to input anything to create a game? Does the user's device have the necessary hardware to initialize the game? How long will the user wait during initialization?

Acceptance Tests: Must test if game is operating correctly after a game save has been created. Must test the initialization process efficiency and functionality.

#**006 - Calculating Production Rate**

Description: The game application system must calculate the production rate of money and materials that are produced by factories.

Rationale: The game needs to give the user the correct amount of resources as industrial area of play works.

Fit Criterion: How many factories has the user placed? What are the statistics of these factories?

Acceptance Tests: Must test if production rate is being accurately calculated based on the amount and types of factories that are placed.

#**007 - Calculating Pollution Rate**

Description: The game application system must calculate the pollution rate of factories.

Rationale: The game needs to set the pollution rate in order to trigger environmental events correctly which is the interesting dynamic aspect of the whole game.

Fit Criterion: How many factories has the user placed? What are the statistics of these factories? What environmental events could trigger?

Acceptance Tests: Must test if pollution rate is being accurately calculated based on the amount and types of factories that are placed. Must test if environmental events are triggered correctly at specific stages of pollution rate.

3 Data Requirements

#008 - Saving Games

Description: The game application must store game data and progression in the local storage and potentially the server database. This should not contain any personal information, but if the saves will be stored on the server then it's possible that we will need to store the user's user ID and username.

Rationale: Games need to be saved to a storage system so the player can return to their game later.

Fit Criterion: How much storage could be used? How much storage does the player's device have available? We must establish an effective storage system to avoid using too much storage.

Acceptance Tests: Game saves need to be tested by loading saves in order to ensure that the games were saved properly and can load without any errors.

4 Performance Requirements

4a Speed and Latency Requirements

When the user is playing the game there should be as little lag as possible to make the game more playable and enjoyable for the user. When making a decision in the game like placing a new industrial building or when facts appear on the screen on how the ocean and environment is being affected by the players decision, it is okay if there is a small amount of delay but nothing over a few seconds.

#009 - Performance

Description: The application must be fairly fast at making decisions and generating buildings, terrain, and educational facts.

Rationale: The application must be fast because no one wants to play a game that lags which ruins the entire experience of both the game and learning.

Fit Criterion: The loading of terrain and other important information and objects must take a few seconds at most.

Acceptance Tests: Test the average times it takes for each action and information to be loaded and make sure they are properly listed.

4b Precision or Accuracy Requirements

The information needs to be very accurate at all times, every decision that the player makes must have a specific action applied to it. This is very important because this game is educational and must be accurate at all times to keep actions accurate and all facts based on those actions one hundred percent accurate as well so there is no wrong information.

#010 - Precision and Accuracy

Description: The application must be as accurate as possible.

Rationale: The game has certain actions that end with certain outcomes in the oceans and they must be accurate to properly educate the users.

Fit Criterion: Applications should be able to update after every user interaction and over short periods of time for things such as random in game events.

Acceptance Tests: Test to make sure that the test updates at the right time to make sure everything is functioning properly.

4c Capacity Requirements

The application must be able to hold all players in-game information that create an account and play and store it until the user wants to clear the data, restart the game, or when they lose. The game must handle at least a few thousand players at a time within the period from 8:00 A.M. to 9:00 P.M. and slightly less at all other times.

#011 - Capacity

Description: The system shall hold all users in-game information and be able to handle a few thousand users at peak hours.

Rationale: These capacity requirements ensure that all the players that want to play the game are able to play and load their information at the times they want to play.

Fit Criterion: The game must handle a few thousand players and store all their information to be used when they log back into the game.

Acceptance Tests: Stress test the servers by creating many concurrent players during peak hours and test retrieving all of their in-game information.

5 Dependability Requirements

5a Reliability Requirements

The application should almost never crash since avoiding a crash completely is unavoidable. If a crash happens the application should not corrupt and should have all of the players data properly saved before the crash so no progress or minimal progress is lost.

#012 - Reliability

Description: The application must minimize crashing as much as possible and must have a backup/fail-safe in place in case a crash occurs.

Rationale: Since crashing would ruin the experience of playing and learning while using the application and might cause player data to be lost it is important for the application to be durable and prevent crashes as much as possible.

Fit Criterion: Test all possible situations that might cause the game to crash and check to see if the player data is saved and nothing is corrupted or damaged.

Acceptance Tests: Test the limits of the application to see how often the application crashes.

5b Availability Requirements

The game will be available 24/7 but should have a higher capacity for players from 8:00 A.M. to 9:00 P.M. because that is when more people will be on and the time also contains the hours of the school day so many people can learn and play during that time.

#013 - Availability

Description: The application should be available 24/7 and have higher player capacity from 8:00 A.M. to 9:00 P.M.

Rationale: People can play the game at any time but the time from 8:00 A.M. to 9:00 P.M. is the time most people will be using the educational game if used either at home or school.

Fit Criterion: The uptime should be as high as possible except when there are scheduled maintenance which should happen outside of the higher player capacity time when possible.

Acceptance Tests: Test to see availability of the users and test to see if the application is available for 24 hours a day on most days.

5c Robustness or Fault-Tolerance Requirements

During any kind of shortage or failure, the users data will not be affected but the application won't be able to load any information to the game that is not already there. But if the application is offline the game should still be playable because it is an offline single player game and when it becomes online again the data should be saved online instead of locally.

#014 - Fault-Tolerance

Description: The player should still be able to play the game if a failure or something happens with the data that is saved locally on their device and it will update when back online.

Rationale: The application is a single player game so the data can be saved locally and can be saved online when available.

Fit Criterion: Check if users are able to continue playing the game while they are offline and what can be accessed during maintenance.

Acceptance Tests: Test what the users are able to do on the application while it is offline and then check if the application saves the data when it goes back online.

5d Safety-Critical Requirements

The application will not sell any user information that is used to create and access the account. The application will keep all user data private and secure.

#015 - Safety

Description: The application will not sell or distribute any player account information and keep it secure from unauthorized access.

Rationale: Since each player must create an account to access the game to have all information saved it must insure that none of the information is shared to anyone.

Fit Criterion: Only the person who made the account will have access to their own information and will be able to change it.

Acceptance Tests: Create multiple accounts and test if anyone else is able to access the information from anywhere in their game or anywhere else. Test if anyone working on building the application have access to the information or not.

6 Maintainability and Supportability Requirements

6a Maintenance Requirements

This game app will require lots of regular system maintenance not only for updates but also for bug fixes. Additionally, server changes and compatibility between multiple platforms will be required. So, a new software team will be required to update the game and fix any bugs accordingly. However, to maintain good communication developers will have to describe any changes to the code inorder for other/original developers to know what exactly is being changed.

#016 - Maintenance

Description: This game requires regular maintenance to implement new updates and maintain any bug fixes.

Rationale: The game must be updated regularly in order to keep engagement and bring new content to any user who is playing the game. Bugs must be minimized in order to bring the best experience to users, educate users further, and to minimize any profit loss.

Fit Criterion: If no maintenance is done it can lead to game crashes or any functionality within the game to not work properly.

Acceptance Tests: Test regularly which can include, but is not limited to: server tests, bug fixes test, run time tests, etc.

6b Supportability Requirements

Supportability requirements include regular content updates that help reflect on the education side of how the world was affected since the industrial revolution. Some of these content updates will include new marine spaces, new effects with new species, and new landscape inorder to show how the environment in general is changing. Apart from this other Supportability requirements like a FAQ page inorder to answer any questions users may have or a ticket system that allows users to report any bugs/errors within the game. This will all be maintained by the software development team while the FAQ page and ticket system will be managed by the customer service team.

#017 - Supportability

Description: Support maintenance must be able to create a healthy relationship with its users in order to be as effective as possible. Additionally, it will also help bring new content for users' engagement.

Rationale: Customer support is needed inorder to have a relationship with users at all and to get feedback from the game. Additionally, ideas will also be considered.

Fit Criterion: Customer support is important for customers and for business.

Acceptance Tests: Feedback from users and reports of any bugs.

6c Adaptability Requirements

This game will be the first released PC and may be cross platform i.e IOS/Android(MOBILE) in the future. Furthermore, any updates will be released at the same time depending on the current compatibility. The software development team will be in charge of doing this task and making sure that updates run smoothly. Modifications will be made to devices that are higher OS/version type in order to best suit their device.

#018 - Adaptability

Description: The game may be compatible with IOS/Android in future. First, it will only be available for PC and any updates will occur only to current compatibility

Rationale: This is required to make sure our game remains compatible with all kinds of user devices.

Fit Criterion: This is able to reach many users that have different devices.

Acceptance Tests: Compatibility test to ensure it works on certain devices.

6d Scalability or Extensibility Requirements

At first launch, the game should be able to handle users by the hundred of thousands in order to make sure the game will work with lots of users. It should run on their device smoothly, be able to make purchases, and in general just being able to play the game with minimal bugs.

#019 - Scalability and Extensibility

Description: The game will provide scalability and extensibility towards any users.

Rationale: This must be handled in case the game performs much better than expected leading to a large number of people who may want to play.

Fit Criterion: Game should provide extensibility towards all users and scalability in order to not affect users experience if lots of players try to play the game.

Acceptance Tests: Scalability and Extensibility tests

6e Longevity Requirements

This game will be functional and operate as long as there is profit gained from the game or any donations are able to keep the game running. To test the Longevity we would have to look at the data like if users are staying engaged, or if they're buying any micro-transactions. We can collect this data and see from 3-5 years compared to when it was launched if the game should be continued or not.

#020 - Longevity

Description: The game must keep running without any errors for as long as the game is still profitable and worth keeping up.

Rationale: This is required to see if the game is liked and if it's still worth supporting business wise.

Fit Criterion: Be accessible to any user around the world.

Acceptance Tests: Yearly check and then 3-5 check.

7 Security Requirements

7a Access Requirements

The Ocean Inc. application holds a few personal details from the user such as an email and password for account creation. So it should restrict anyone from being able to access the details except authorized system processes.

#021 - Access

Description: Users data must be secure and not be able to be accessed by anyone besides authorized system processes where it is needed to be used.

Rationale: This is required to keep all user data secure and private to prevent any leaks.

Fit Criterion: If the application somehow has a security breach, the team where the breach took place will be notified where it happened and who did it.

Acceptance Tests: Make security breach tests to make sure the system notifies properly.

7b Integrity Requirements

Developers will perform security checks and data backups to prevent any data from being stolen or lost for both the game and the user's information used in the game. Data checks will be done from time to time to ensure that everything is safe and not lost.

#022 - Integrity

Description: Users personal and in-game data will be backed up every week and will perform tests to ensure the data's integrity.

Rationale: To minimize chances of data being lost or stolen.

Fit Criterion: To ensure no game progression is lost or personal data is lost or stolen.

Acceptance Tests: Test backing up user data as well as the database functionality.

7c Privacy Requirements

Ocean Inc. doesn't hold a lot of personal data but for that data that it holds, the email/usernames will be unique so only the account owner will be able to access their own account and information. To access personal accounts the user will have to use their email address and password, and will only be able to change their information from their personal email (with the forget password button) used to create the

account. The game will also have terms and conditions, which will also notify players when they have changed.

#023 - Name

Description: Only the account holder should be able to access their own account and will be notified of any changed terms and conditions.

Rationale: All user data is personal and should not be accessed by anyone besides the account owner.

Fit Criterion: This ensures there are no data breaches to maintain privacy for the user.

Acceptance Tests: Make sure users can only access their accounts with the correct email and password and test changing the terms and conditions.

7d Audit Requirements

The game should keep a record of important player actions and progress and the application will have a history of what each player has done. This can help resolve issues if players report problems and allow for analysis of how players interact with the game.

#024 - Audit

Description: All in-game information and actions will be stored.

Rationale: Helps track users actions to troubleshoot any player problems and fix bugs to improve the game experience.

Fit Criterion: All important actions are stored and able to be accessed by authorized users to fix problems.

Acceptance Tests: Test the audit and ensure everything is properly recorded.

7e Immunity Requirements

The application will be required to have a system to prevent virus attacks, malware, or any other harmful software to take down the game or take user data. The user's information such as email, password, etc. will have the highest risk of being targeted so there will need to be a team working on the security system.

#025 - Name

Description: The game needs a firewall or some other security system to prevent any malicious attacks from accessing the servers.

Rationale: It is important to keep everyone's data private such as passwords, email addresses, and game progress so a good firewall or security system must be in place and be managed by a team.

Fit Criterion: This will make sure userdata and progress is protected and saved properly.

Acceptance Tests: Test how firewall and security systems react and handle breaches.

8 Usability and Humanity Requirements

8a Ease of Use Requirements

The application will help users easily upgrade their business assets while providing quick access to resources that help mitigate damage to the ocean.

#26 - Ease of Use

Description: Players should be able to see pollution metrics and options for sustainable upgrades as they grow their empire, learning about the balance between business growth and environmental impact.

Rationale: To encourage environmentally conscious decisions, the game must make pollution consequences visible and include ways to mitigate them.

Fit Criterion: Players should grasp pollution mechanics and sustainability options within their first session.

Acceptance Tests: Test that players receive feedback when making sustainable or high-pollution decisions.

8b Personalization and Internationalization Requirements

Ocean Inc allows players to personalize their experience by customizing their company name, logo, and factory types, making gameplay more engaging and tailored to individual preferences.

#27 - Personalization and Internationalization Requirement

Description: Players can choose unique names and logos for their company and select the types of factories they operate, adding a personal touch to their business empire.

Rationale: Personalization helps players feel more connected to the game and their progress, enhancing player satisfaction and immersion.

Fit Criterion: Players should be able to set or update their company name, logo, and factory types at the start of the game and through settings at any time.

Acceptance Tests: Confirm that players can customize their company name, select or upload a logo, and choose factory types during initial setup and through settings at any time.

8c Learning Requirements

Ocean Inc will provide a tutorial at the beginning of the game and a help menu to provide players guidance on how to play the game.

#28 - Learning Requirements

Description: Players will receive an interactive tutorial that introduces game mechanics, objectives, and controls. The help menu will provide ongoing support with FAQs and tips throughout the game.

Rationale: A structured learning experience helps players quickly acclimate to the game, enhancing enjoyment and reducing frustration, leading to a more positive user experience.

Fit Criterion: New players should be able to complete the tutorial in under 10 minutes and access the help menu without confusion.

Acceptance Tests: Confirm that the tutorial effectively teaches key gameplay elements in under 10 minutes and that the help menu is easily accessible, providing clear and relevant support throughout the game.

8d Understandability and Politeness Requirements

Ocean Inc will utilize clear language, helpful prompts, and polite communication throughout the game to ensure players feel supported and engaged.

#29 - Understandability and Politeness Requirements

Description: The game will feature intuitive language and visual cues to guide players, along with polite notifications and feedback. All key terms and functionalities will be explained clearly in the help menu, ensuring players understand their options without feeling overwhelmed.

Rationale: By prioritizing understandability and politeness, Ocean Inc aims to create a welcoming environment where players can learn and enjoy the game without frustration or confusion.

Fit Criterion: The game should use simple language and polite prompts, making it easy for players to navigate and understand all features and options.

Acceptance Tests: Confirm that all prompts and messages use clear, polite language, and conduct user testing to ensure players can easily understand key terms and functionalities in the help menu.

8e Accessibility Requirements

Ocean Inc will be designed to ensure accessibility for all players, including those with disabilities.

#30 - Accessibility Requirements

Description: The game will include features such as adjustable color settings for colorblind users, text-to-speech functionality for visually impaired players, and simplified controls to accommodate various physical abilities. The application will comply with the Americans with Disabilities Act.

Rationale: Making Ocean Inc accessible will enhance user experience for players with disabilities and broaden the game's audience, ensuring inclusivity and compliance with legal standards.

Fit Criterion: The game must have an adjustable colorblind mode and a text-to-speech option for information delivery.

Acceptance Tests: Confirm that the colorblind mode effectively accommodates various color vision deficiencies and that the text-to-speech feature accurately narrates on-screen information and is easy to use.

8f User Documentation Requirements

Ocean Inc will provide comprehensive documentation to assist users in understanding and navigating the game.

#31 - User Documentation Requirements

Description: The game will include a detailed user manual accessible both in-game and online, covering gameplay mechanics, objectives, and controls. Additionally, there will be an installation guide, a troubleshooting guide, and a terms and conditions document outlining user permissions and data usage.

Rationale: Providing clear and accessible documentation will enhance the user experience, allowing players to fully understand the game and its features, while ensuring legal compliance and protecting user data.

Fit Criterion: The user manual must thoroughly explain all game functionalities, and the terms and conditions must clearly outline permissions related to user data and account security.

Acceptance Tests: Review the terms and conditions with a legal expert for compliance, and conduct user testing to ensure the user manual is clear, comprehensive, and accessible both in-game and online.

8g Training Requirements

Ocean Inc will provide the necessary training resources for users to understand and effectively play the game.

#32 - Training Requirements

Description: This game does not require players to have prior experience with simulation or management games. Basic tutorials and online resources will be available to help users learn the gameplay mechanics and strategies.

Rationale: The game aims to be accessible to a wide audience, including those new to gaming, so providing clear training materials is essential for enhancing user engagement and enjoyment.

Fit Criterion: The game will offer comprehensive tutorials, guides, and online resources to ensure users can easily learn the game mechanics and strategies without prior gaming experience.

Acceptance Tests: Confirm that tutorials and online resources effectively teach gameplay mechanics and gather user feedback on their clarity and usefulness.

9 Look and Feel Requirements

9a Appearance Requirements

#33 - Appearance

Description: The application will be a 3D-isometric game with blue and green colors representing the ocean and environment theme. There will also be levels of pollution chart represented by green for low pollutions, yellow medium, and red high over the course of the game. The overall appearance of the game should be attractive to a wide audience to make the game appealing to play.

Rationale: The appearance should align with a fun and educational game to be appealing and engaging with all players.

Fit Criterion: A sample of people from people who attend schools and other people who enjoy educational simulation games, as well as people who are environmentally conscious will make sure the final product satisfies current standards.

Acceptance Tests: Conducting surveys with people from schools and other people who would be interested in playing the game to get feedback about the designs.

9b Style Requirements

#34 - Style

Description: The application must look fun, interactive, and easy to understand and use for many player age ranges. The visuals must have a balance of industrial realism but also educational with many cues for outcomes such as pollution levels.

Rationale: The game needs to be easy to use as well as fun to use and play so that no matter who wants to play it, it will be user friendly and easy to learn with.

Fit Criterion: After a certain amount of play of a group of people, at least 75% of players should have an increase of knowledge of the ocean pollution caused by industries as well as agree that the game looks and conveys this information in an effective way.

Acceptance Tests: Conduct around 30 minute surveys with players to get the intended amount of gameplay and education throughout the game.

10 Operational and Environmental Requirements

10a Expected Physical Environment

#35 - Expected Environmental Requirements

Description: Ocean Inc will be released on PC systems and since the game will run on servers it will not need to really worry much about physical environments unless there is an outage caused by weather conditions.

Rationale: This is important because it will help name what the user will need in order to play the game and where it's expected to be released in.

Fit Criterion: The game will be available almost through any weather conditions whether it snows, rains, or is sunny.

Acceptance Tests: We will test the connection between users and the game in different weather conditions in order to make sure that the game runs smoothly.

10b Requirements for Interfacing with Adjacent Systems

#36 - Requirements for interfacing

Description: Ocean Inc will be on PC systems. We will partner with Steam/google web store in order for users to access the game. We will also partner with many educational institutions and climate organizations in order to be able bring more awareness into the schools or people in general.

Rationale: This is important because many schools have access to computers or chromebooks thus, leading to schools being able to access this game to help teach in a fun-interactive way. Additionally, anyone who has a computer will be able to play this game.

Fit Criterion: The application will be available on almost any computer that is able to support it and any organization that wants to bring awareness.

Acceptance Tests: Test to see if the game can be downloaded both on steam and webstore. Tests to make sure that it has no restrictions that schools may flag as this is an education game.

10c Productization Requirements

#37 - Product requirements

Description: The game will be available on steam or web app store which can be bought for anyone for free.

Rationale: By making this game free we give a chance to many people to learn about the effect of industrial revolution on the ocean which is shown in the game.

Fit Criterion: Software developer will make sure that game is installable on steam and web store.

Acceptance Tests: Test to make sure that game is free and installable in all available PCs.

10d Release Requirements

#38 - Release

Description: Mataineve will be released every month in order to bring new content and fix any bug fixes. Emergency maintenance will be issued if there is a game breaking bug. Then Overall, maintenance will be every year to help improve graphics, UI, and functionality.

Rationale: It's important to fix these issues because it will help boost the users' engagement and will help bring more awareness to climate change.

Fit Criterion: Ocean Inc will build upon its current functionality and features and implement new ones in order to enhance users experience.

Acceptance Tests: We will test to see how our game performs against others and how different UI or functionality is.

11 Cultural and Political Requirements

11a Cultural Requirements

This game will be available globally and does not target any certain culture. Everyone is welcome who wants to learn the effects of the industrial revolution to the ocean climate changes or anyone who just wants to play a simulator type game.

#39 - Cultural

Description: The game will be available to any country/culture that wants to play.

Rationale: This game is meant to be educational therefore, being inclusive helps bring more awareness of the current climate and maybe helps the world fix this issue together.

Fit Criterion: The game will provide support for different languages for each culture.

Acceptance Tests: Test the game to see if it is appropriate for each country.

11b Political Requirements

This game is intended for all people and will be available on PC at launch and mobile might be implemented within the future. This will require political requirements in order to meet certain codes within other countries.

#40 - Political Requirements

Description: This game will have certain political requirements and will be adjusted based on the country.

Rationale: Since PC will be the most common system until mobile release then it will have easier access to more people around the world.

Fit Criterion: The game will be available in every country and every PCthat supports the PC system(steam).

Acceptance Tests: Test to see if the game is available in other countries besides the U.S and is able to be played.

12 Legal Requirements

12a Compliance Requirements

#41 - Legal Requirements

Description:

- COPPA requirements need to be met since this game will be educational which means kids under the age of 13 will be able to access this game.
- Data privacy and security: All the personal information collected from the users needs to be protected under the Data Protection Act in order to preserve user privacy and confidentiality and any possible lawsuits.
- Any other laws that are in other countries will be applied to their version to make sure their laws are adhered to.

Rationale: We must meet the requirements in order to avoid any sanctions and lawsuits from people/governments. We must also do this to avoid getting banned in other countries.

Fit Criterion: protect user information from unauthorized sources and adhere to any laws from other countries and the U.S.

Acceptance Tests: A legal team to manage the game legalities, and testing for security of the application. We would also test that all data is being protected and is being stored with encryptions.

12b Standards Requirements

#42 - Standard requirements

Description:

- Protecting User Data from any unauthorized source is important to maintain the integrity of the game and with our users.
- Maintain a game with minimal bugs and content updates in order to keep users engaged and happy with the content.
- IP compliance is necessary for our game to be unique in our own way and to show users it's a different type of game then they are used to.

Rationale: It's important for the game to have these standard requirements or else the game will not meet the goals it was intended to make because of the game in general or legal issues.

Fit Criterion: The software development team will be the ones to make sure most of these requirements are met while the legal team will focus on IP compliance and additional security measures.

Acceptance Tests: Testing for all features, security testing, multiple updates, etc.

13 Requirements Acceptance Tests

Test 1-4: Use Cases
Test 5: Initializing a new saved game
Test 6: Calculating Production Rate
Test 7: Calculating Pollution Rate
Test 8: Saving Games
Test 9: Performance
Test 10: Precision and Accuracy
Test 11: Capacity
Test 12: Reliability
Test 13: Availability
Test 14: Fault-Tolerance
Test 15: Safety
Test 16: Maintenance
Test 17: Supportability
Test 18: Adaptability
Test 19: Scalability and Extensibility
Test 20: Longevity
Test 21: Access
Test 22: Integrity
Test 23: Name
Test 24: Audit
Test 25: Name
Test 26: Ease of Use
Test 27: Personalization and Internationalization Requirement
Test 28: Learning Requirements
Test 29: Understandability and Politeness Requirements
Test 30: Accessibility Requirements
Test 31: User Documentation Requirements
Test 32: Training Requirements
Test 33: Appearance
Test 34: Style
Test 35: Expected Environmental Requirements
Test 36: Requirements for interfacing
Test 37: Product requirements
Test 38: Release
Test 39: Cultural
Test 40: Political Requirements
Test 41: Legal Requirements
Test 42: Standard requirements

13a Requirements – Test Correspondence Summary

	Requirements										
Test Number	1	2	3	4	5	6	7	8	9	10	11	12
1	x											
2	x											
3	x											
4	x											
5		x										
6		x										
7		x										
8			x									
9				x								
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35										x		
36										x		
37										x		
38										x		
39											x	
40											x	
41												x
42												x

Table 1 - Requirements - Acceptance Tests Correspondence

13b Acceptance Test Descriptions

#43 - Requirements Acceptance Tests

Acceptance tests must verify that all required functionalities perform as specified.

III Design

1 Design Goals

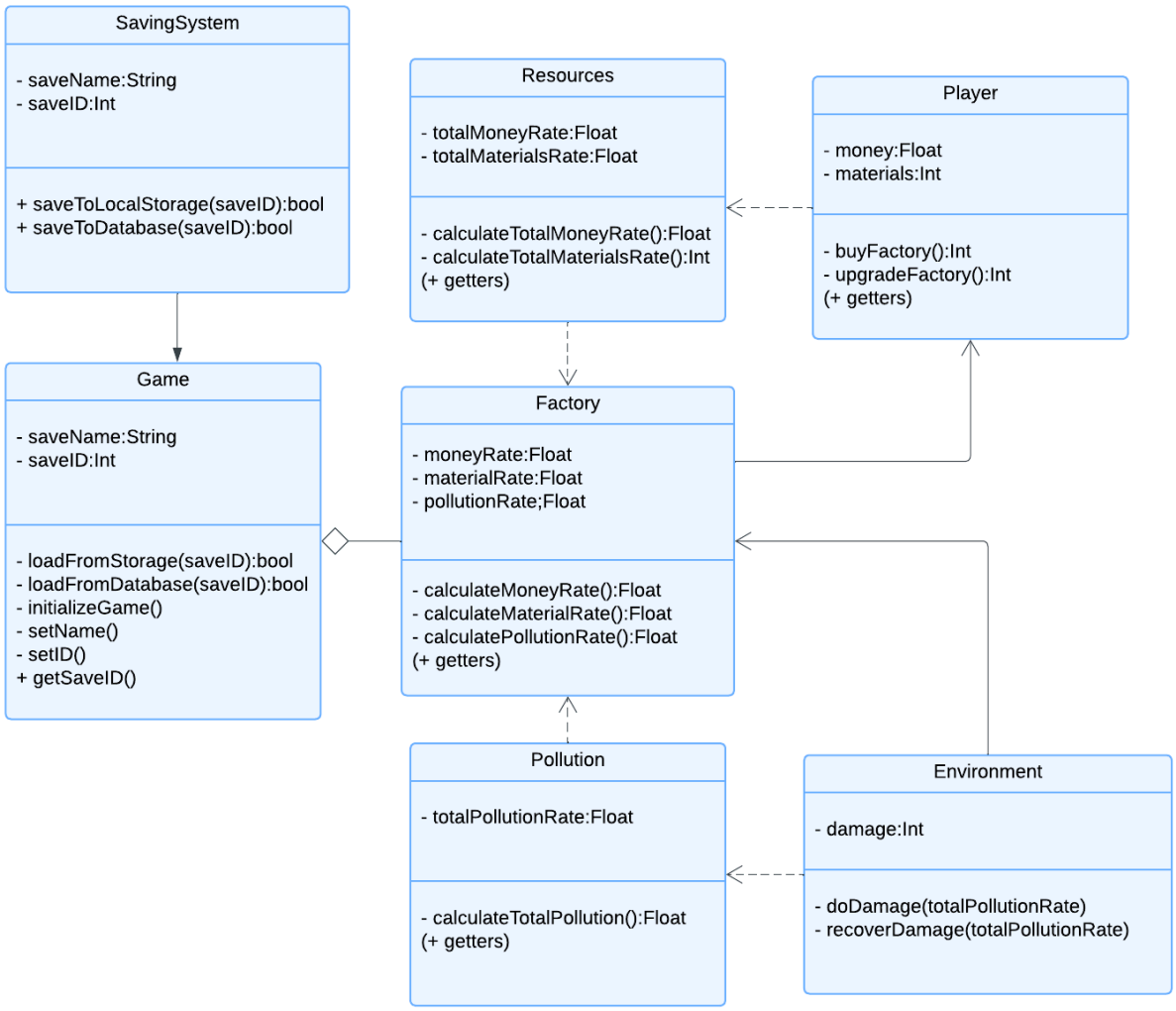
The game's goal is to serve as an environmental simulator that raises awareness of ocean pollution and climate change from industrial buildings by focusing on the following areas. Track real-time Industrial impact based on all in-game actions taken by the players. Process the in-game data to generate the environment and the impact reports to help players understand the consequences of their actions. Environmental accuracy must properly show the user a realistic representation of ocean pollution. Real-time environmental alerts for pollution like increasing sea levels and high levels of pollution.

2 Current System Design

The proposed new system, Ocean Inc., is not supposed to replace any current system that is currently on the market. Instead it should be a new and similar product being a fun game but with new functionality of learning and new gameplay overall.

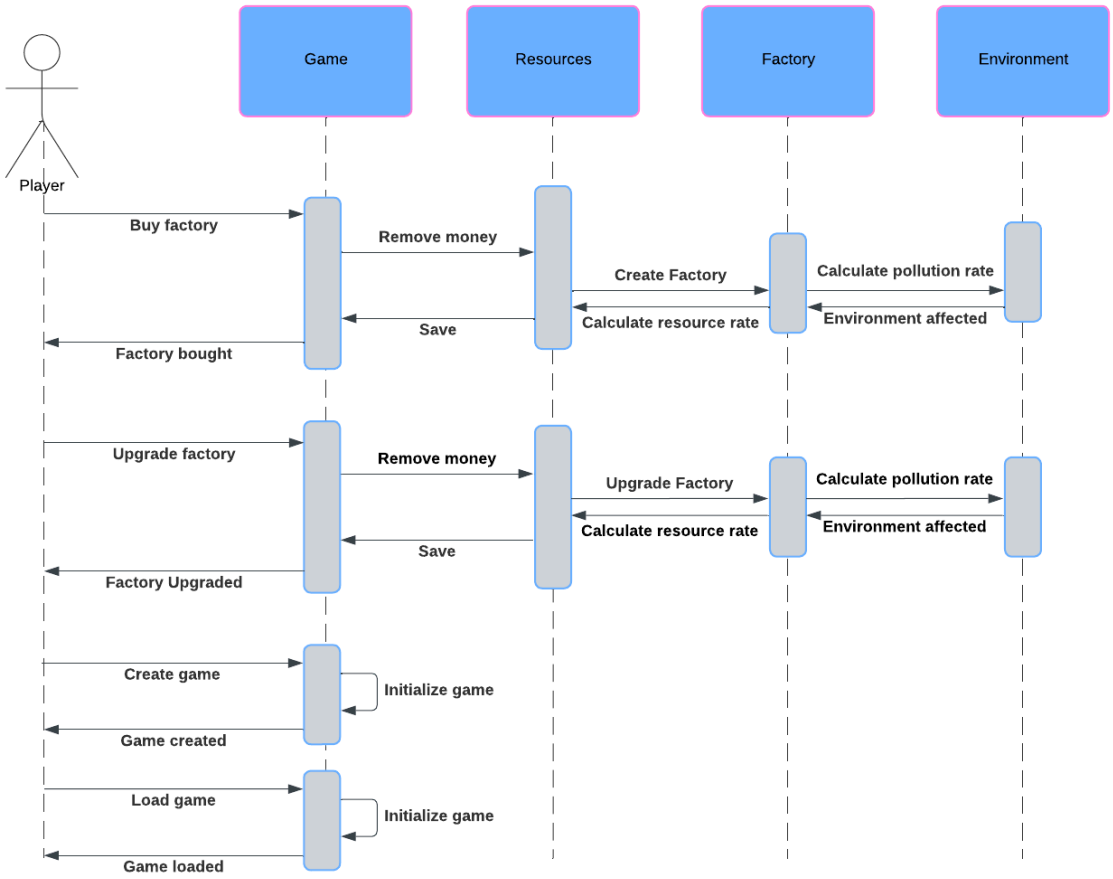
3 Proposed System Design

3a Initial System Analysis and Class Identification



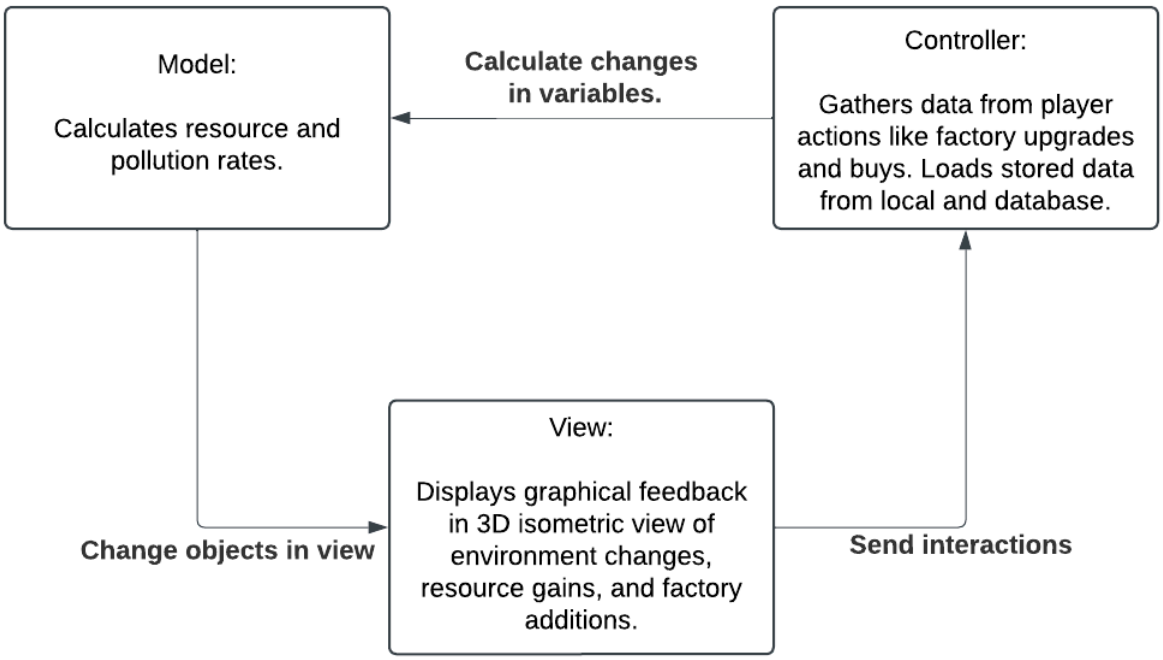
The diagram above shows an initial class structure containing the most important classes of the proposed system. Developers may modify the diagram as they see fit.

3b Dynamic Modelling of Use-Cases



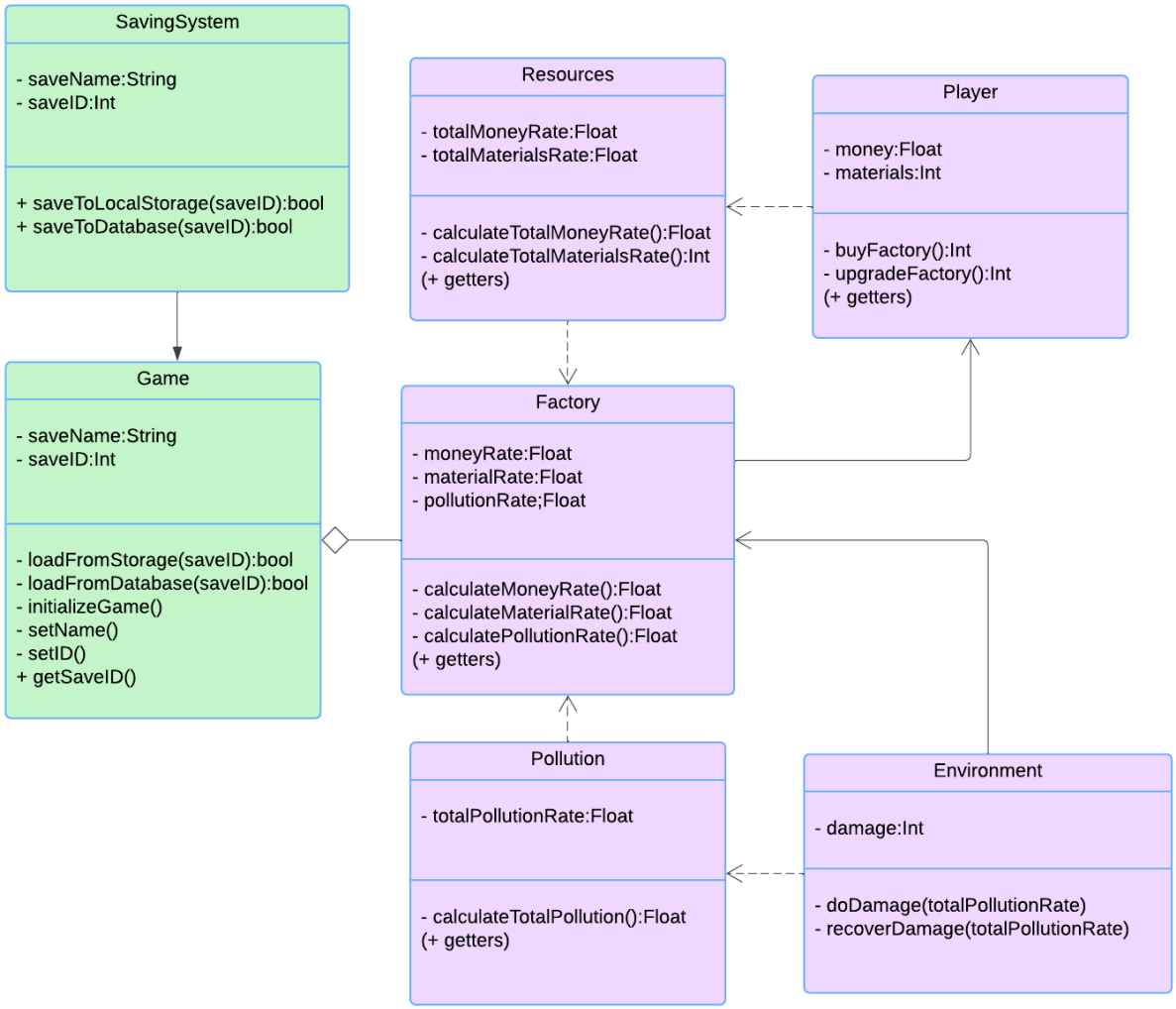
The sequence diagram above contains the most essential use cases such as buying factories, upgrading factories, creating and loading a game.

3c Proposed System Architecture



The game's graphical view may change due to the player's actions. The player will often buy and upgrade factories in order to get more resources and as a consequence they will be increasing the pollution rate. As pollution rate increases, the playable environment may change. Thus, it's beneficial to have model-view-controller architecture in order to consistently give the player feedback based on their actions.

3d Initial Subsystem Decomposition

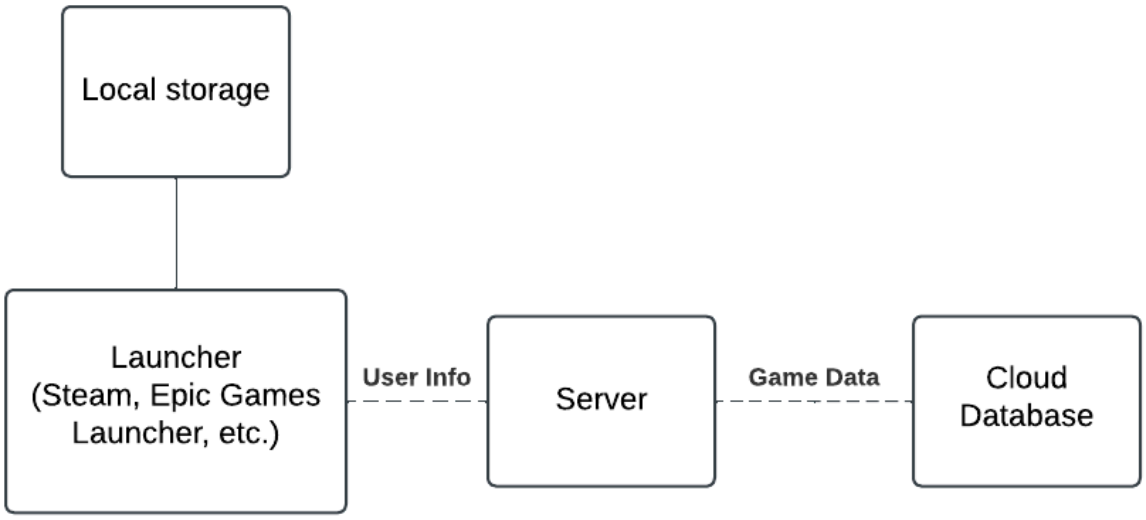


Green: This subsystem handles initializing, loading, and saving the game instance.

Magenta: This subsystem handles gameplay mechanics and calculations.

4 Additional Design Considerations

4a Hardware / Software Mapping



The majority and most essential mappings simply will rely on the communication of the game launcher and local storage of the user. Server and cloud data may be used for loading remotely stored game data if necessary.

4b Persistent Data Management

Players of Ocean Inc. should expect to see their game is successfully stored locally and remotely. Cloud and remote database saves should keep the player's progress secure when their local save is corrupted or accidentally removed. Even so, local saves should be consistently and successfully created in order to ensure that the player can access their game even when offline since this is a singleplayer game.

Relevant game variables such as position, resources, and pollution rates should be stored in fast and reliable data structures such as hash tables or self-balancing trees.

4c Access Control and Security

We need to make sure that remotely stored game data are only accessible to the appropriate users. No personal sensitive data should be at risk since it won't be stored in the first place.

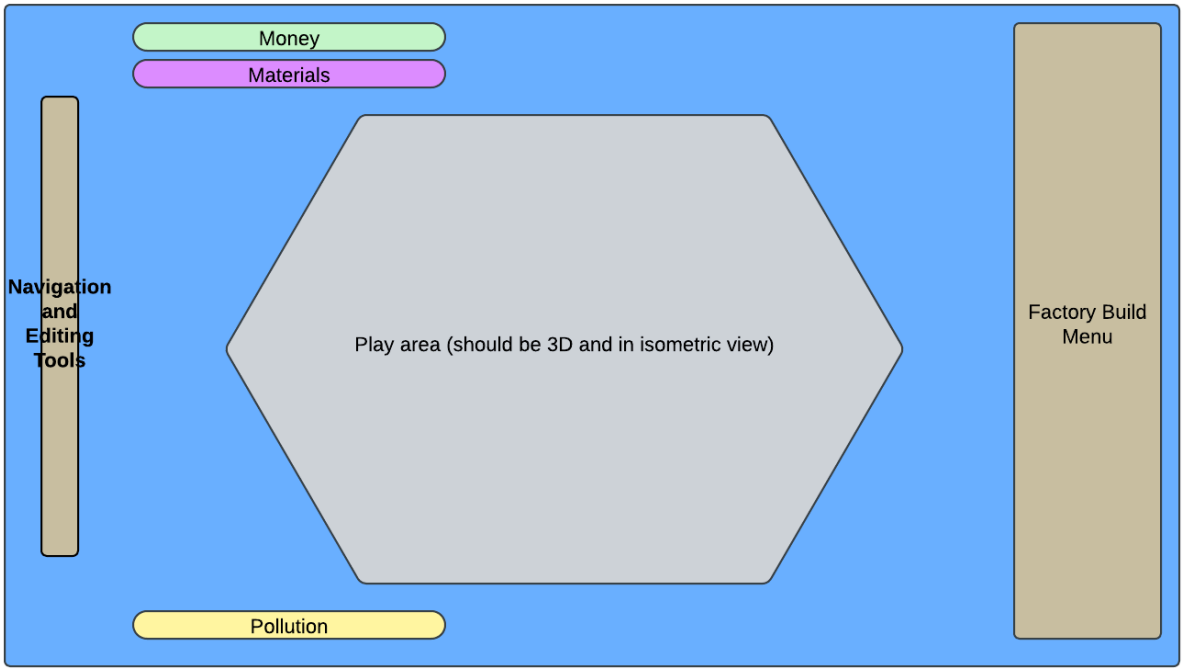
4d Global Software Control

Users will only access servers that are closest to their geographical location. Otherwise, this game will not require access to remote locations, typically the user's local systems will be sufficient to run this game.

4e Boundary Conditions

The game launch process is a major boundary concern since it must reliably and successfully load the game's assets and instances. Files must avoid corruption when crashes and errors occur on the startup process. Database and cloud data must maintain a standard format and consider data overflows.

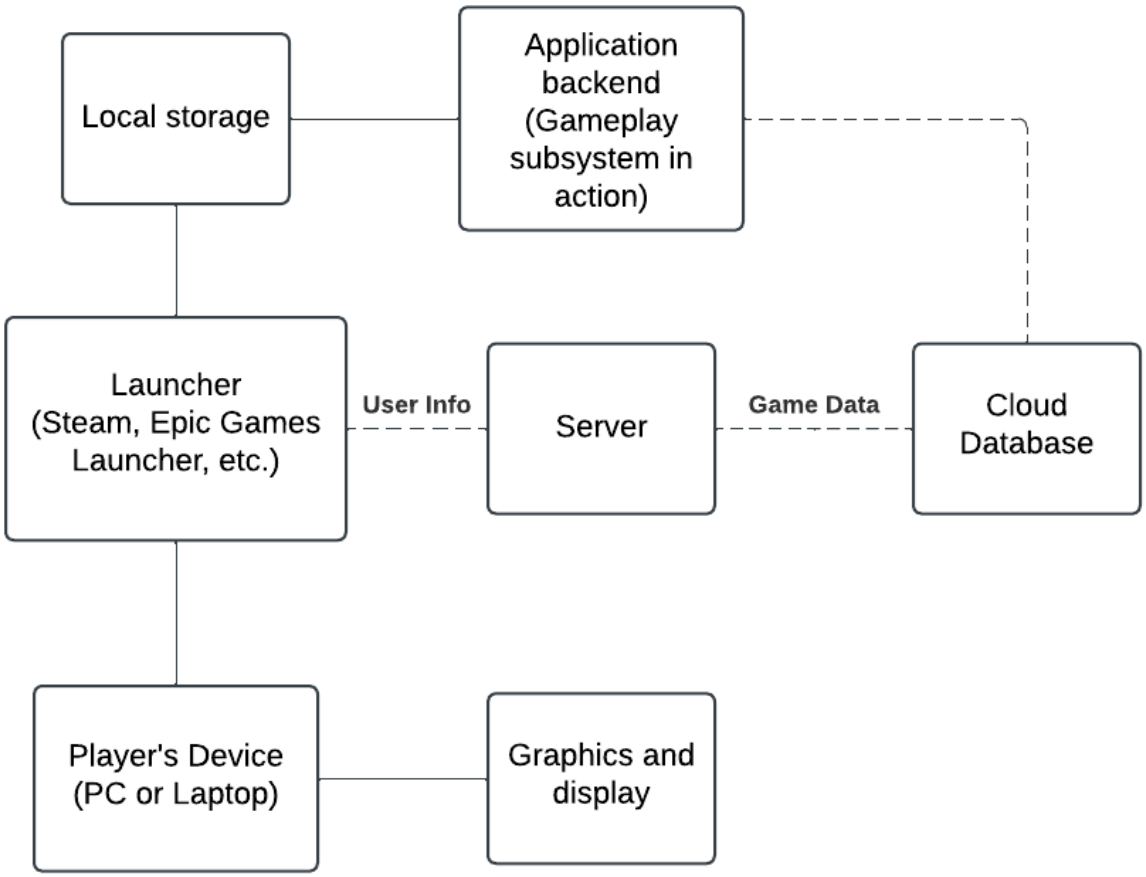
4f User Interface



4g Application of Design Patterns

N/A

5 Final System Design



6 Object Design

6a Packages

There is no specific requirement to add class packages, developers are free to use any class packages they need to.

6b Subsystem I

N/A

6c Subsystem II

N/A

6d etc.

N/A

IV Project Issues

1 Open Issues

Some open-ended issues that Ocean Ink may face include handling large amounts of real-time environmental data, balancing educational and entertainment value, optimizing gameplay mechanics, and addressing server performance during peak usage. Managing and integrating real-world climate data dynamically could be challenging, as outdated or inaccurate information would reduce the game's credibility and impact. Striking the right balance between making the game fun and ensuring it remains educational without overwhelming the player is another critical concern. Additionally, the simulation's complexity might strain server capacity during peak playtimes, potentially causing lag or crashes. Finally, incorporating data-driven environmental mechanics while maintaining a seamless user experience will require advanced technical solutions and careful optimization to ensure smooth gameplay.

2 Off-the-Shelf Solutions

2a Ready-Made Products

Existing tools like Unreal Engine and Unity provide robust 3D design and optimization features suitable for Ocean Ink's development. Libraries such as ClimateMachine or NOAA climate models could aid in simulating pollution and sea-level rise. Distribution and server needs could leverage platforms like Steamworks or Epic Online Services. However, core mechanics, including real-time environmental simulations and educational features, will likely need to be custom-built to meet the game’s unique requirements.

2b Reusable Components

Developers can utilize common libraries and toolkits to streamline the development of Ocean Ink. For environmental simulations, libraries like NumPy and SciPy can handle complex calculations, while Matplotlib or Plotly could visualize environmental changes. Game development toolkits such as Unreal Engine’s Blueprint system or Unity’s C# libraries can assist in building core mechanics. To manage real-world data integration, APIs or datasets from sources like NOAA or Meteostat can be incorporated. Additionally, physics engines like Havok or Bullet Physics may be used for realistic environmental interactions, reducing the need for custom-built solutions.

2c Products That Can Be Copied

This application is the team's first project, so there are no existing products that can be legally reused or incorporated into its development.

3 New Problems

3a Effects on the Current Environment

Development could be complex for simulation, it will require significant technical and knowledge expertise and coordination between a few groups of people to be able to accurately produce the game and environment for educational purposes.

Since Ocean Inc. is an educational game, individuals and organizations involved in pollution prevention and climate change advocacy may have varying perceptions of its content. If the game's educational aspects are not handled accurately or in a thoughtful way, it could face backlash for misrepresentation or oversimplification of these issues.

3b Effects on the Installed Systems

The PC requirements might be too high for certain computers depending on how the game is created, but it should be available for as many as possible.

Distribution platforms such as steam and epic games could have compatibility issues with some devices which could impact different users' experiences.

3c Potential User Problems

System requirements might lead to a worse user experience.

Players might find the game difficult whether or not the player understands how to play the game either because they haven't played many games before or find the simulation aspect too hard. Also player reactions to losing all their progress in unavoidable or unfair situations in the game.

3d Limitations in the Anticipated Implementation Environment That May Inhibit the New Product

Hardware limitations could reduce the game's reach to some people who want to play the game and be able to learn. The environment simulations will require a lot of computation and resources so limiting it can lower user experience.

3e Follow-Up Problems

A sudden demand of players exceeding the capacity of the servers could cause a problem if not enough servers and staff are available to handle the load. Another possible problem is that educational games generally must meet different educational requirements and content standards which might complicate distribution.

4 Migration to the New Product

4a Requirements for Migration to the New Product

Not Applicable because this game isn't being designed to replace an existing product.

4b Data That Has to Be Modified or Translated for the New System

Not Applicable, no pre-existing systems or data are required to make this game.

5 Risks

Potential risks can include but not limited to: game breaking bugs, unsatisfactory features, and inaccurate database values. Since this is a game there is obviously going to be a bug that can break the game. We just have to test the game to make sure it does not occur as often. Since this is a simulator/educational game it may underperform just because it may have competition with other games in the same category. In order to minimize this risk we have to make sure that the game is appealing and unique in its own way. Inaccurate database values is a risk that can happen if the database that is being used is in some way compromised leading to information being leaked/deleted. Additionally, low quality/productivity is something that can also happen leading to game features/content not being produced. Lastly, anything regarding security is a possible risk to the company and users.

6 Costs

Resources needed for this game to be finished includes but are not limited to software developers, lawyers, marketing team, 3rd party banking permissions , and cloud storage. The price for this game would be 1-2 million dollars because the game has to be maintained and created. Additionally, as it's an educational game we must adhere to any laws in the U.S, COPPA laws, and any foreign laws. Since the game will be purchased as a one time purchase then it will need access to payments to buy the game whether its on a 3rd party website or the actual game page itself. We also need to test the game and add security barriers in order to ensure the games safety for users. Finally, any costs associated with marketing in order to ensure this game has traffic when released and to ensure lots of people know about the game so they can play/share.

7 Waiting Room

Development for mobile support like IOS and android games. Be available on their respective stores like google play store and app store. Add some type of clubs in order to compete for who can cause the most pollution. Other features can include achievements, friend system, collabs, pvp system, and club/solo events. Additionally, implement past the tower levels we currently have in order to bring more content to the game. These are all very common and important features that most of the popular games have that users tend to really enjoy. These won't be available at release but it's something that could be added in the future to grow an audience who don't have access to a PC and also implement new features to retain current daily users.

8 Ideas for Solutions

Some solutions can include being able to make the game available for mobile devices which means it will have to adapt to JAVA in android and in SWIFT for apple devices. However, first it must be approved by both companies in order to get the game posted which the legal team would have to handle. PVP systems, clubs, events, and collabs can be solved when the game has a healthy amount of daily users that allow for certain collabs to happen and to develop systems that require large amounts of current users. So, marketing team would be in charge of promoting the game and getting with organizations that are willing to back the game and promote the awareness

9 Project Retrospective

What worked well:

- Figuring out core features of the game which was done very early in the project.
- Team kept updating any progress throughout the whole project.
- Able to meet with a group to make progress physically and remotely.
- Met all deadlines that were needed for the project.

What didn't work well:

- At the start figuring out what project we wanted to do.
- Being able to all work at the same time.
- Figuring out some of the other parts of the project besides the functionality of the game like cost, legal problems, and risks.
- Meeting at specific times all at once due to scheduling and time conflicts.

V Glossary

Factories - Buildings that the player can build which will either make them money or gather resources along with producing pollution.

Playable Area - The space where the player can build factories.

Build Menu - A menu that contains the different factories available to build.

Pollution Meter - A meter that displays how much pollution the factory is producing.

Resources - The money and materials available to a player.

Upgrades - Factories can be upgraded in different ways to increase productivity or reduce pollution.

Pollution Rate - Rate of pollution produced by a factory. {Pollution unit per day}

Pollution - A substance or thing that has harmful effects in an environment.

Local Storage - Persistent data that is stored locally on a computer or device that typically belongs to the user.

Launcher - An application that acts as a library for games which handles the startup process of said games.

Cloud Storage - Persistent data that is stored in remote locations and can be accessed through an internet connection.

VI References / Bibliography

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