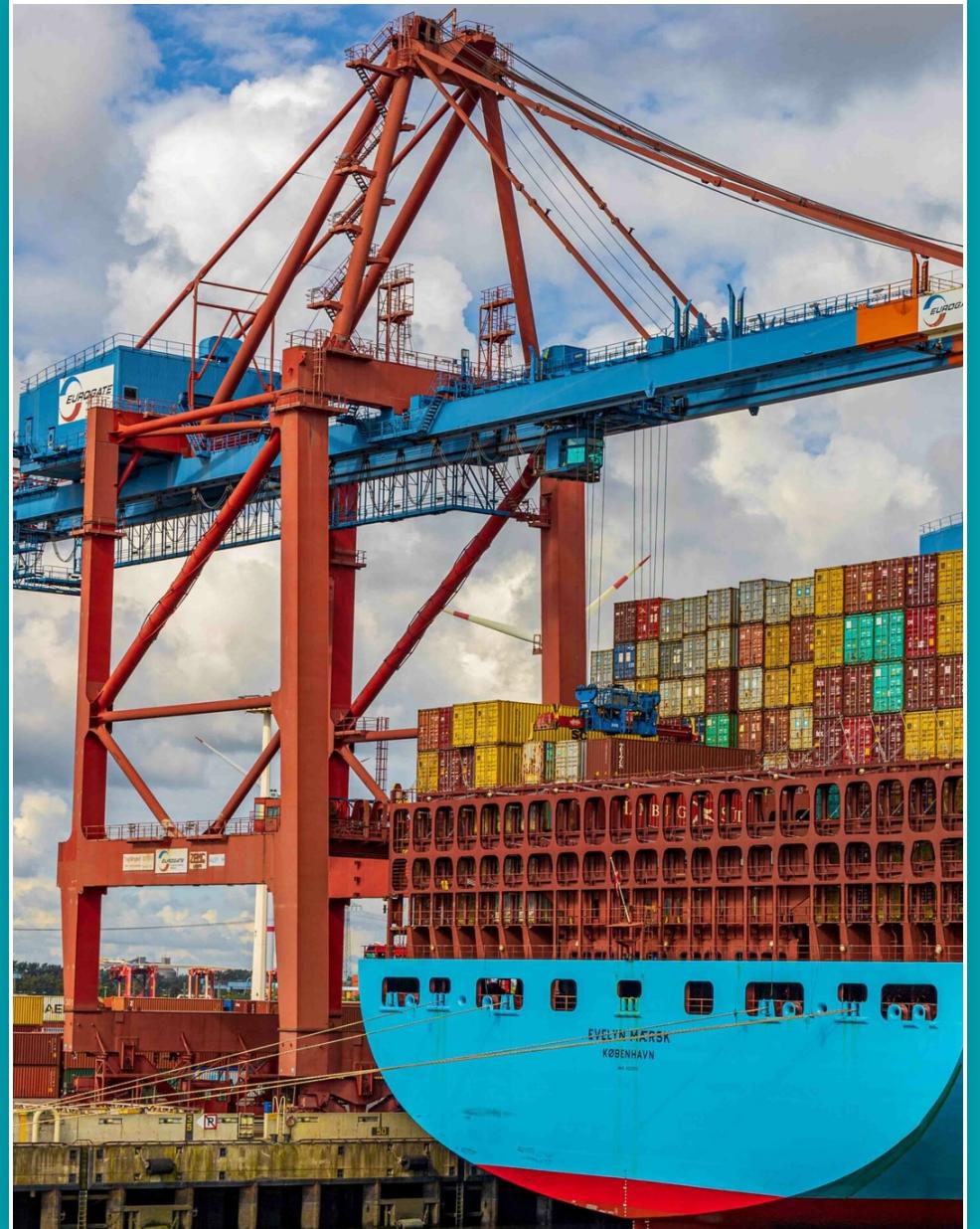


# Digital Transformation for Ports

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## Team Members



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- 2 Problem Statement
- 3 Challenges
- 4 Objectives
- 5 Literature Survey
- 6 Key activities/Services
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# Content (cont.)

**11** Prototype

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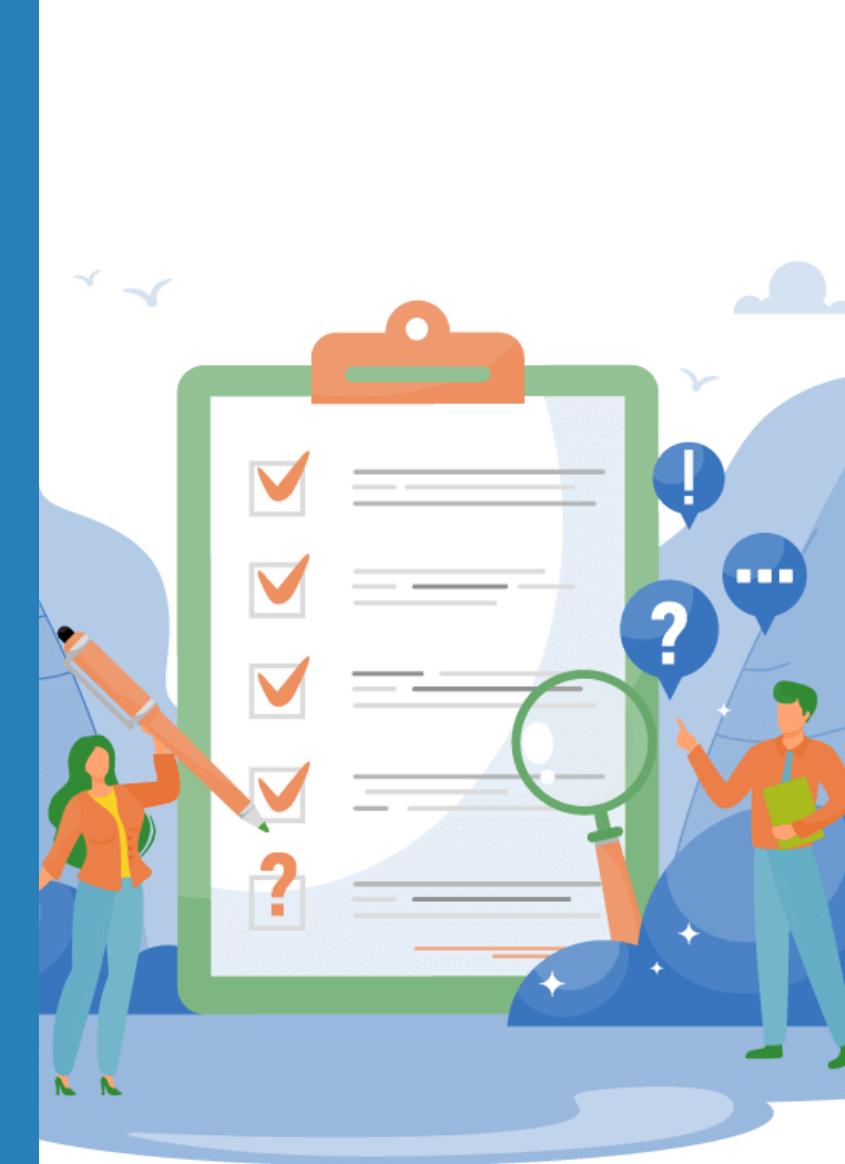
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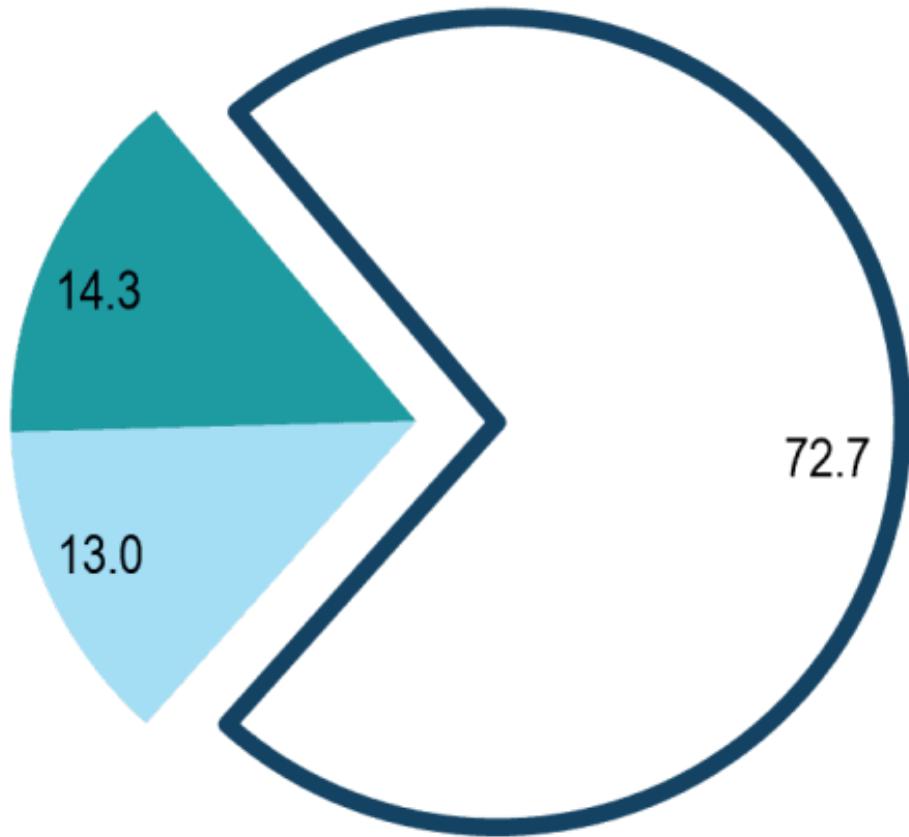
**15** Plan of Project II

# Abbreviations

- ✓ **IOT: Internet Of Things**
- ✓ **PCS: Port Community System**
- ✓ **EAFMS: Egyptian Authority For Maritime Safety**
- ✓ **GOEIC: General Organization For Export and Import Control**
- ✓ **IMO: International Maritime Organization**
- ✓ **DB: Database**



## Value of World Trade



# Introduction

## About the ports

---

- Port **Definition**
- **Ports** and global economy

■ Seaborne ■ Airborne ■ Overland



# About the ports

---

## **Egyptian Ports**

five major commercial ports in Egypt: Greater Alexandria Port (Alexandria and Dekheila port), Damietta Port, Port Said Port, Suez Port (including Adabiya Port) and Safaga Port.

90% of maritime traffic handled at commercial ports.

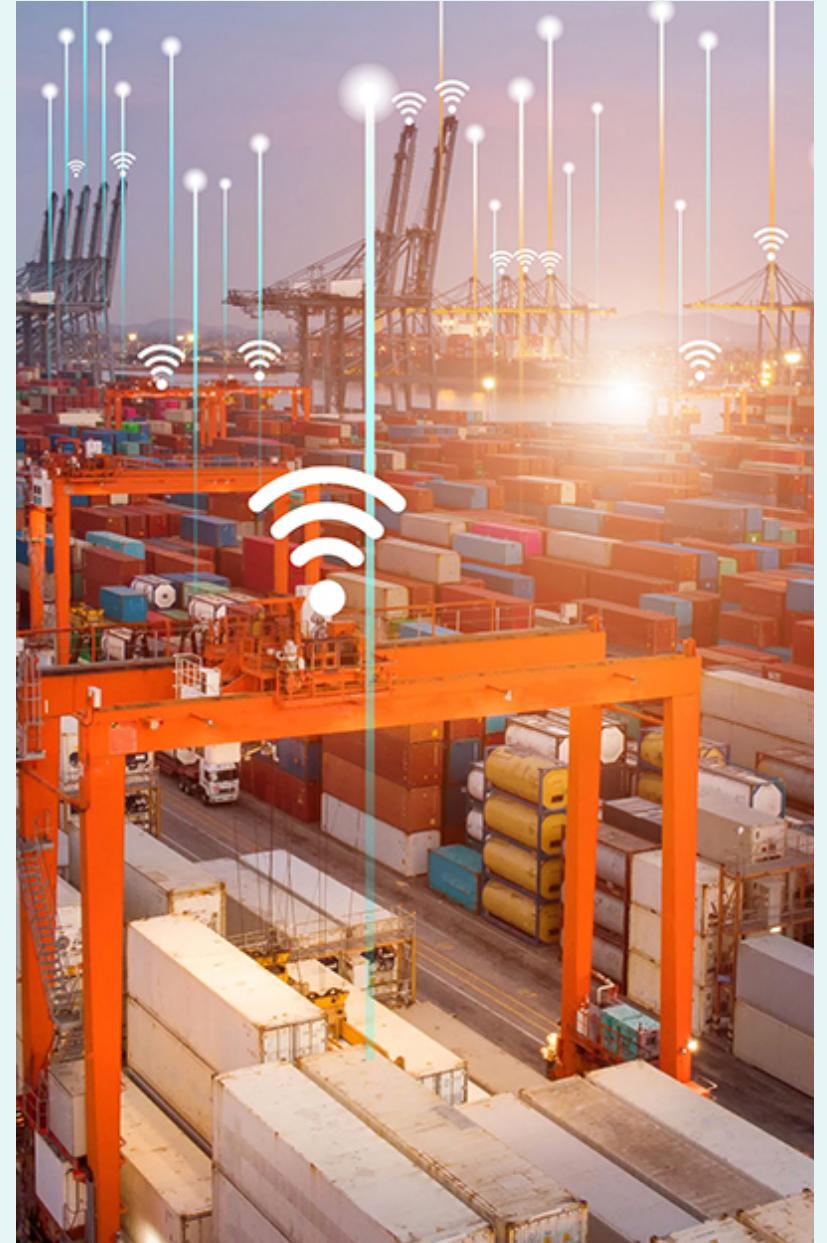
## **Alexandria Port**

Alexandria Maritime Port occupies the leading position in the ports of Egypt.

60% of Egypt's foreign trade.

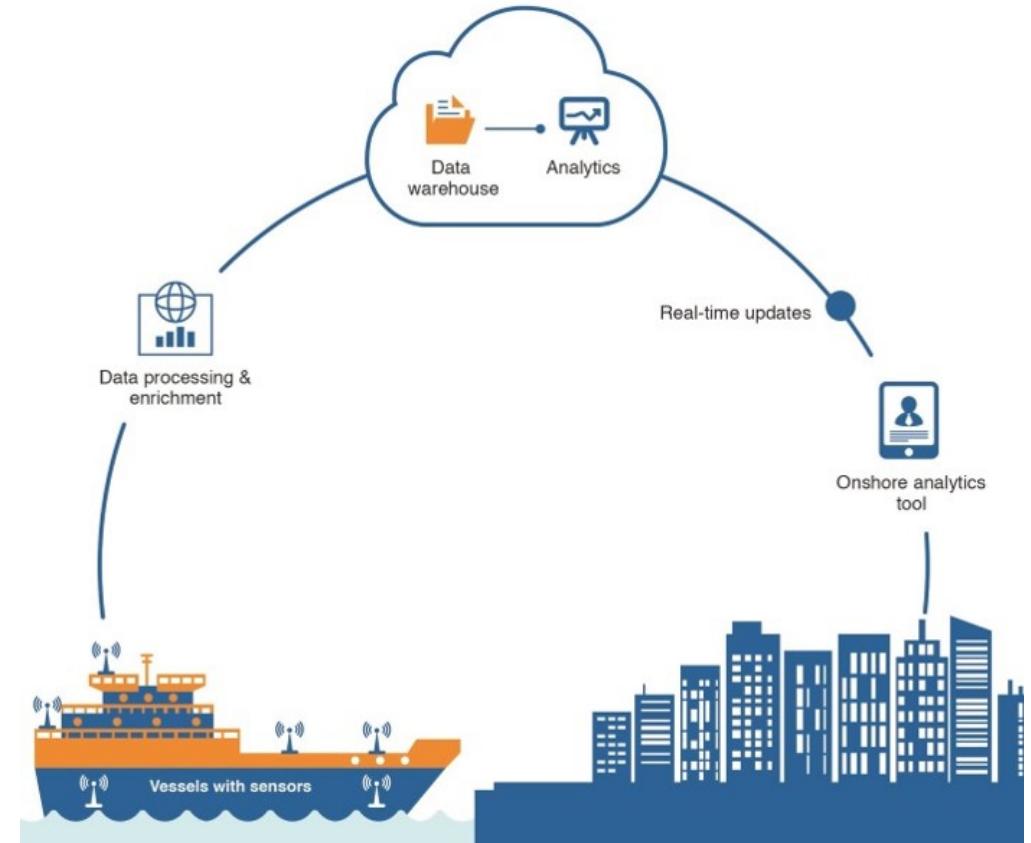
# Smart ports

- Improvement of port productivity and efficiency.
- AI, IoT, and Big Data.



# IOT and Maritime Industry

- Ships equipped with sensors.
- Provide tangible information and decision support tools.



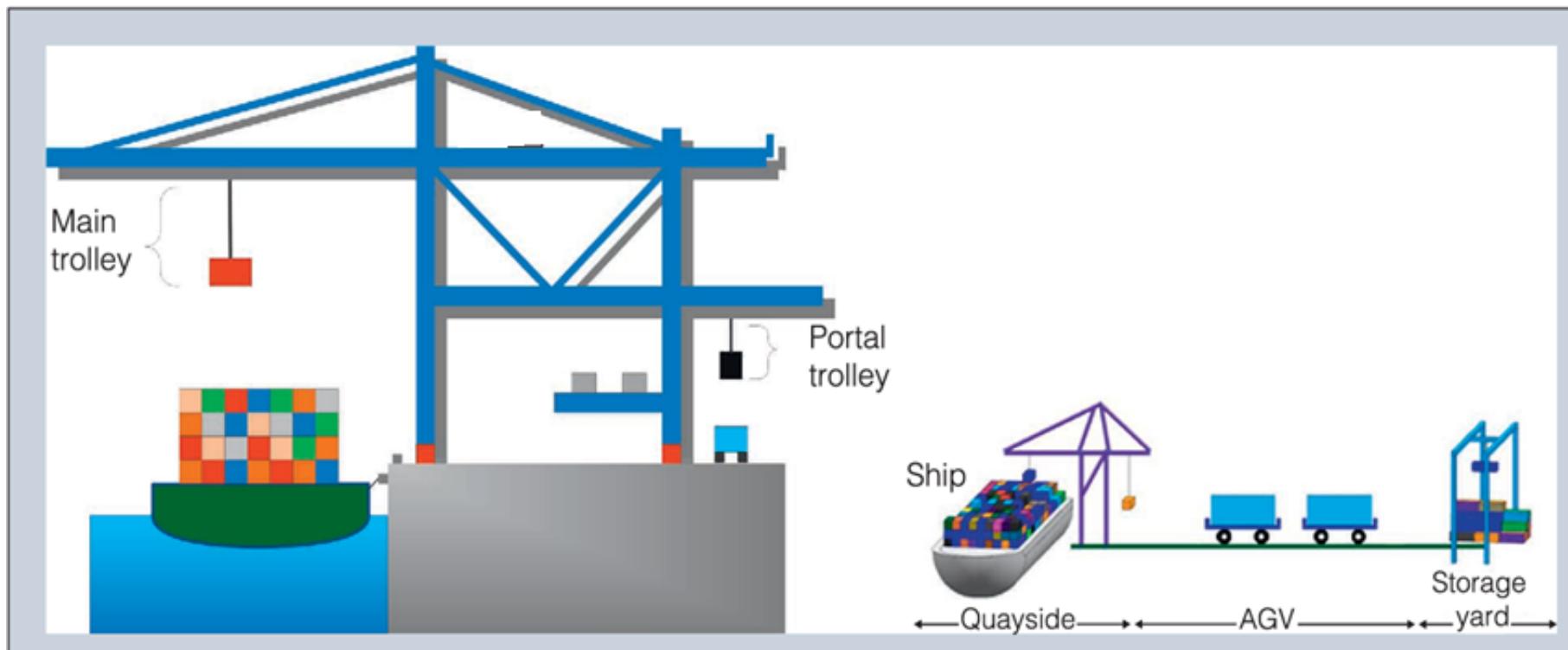
# IOT Applications in Ports

Smart storage systems can detect the needs of the cargo and adjust factors to increase product quality and decrease cargo damage.



# IOT Applications in Ports (cont.)

## Sensors monitoring



# Big Data in Maritime Industry

---

## Forecasting & Planning



# Port Community System



- Port Community Systems are a form of **Single Window** for Trade.
- A Port Community System optimizes, manages and automates logistics-efficient processes.

# Problem Statement

- ✓ Digitalization can help port authorities comply with industry regulations and standards.
- ✓ It can also protect against data loss and tampering.
- ✓ Implementing digital technologies can be a challenge for port authorities, as it may require new infrastructure and integration with existing systems.
- ✓ The benefits of digitalization for ports include increased efficiency, reduced manual labor, and improved accuracy and resource management.





# Challenges

## Data Integration

**The data must be collected from multiple stakeholders.**

## Security

**system must be able to protect sensitive data from unauthorized access.**

## Cost

**cost of the hardware and software needed to run the system must be taken into account.**

## Compliance

- Port community systems must comply with local and international regulations and standards.**
- the regulations and standards vary from country to country.**

## Scalability

**The system must be able to handle increased volumes of data and transactions**



# Objectives

- Centralized database connects all parts of PCS
- Electronic exchange of information between transport operators within the port and hinterland connections, as well as between port users, Customs, and other authorities.
- In this project, we design a digital system for Alexandria port to exchange information in the port community system.



# Literature Survey

Digitalization of ports has been a topic of interest for researchers and practitioners in the field of logistics and supply chain management. The benefits of digitalization include increased efficiency, transparency, and cost savings. In this literature survey, we will review the current state of research on digitalization of Alexandria port, one of the largest and busiest ports in Egypt.

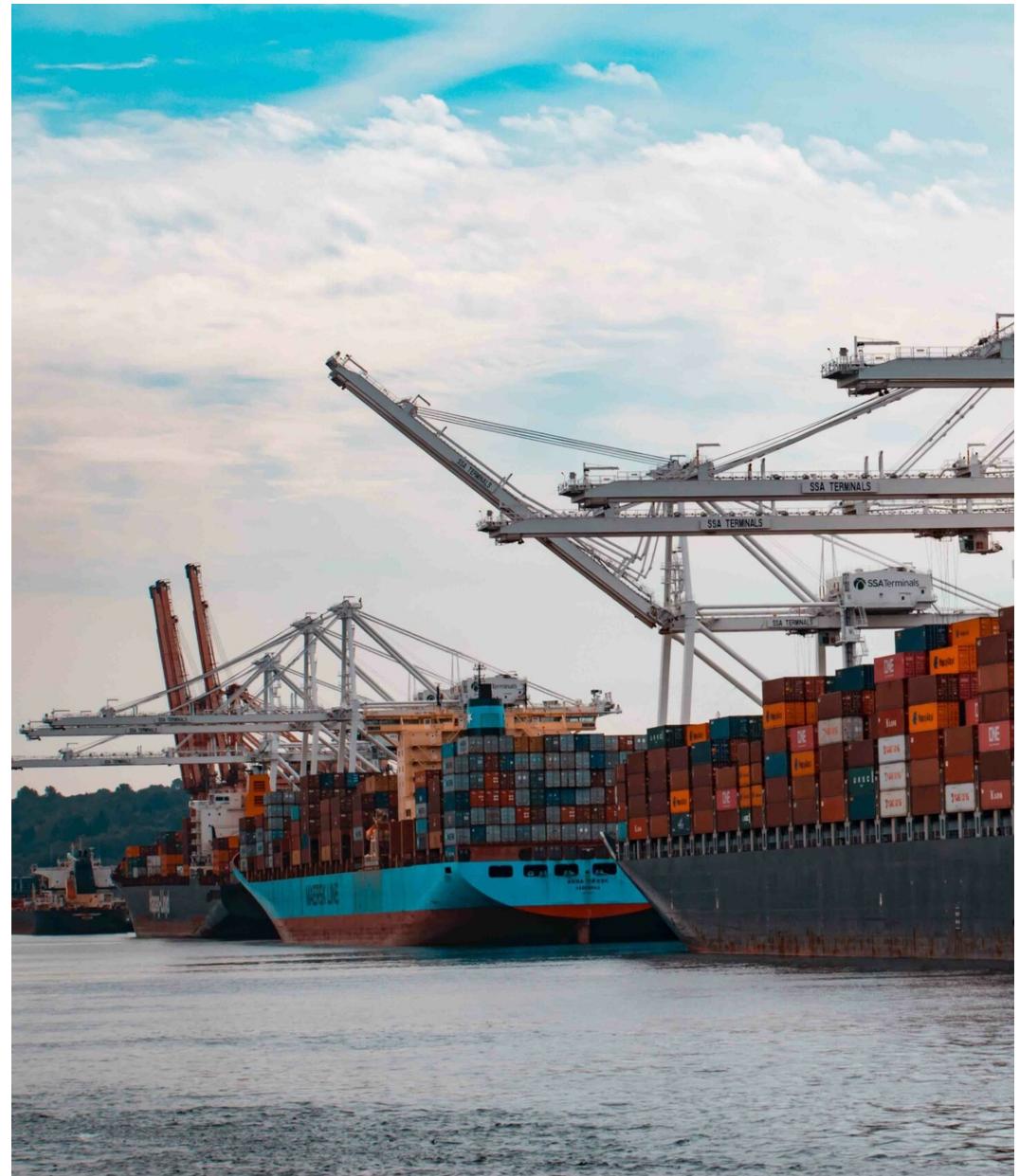
## Literature Survey (cont.)

One study found that the implementation of a digital platform at Alexandria port resulted in significant improvements in the efficiency of container handling operations. The digital platform allowed for real-time tracking of containers, which reduced the time needed for paperwork and improved the accuracy of inventory management. In addition, the digital platform facilitated communication between various stakeholders, including shipping companies, customs officials, and terminal operators, leading to increased transparency and collaboration. [1]



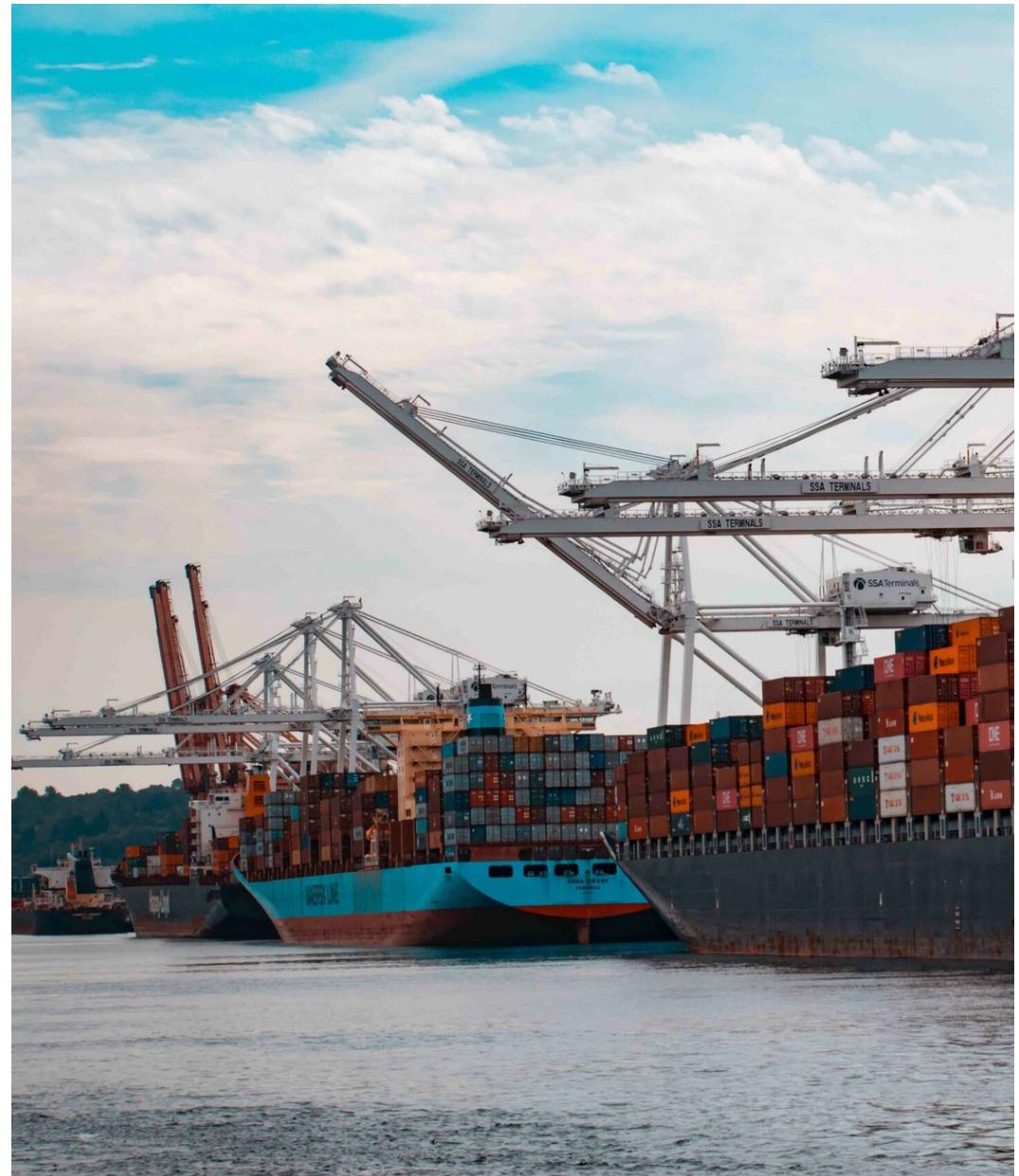
## Literature Survey (cont.)

Another study examined the impact of digitalization on the performance of Alexandria port by analyzing data on vessel turnaround times and container handling times. The results showed that digitalization was associated with a significant reduction in turnaround times and an increase in the number of containers handled per hour. The authors attributed these improvements to the use of digital technologies, such as real-time tracking systems and automation, which facilitated the exchange of information and reduced the need for manual labor. [2]



## Literature Survey (cont.)

A third study investigated the potential of using blockchain technology for supply chain management at Alexandria port. The authors proposed a blockchain-based platform that would allow for the secure and transparent tracking of cargo from the point of origin to the final destination. The platform would also enable the automatic execution of smart contracts, which could reduce the risk of disputes and improve the efficiency of supply chain operations. [3]



## Literature Survey (cont.)

Overall, the literature suggests that digitalization has the potential to significantly improve the performance of Alexandria port. Further research is needed to understand the long-term impacts of digitalization and to identify best practices for implementing digital technologies in the port industry.



# Services that will be introduced



**Centralized  
Database**



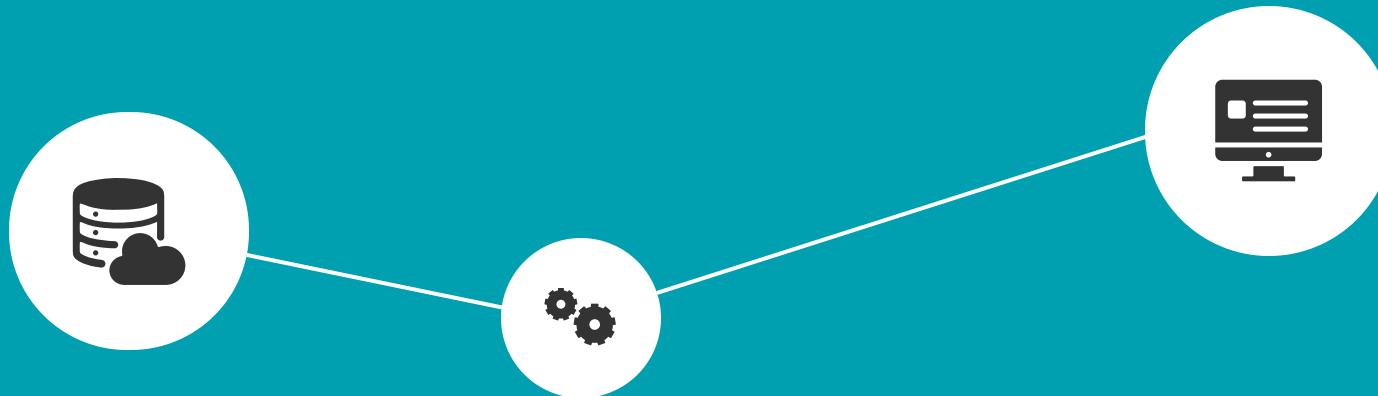
**Ship Movement  
Monitor**



**Information Sharing**



**System Platform  
Management**



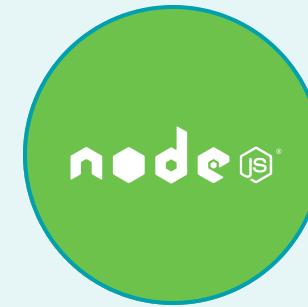
System Architecture  
Figure including phases &  
relations among phases



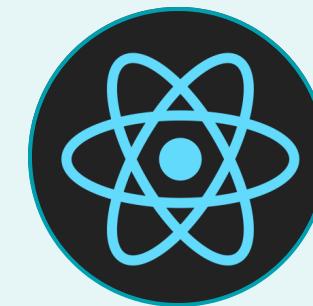
# Architecture



**Database**  
Oracle DB



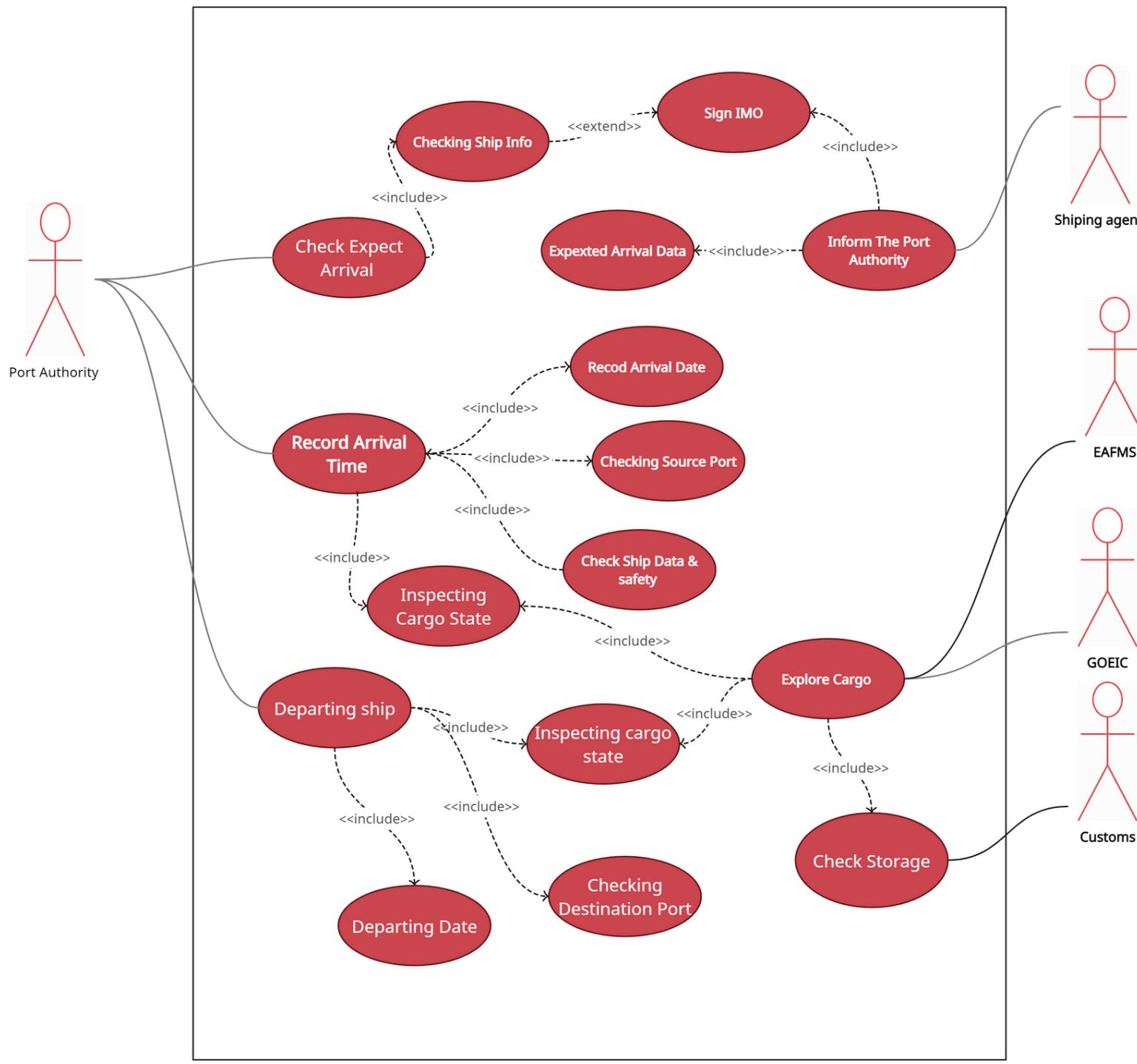
**Back-end**  
node.js

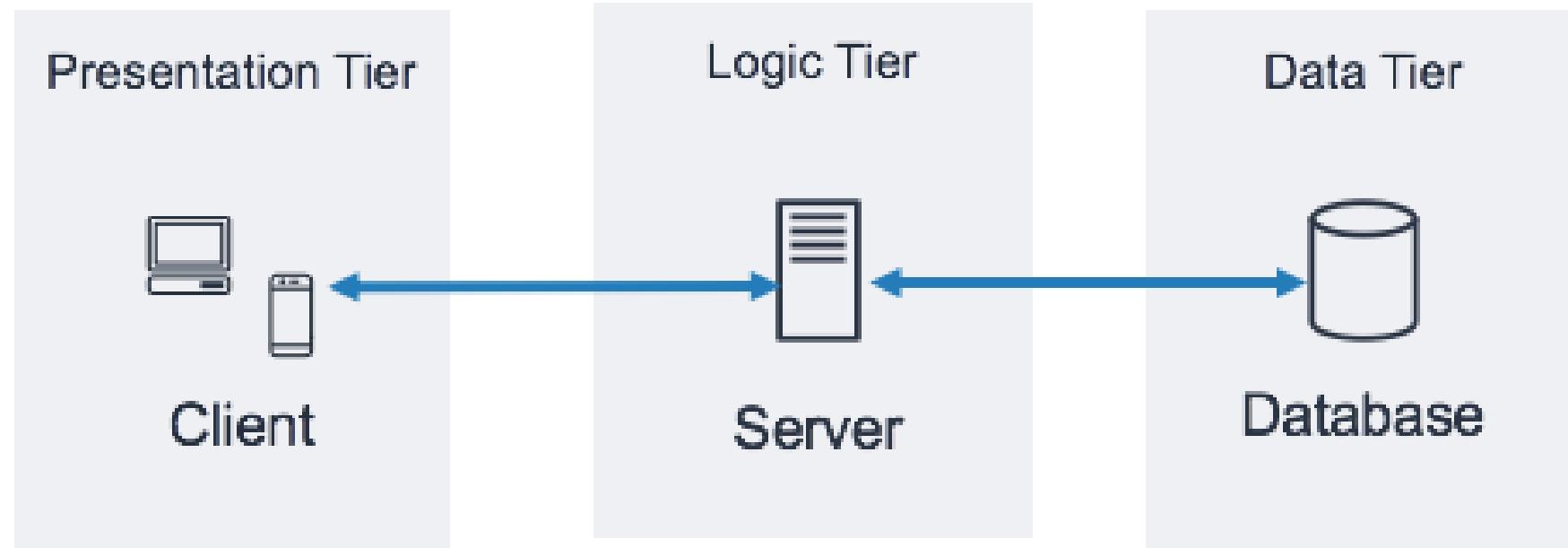


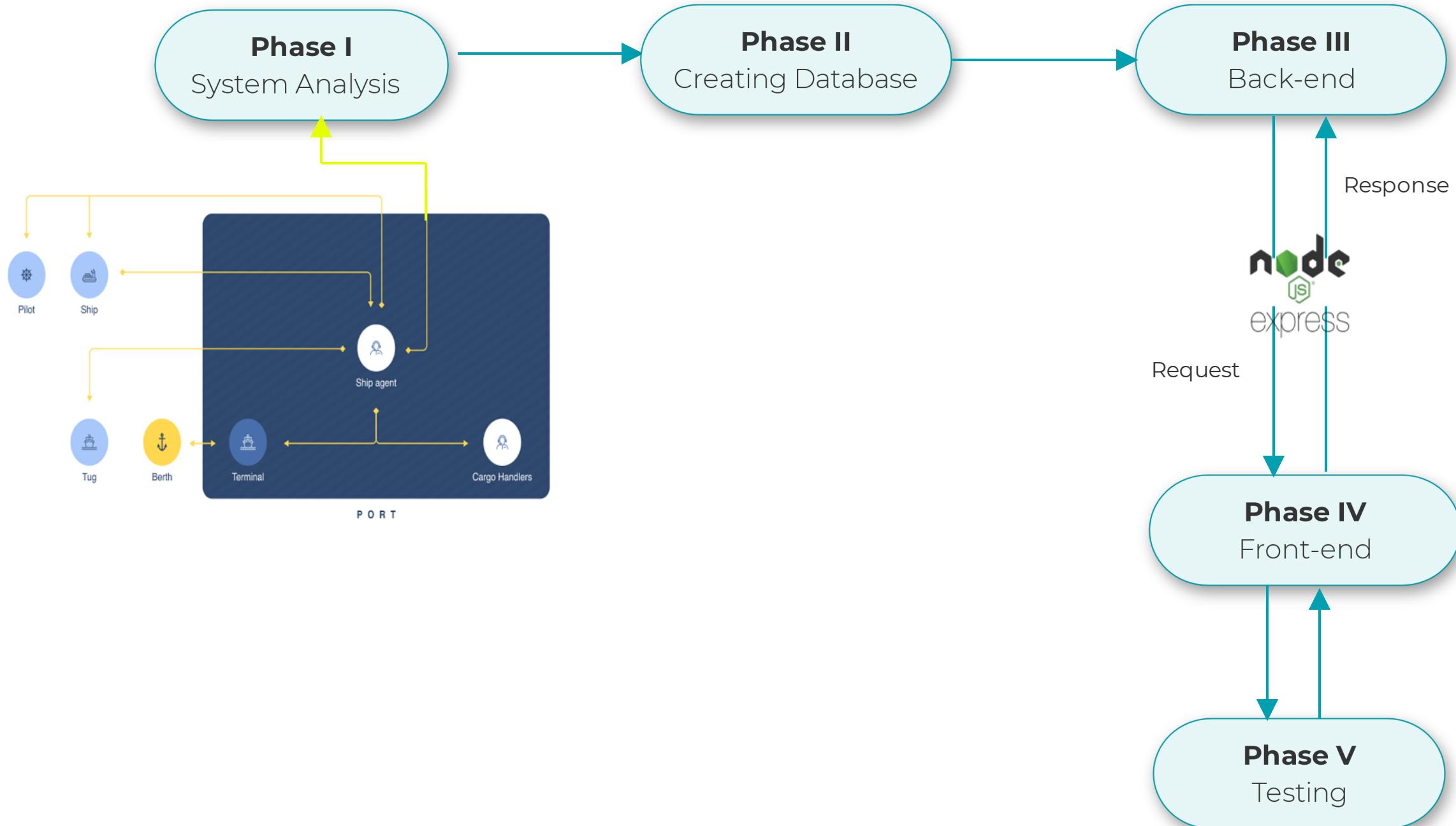
**Front-end**  
React



# Use Case









---

The technical description  
of each phase

# The technical description of each phase

The Port management system is composed of **5 phases**.

## 1 Data **Analysis**

- Data Preprocessing
- Data Cleaning
- Create databases
- Insert data

## 2 **Oracle** Implementation

## 3 **Back-end** Implementation

- Create servers
- Upload database on servers

## 4 **Front-end** Implementation

## 5 **Testing**



# Phase I: Data Analysis

- Ships Inform the Port Community System through their **on-ground agent**.
- Agent informs them of the **IMO**, so the Port Authority can then **retrieve** information from.
- Meanwhile the Agent informs the **Expected arrival time** to the PCS.
- The ship arrives at the berth, the shipment is taken to warehouses then system should record its **actual arrival data**.
- When the ship departs, System records its **departure data**.



# Data Preprocessing

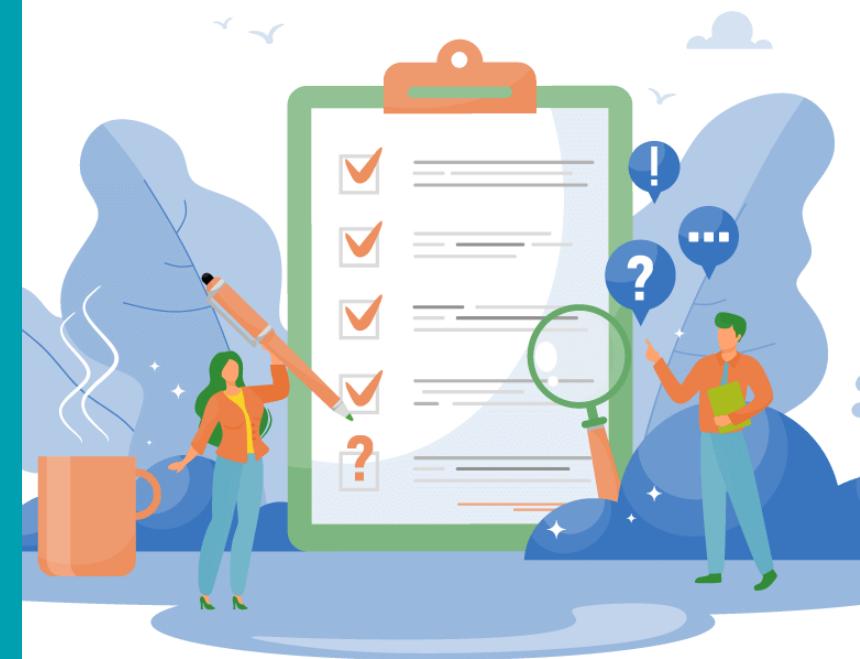
- Data **Manipulation**: The data is being updated when there is a new information about the arriving ships : Ship Description, Ship Departure, Ship Arrival, Ports, Ship Type, Countries, Operations, Agents

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- Data **cleaning** is the process of fixing or removing incorrect, corrupted, incorrectly formatted, duplicate, or incomplete data within a dataset.

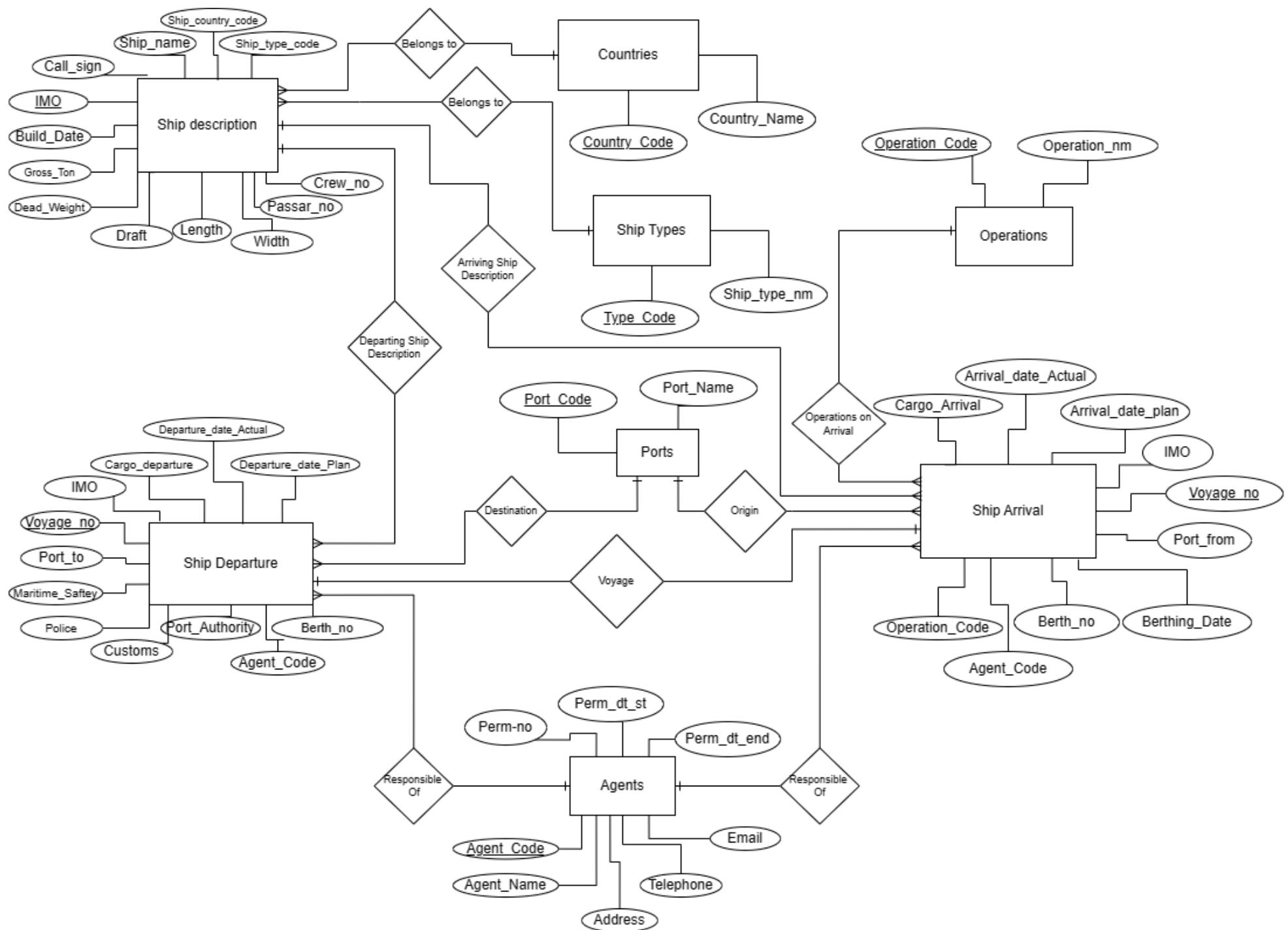
# Relations between data

- ✓ Each Country can have multiple ships with different description.
- ✓ Each Ship Type can have multiple ship description.
- ✓ Each Operation can be done by multiple Arriving ships.
- ✓ Each Ship with a specific description can arrive multiple times.
- ✓ Each Ship with a specific description can depart multiple times.
- ✓ Different ships can depart to the same destination port.
- ✓ Different ships can arrive from the same Origin port.





# ERD



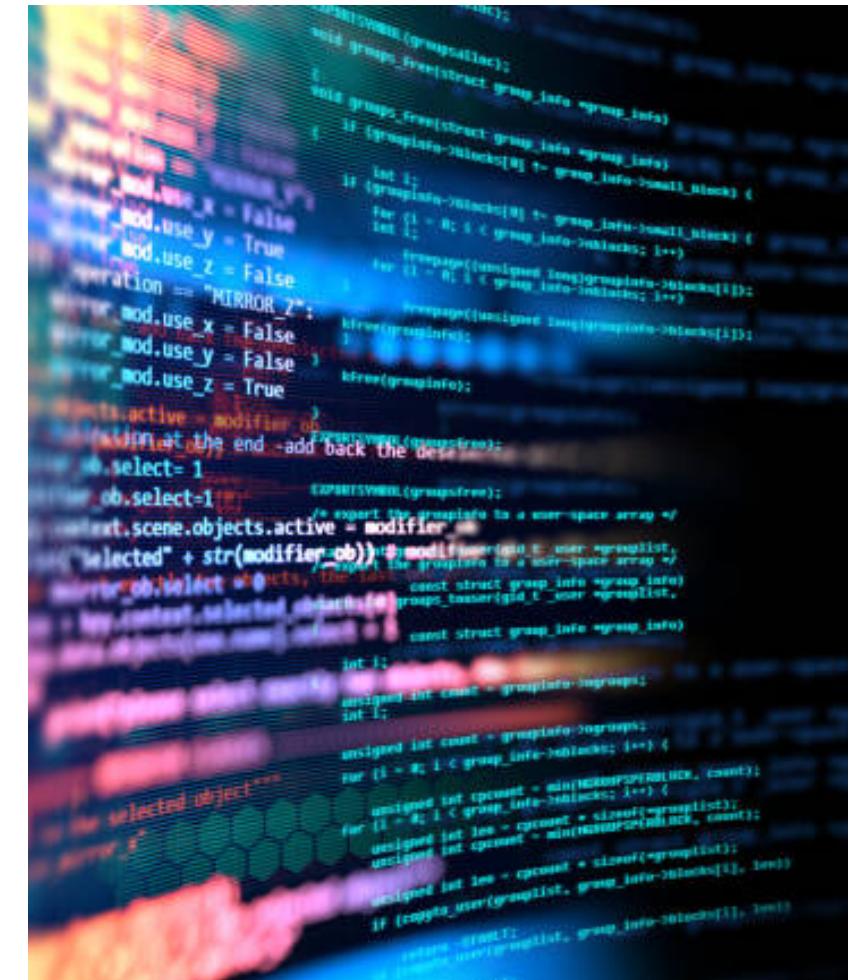
# Phase II: Oracle Implementation

- Oracle Database Implementation is a process of :  
Installing – Managing - Configuring an Oracle database
- in order to ensure the most reliable and efficient use of the technology. This entails:  
setting up disk storage - configuring memory settings - developing a network infrastructure - choosing the appropriate Oracle software to deploy.
- The ultimate goal is to have an optimized system that is :  
Secure - reliable - easily maintainable - cost-effective.
- A successful implementation requires extensive knowledge of both the Oracle platform as well as a deep understanding of the Port's IT needs.

# Phase III: Back-end Implementation

The back-end is going to be implemented in 2 ways

- 1 Using Oracle's REST API to add direct access for a system admin to the database for super user control.
  - 2 Through node.js and express as a framework with the implementation of oracleDB library to provide a simple API to execute SQL queries.





# Phase IV: Front-end Implementation

translating designs and static mockups into dynamic user interfaces

## **HTML, CSS and JavaScript**

so that a user can see and interact with them directly.

**Code to detect different browser events and implement features**

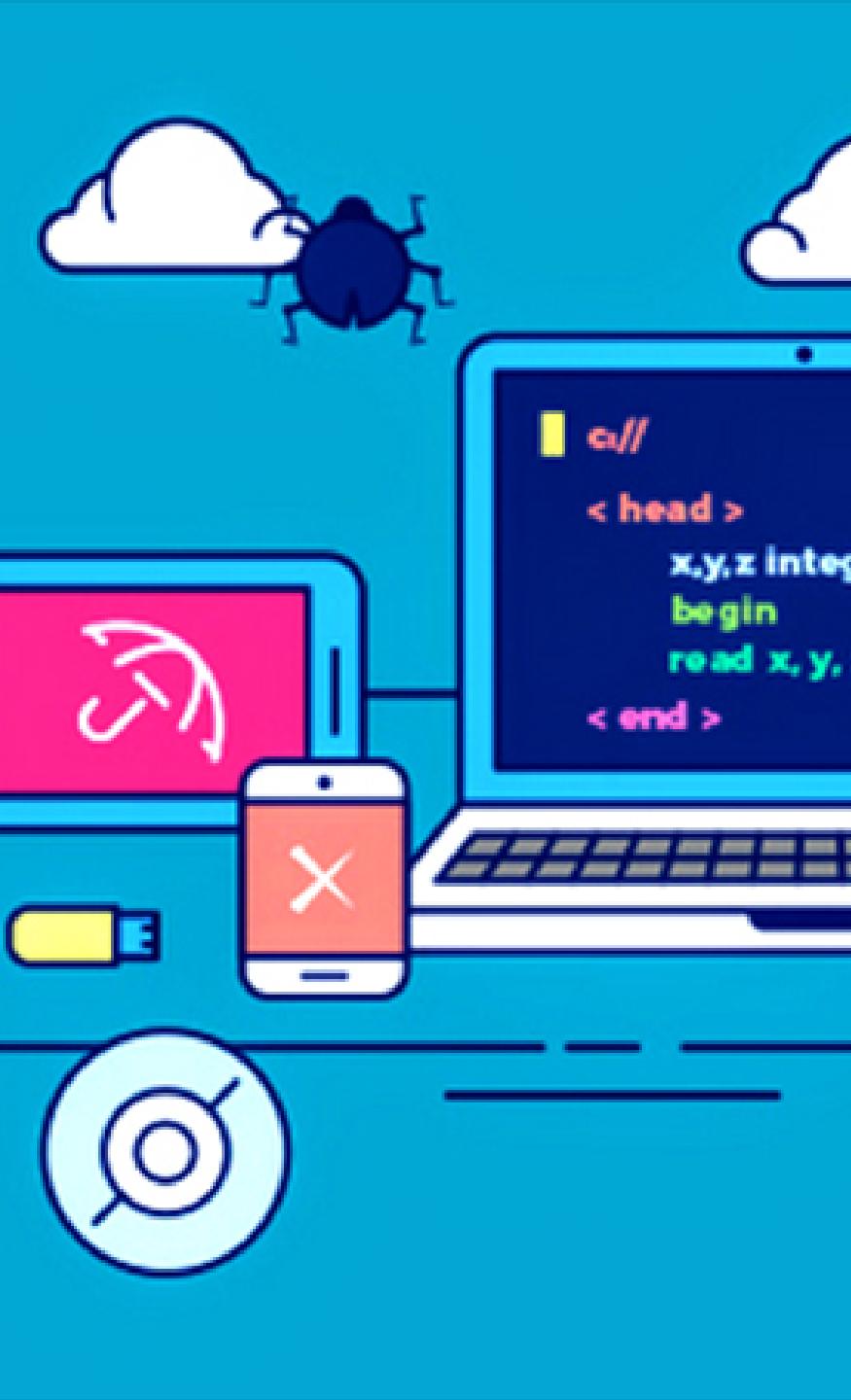
some libraries are used.

**Highly responsive interfaces**

React

# Phase V: Testing

The code is usually tested across multiple browsers on multiple devices in order to ensure cross-browser compatibility and make sure all users have the same experience while they interact with the website or application.





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# Design constraints

# Design Constraints

- 1 Time Constraint
- 2 Budget Constraint
- 3 Technical Constraint
- 4 Usability Constraint
- 5 Security Constraint
- 6 Legal Constraint



# Database Platforms

Platform	Advantages	Disadvantages
<b>Oracle</b>	<ul style="list-style-type: none"><li>i. <i>Fast indexing data.</i></li><li>ii. <i>Supports clustered environment.</i></li><li>iii. <i>Various tools to handle the data.</i></li><li>iv. <i>Fast with large databases.</i></li><li>v. <i>PL/SQL provides an efficient way to develop data-intensive processes that are able to interact with data without transferring it to an app server.</i></li><li>vi. <i>Rich programmability model: the database supports not only the very rich SQL but also PLSQL, Java and it has very good command-line tools that make change management easy and efficient.</i></li></ul>	<ul style="list-style-type: none"><li>i. <i>New (actually it is more than five years old) multi-tenant architecture is not as straightforward as SQL Server.</i></li><li>ii. <i>Many features require additional licensing that increase the total cost.</i></li><li>iii. <i>One of the most difficult vendors to work with.</i></li></ul>
<b>MySQL</b>	<ul style="list-style-type: none"><li>i. <i>Replication between instances is very spontaneous.</i></li><li>ii. <i>Database backup and restoration is easy.</i></li><li>iii. <i>Excellent community support.</i></li></ul>	<ul style="list-style-type: none"><li>i. <i>Tends to be getting slow with large databases.</i></li><li>ii. <i>Unhelpful error messages.</i></li><li>iii. <i>It is not always stable.</i></li></ul>
<b>Microsoft SQL Server</b>	<ul style="list-style-type: none"><li>i. <i>Easy to configure and use with Visual Studio and ASP.Net.</i></li><li>ii. <i>Data Security.</i></li><li>iii. <i>Easy to understand and use.</i></li><li>iv. <i>It is easy to export database and tables in the form of SQL query or a script.</i></li></ul>	<ul style="list-style-type: none"><li>i. <i>Database backup and recovery functionality need improvement.</i></li><li>ii. <i>It can be expensive to license.</i></li><li>iii. <i>No visualization of data.</i></li></ul>
<b>MongoDB</b>	<ul style="list-style-type: none"><li>i. <i>It stores documents in a JSON-like format.</i></li><li>ii. <i>Very simple with easy to learn and understand syntax.</i></li></ul>	<ul style="list-style-type: none"><li>i. <i>Limitations of document sizes and document nesting.</i></li><li>ii. <i>High memory usage.</i></li></ul>

# Back-end Frameworks

Framework	Advantages	Disadvantages
<b>Node.js</b>	<ul style="list-style-type: none"><li>i. <i>Sharing the same piece of code with both server and client side.</i></li><li>ii. <i>Easy scalability.</i></li><li>iii. <i>Cross-platform development.</i></li><li>iv. <i>JSON support.</i></li><li>v. <i>Full-stack JavaScript.</i></li><li>vi. <i>Global community.</i></li></ul>	<ul style="list-style-type: none"><li>i. <i>Node.js is not suited for CPU-intensive tasks. It is suited for I/O stuff only.</i></li><li>ii. <i>Nested call-back.</i></li><li>iii. <i>Harder to debug.</i></li></ul>
<b>Ruby on Rails</b>	<ul style="list-style-type: none"><li>i. <i>Better code readability.</i></li><li>ii. <i>Ruby puts a strong emphasis on securing solutions made on it.</i></li><li>iii. <i>Ruby is an open source, which gives developers the feasibility to share their codes with other programmers.</i></li></ul>	<ul style="list-style-type: none"><li>i. <i>Shortage of flexibility.</i></li><li>ii. <i>The boot time of the framework is quite long.</i></li><li>iii. <i>The price of a mistake in developing with Ruby on Rails is heavily connected to the performance time.</i></li></ul>
<b>Laravel</b>	<ul style="list-style-type: none"><li>i. <i>Laravel has an extensive library of pre-programmed functionalities.</i></li><li>ii. <i>Highly scalable software allows you to tackle projects of any size.</i></li><li>iii. <i>The software has a safe, built-in access control system.</i></li></ul>	<ul style="list-style-type: none"><li>i. <i>Laravel does have a comprehensive list of built-in features designed to make web development easier.</i></li><li>ii. <i>Laravel has regular updates. Older versions of the product quickly become buggy.</i></li></ul>
<b>ASP.net</b>	<ul style="list-style-type: none"><li>i. <i>ASP.NET follows the MVC architecture, which allows for separate input, process and output of the application.</i></li><li>ii. <i>ASP.NET delivers enhanced performance and scalability.</i></li><li>iii. <i>The framework language allows for easy cross-platform migration.</i></li></ul>	<ul style="list-style-type: none"><li>i. <i>Low Portability.</i></li><li>ii. <i>Complex pages with performance issues.</i></li><li>iii. <i>Lack of abstraction with least control over HTML.</i></li></ul>

# Front-end Frameworks

Framework	Advantages	Disadvantages
<b>React</b>	<i>i. Reusable components.</i> <i>ii. Easy search engine optimization.</i> <i>iii. Easy debugging.</i> <i>iv. Simple UI testing.</i> <i>v. Fast display of a great number of components.</i>	<i>i. Sometimes needs more code to be written.</i> <i>ii. Data changes are processed manually.</i> <i>iii. View-oriented.</i>
<b>Angular</b>	<i>i. Works well for SPAs.</i> <i>ii. Fast SDLC.</i> <i>iii. Requires less code.</i> <i>iv. Perfect testing options.</i> <i>v. MVC.</i> <i>vi. Interactivity.</i>	<i>i. Slow display of a great number of components.</i> <i>ii. Poor SEO options.</i>
<b>Flutter</b>	<i>i. One code base.</i> <i>ii. Fast and efficient.</i> <i>iii. No third Party Integrations.</i> <i>iv. Reusable code.</i>	<i>i. Relatively new.</i> <i>ii. No web support yet.</i> <i>iii. Shortage of libraries.</i>
<b>Vue.js</b>	<i>i. A Fast Performance.</i> <i>ii. A Cross-platform Development.</i> <i>iii. User Friendliness and Low Learning Curve.</i> <i>iv. Components Reusability</i>	<i>i. Too Much Flexibility.</i> <i>ii. Mostly Adopted in The Chinese Market.</i> <i>iii. Smaller Plugging and Tooling Ecosystem Compared to Other Frameworks.</i>



# Software requirements

Software	Version	Why?
Oracle	10g	Fast with large databases
Node.js	node-v18.12.1-x64	Full-stack JavaScript.
React	18.2.0	Reusable components.

# Hardware requirements

## VM-Database / Specs

Item	Architecture	Requirements
Storage	Shared San-Storage	500 GBs SSD local hard disk on each node 2 T Harddisk1 → 500G → SAS (Hard Disk type) Harddisk2 → 500G → SAS (Hard Disk type) Harddisk3 → 500G → SSD (Hard Disk type) Harddisk4 → 50G → SAS (Hard Disk type) Harddisk5 → 50G → SAS (Hard Disk type) Harddisk6 → 50G → SAS (Hard Disk type) Harddisk7 → 50G → SSD (Hard Disk type) Harddisk8 → 50G → SSD (Hard Disk type) Harddisk9 → 50G → SSD (Hard Disk type)
Memory		64GBs
Processor(Cores)		8 core
Platform /Operating System		O.S oracle Linux 7.9
DB Engine		Oracle 19 c

# Hardware requirements (cont.)

VM – Oracle Application server/Specs Per server

VM – Oracle Application server / Specs Per server -----Option		
Item	Architecture	Requirements
Storage	Shared San-Storage	TB 1
Memory		96 GBs
Processor(Cores)		6 core
Platform /Operating System		Windows Server 2019
Architecture Design	Network Load Balance Device (Option)	
No. of Nodes	3 Node	



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Prototype

## Nav bar

admin


## End user

Stakeholder

existing

departing

check	data	Cargo	conform
			Not conformed

done

update

delete

create

Insert

print

Users

Insert

delete

update

user

print

table	pass	user



Looking for a name

ID	UserName	Password	PortSector

ID	<input type="text"/>	Search	Add new		
User Name	<input type="text"/>	Password	<input type="text"/>	Port Sector	<input type="text"/>
	<input type="button" value="Add"/>	<input type="button" value="Edit"/>	<input type="button" value="Cancel"/>	<input type="button" value="Print"/>	



Port Authority

Home

About Us ▾

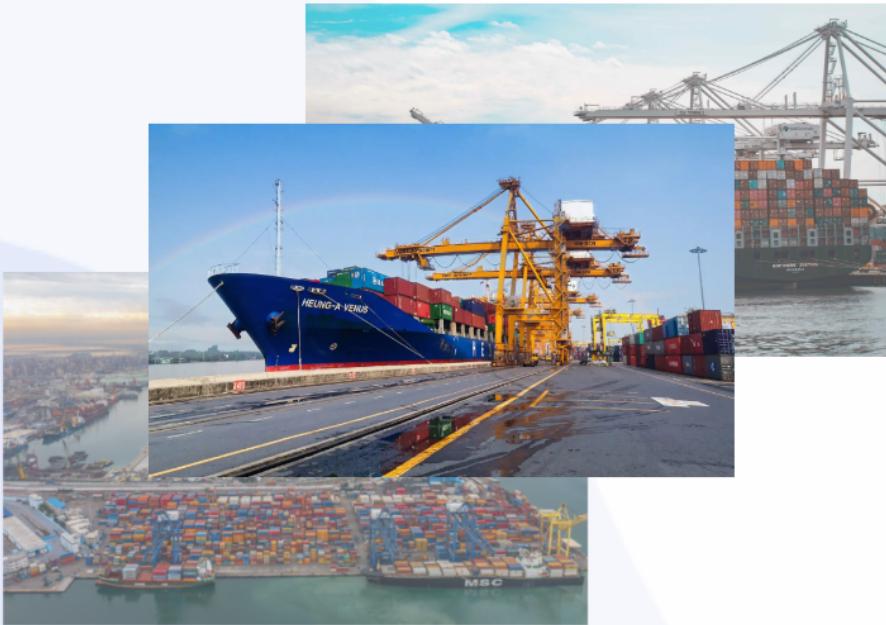
LOGIN



A

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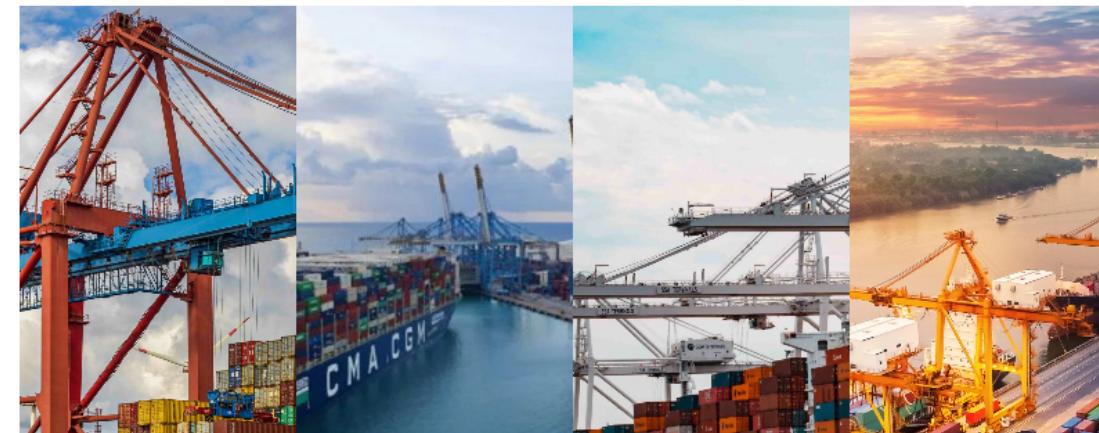
Window Ship

## About Port Authority

We are concerned with the port authority system. Port authorities must also ensure that their digital systems remain compliant with industry regulations and standards. As a result, port authorities are facing challenges in developing the necessary digital infrastructure and integrating new technologies into their existing systems. Digitalization can also help ports handle larger volumes of cargo more efficiently, reduce the need for manual labor, and improve the accuracy of information about cargo and vessels, and better manage the port's resources.

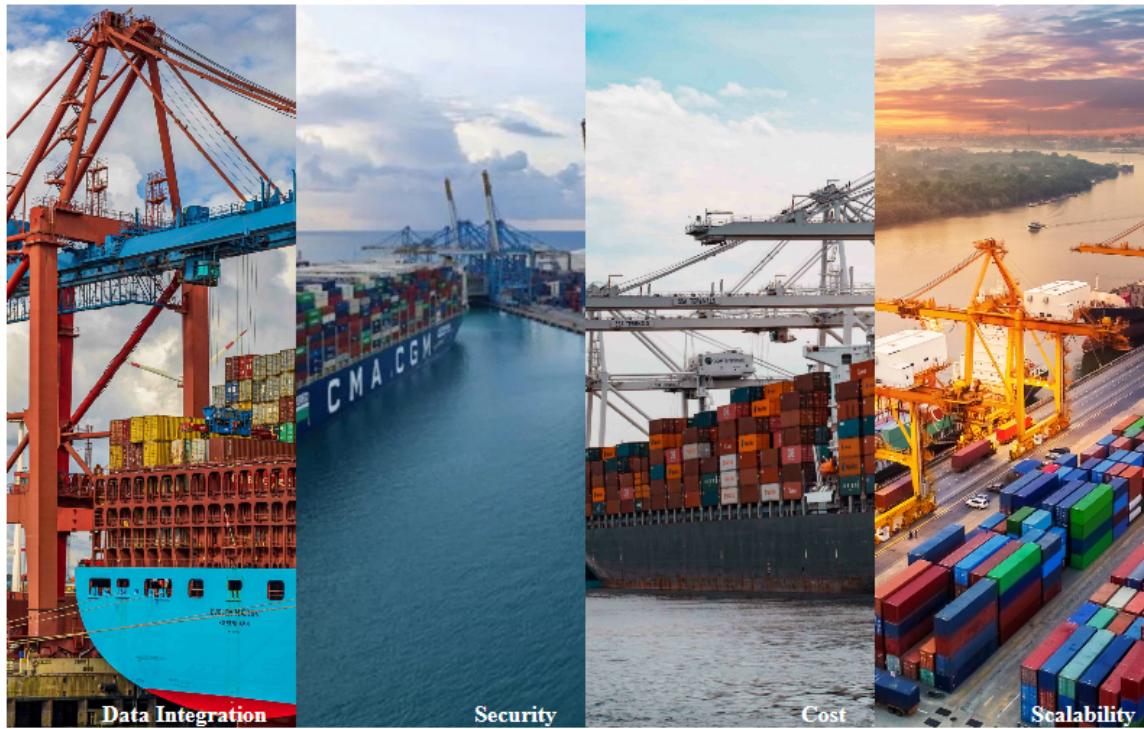


## Our Services



Windows Snap





# Business Model

<p><b>KEY PARTNERS</b></p> <ul style="list-style-type: none"><li>- Customs Authority</li><li>- Import and Export Monitoring Agency</li><li>- Police</li><li>- Logistics Companies</li><li>- Egyptian Health and Safety Department</li><li>- Warehouses</li><li>- Security</li></ul> 	<p><b>KEY ACTIVITIES</b></p> <ul style="list-style-type: none"><li>- Centralized Database</li><li>- Monitor Ship Movement</li><li>- Information Sharing</li><li>- System Platform Management</li></ul> <p><b>KEY RESOURCES</b></p> <ul style="list-style-type: none"><li>- Port Authority Personnel</li><li>- Shipping Agent</li><li>- Database</li><li>- Technical Resources</li></ul> 	<p><b>VALUE PROPOSITIONS</b></p> <ul style="list-style-type: none"><li>- Improve port information flow</li><li>- Improved terminal planning</li><li>- Improved port call efficiency</li><li>- Improved port service planning</li><li>- Enhancing collaboration between government agencies</li></ul> 	<p><b>CUSTOMER RELATIONSHIP</b></p> <ul style="list-style-type: none"><li>- Privacy &amp; SEC of data</li><li>- Provide annual reports</li><li>- Data Exchange</li></ul> <p><b>CHANNELS</b></p> <ul style="list-style-type: none"><li>- Port Website</li><li>- Database for port</li></ul> 	<p><b>CUSTOMER SEGMENTS</b></p> <ul style="list-style-type: none"><li>- Shipping Agent</li><li>- EAFMS</li><li>- GOEIC</li><li>- Customs</li><li>- Container Companies</li></ul>
<p><b>COST STRUCTURE</b></p> <ul style="list-style-type: none"><li>- Server and DB Hardware and System Environment</li><li>- System Development</li></ul>		<p><b>REVENUE SOURCES</b></p> <ul style="list-style-type: none"><li>- Initial Price fee</li><li>- Our optional Service</li><li>- Maintenance fee</li></ul>		

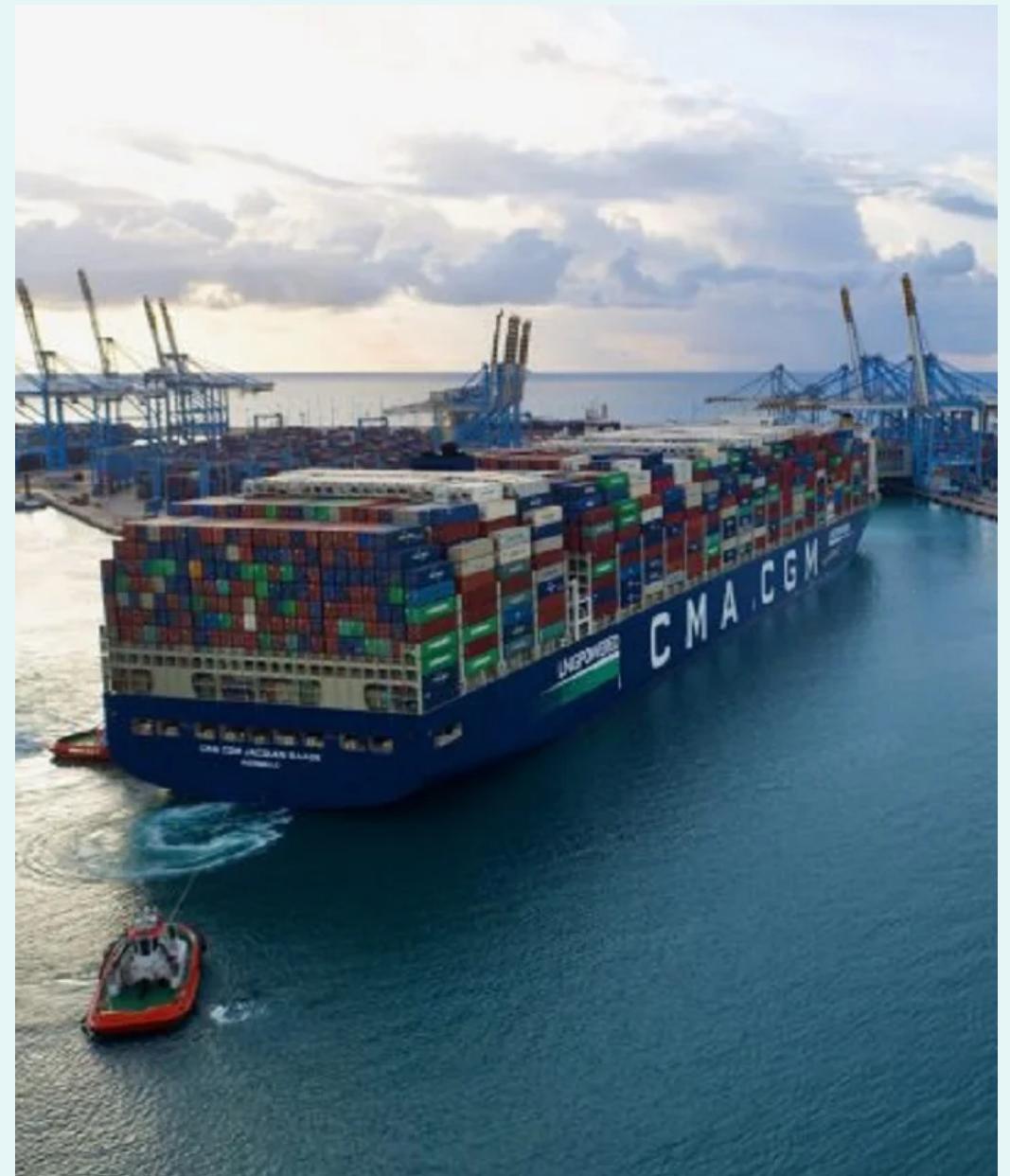


# Cost

- Assuming overall task time is almost 3 months, therefore the total number of hours is about 480 hours before accounting hardships + 10% risk buffers + 10% time eaters
- $480 + 48 + 48 = 576$  Hours
- Considering Average Software Developer pay = 62.5 EGP/hour
- $576 * 62.5 = 36000$  LE
- Total Cost =  $36,000 + 250,000$  (Server Hardware Costs) = 286,000 LE

# Ethics

- **Ethical** considerations
  - Privacy of data
- Users' right to **access** their own data.
- None of the products they offer or advertise **violate** any laws or regulations.



# What has been done in Project I



We have paid multiple visits to Alexandra port to Know the life cycle of the port authority system.



Design the structure of the database.



We have already started collecting some real data.



progress in the front-end implementation.

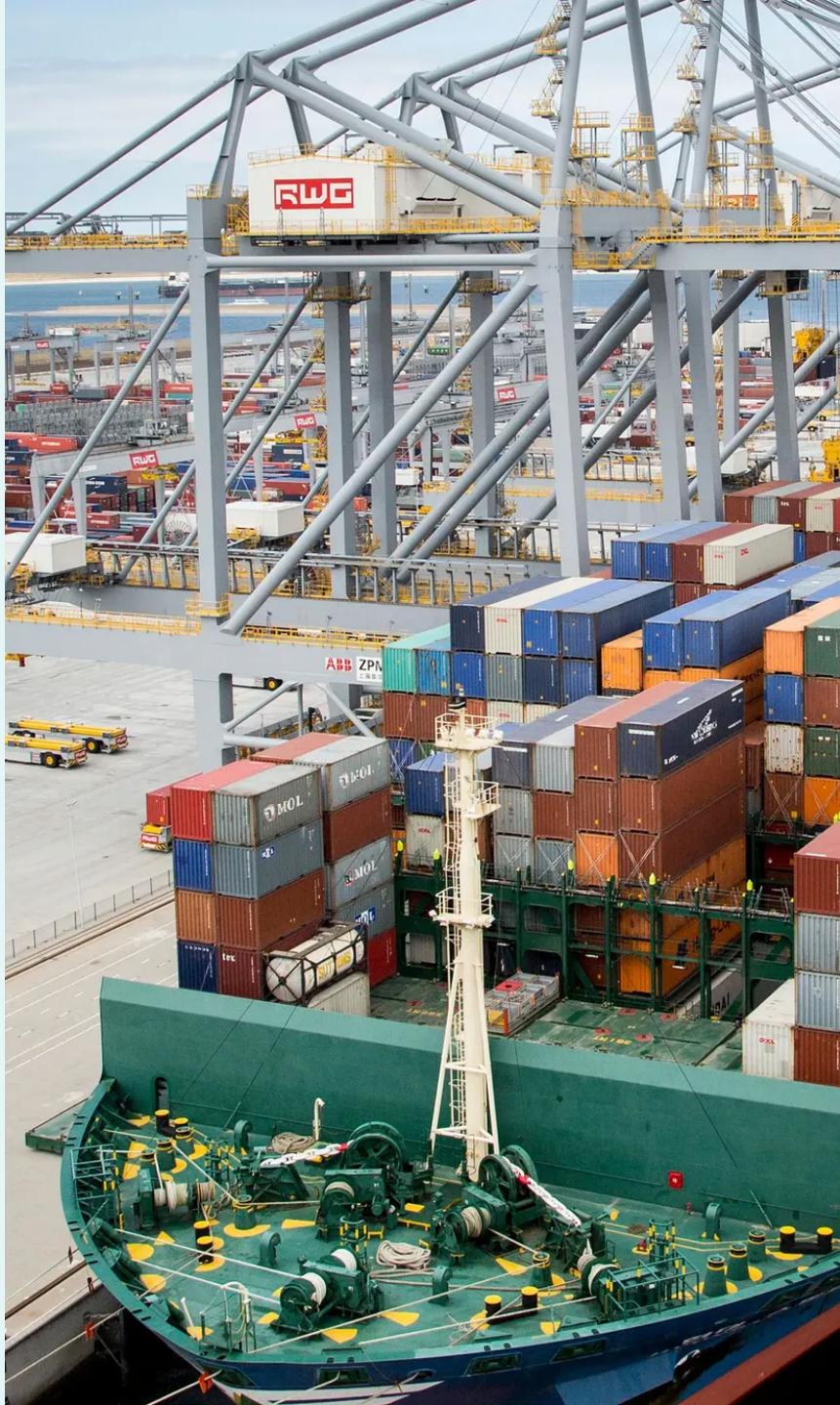


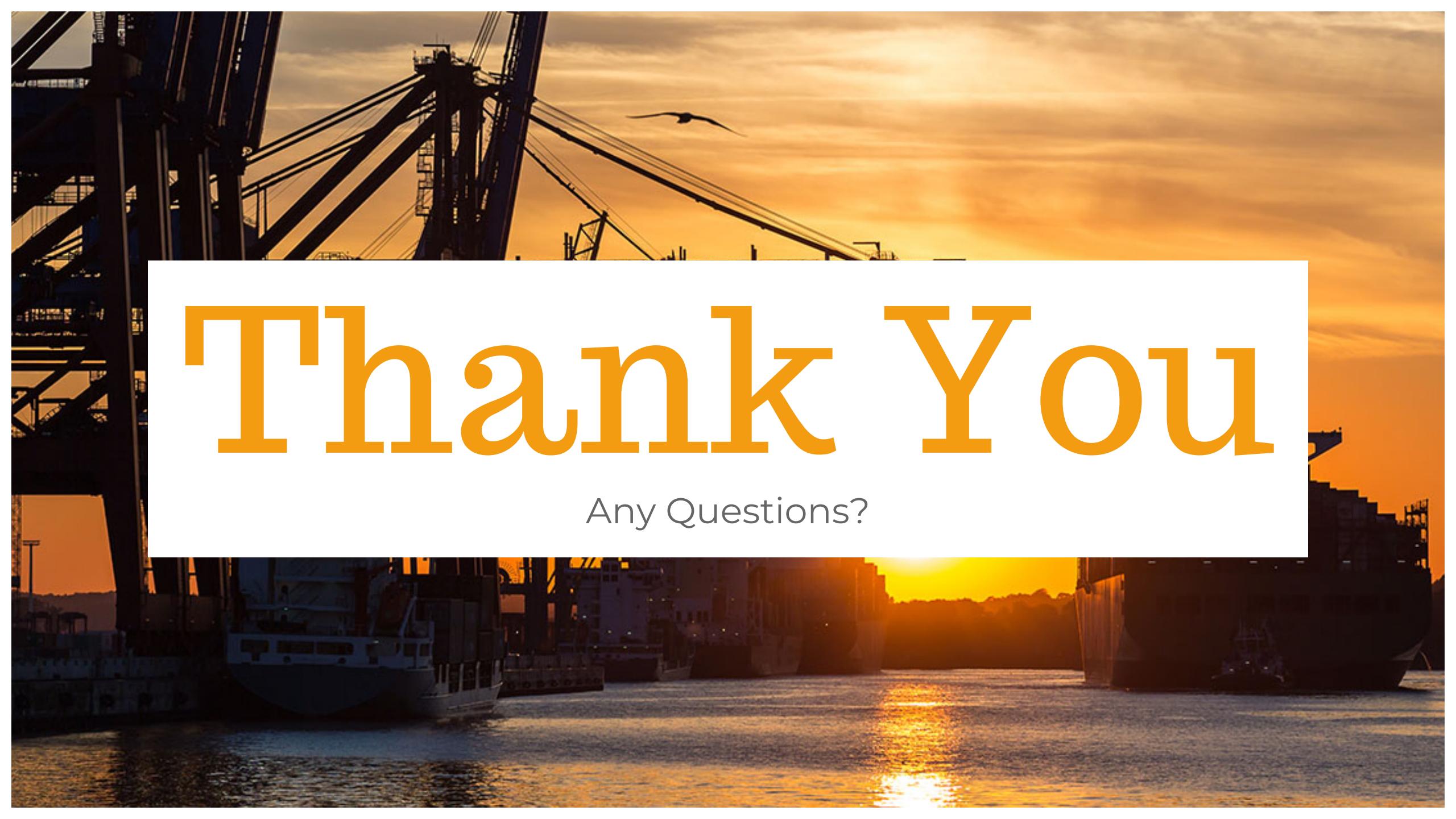
# Plan of Project II

- Implement a database to store port data with high accuracy and high-speed using Oracle.
- Apply data analytics for our data collection using Power BI.
- Create the pages and apply react.js to complete the application.
- Create a back-end using node.js to connect our servers with our website.
- Use Automation testing.

# References

- 1 Othman, A., El Gazzar, S., & Knez, M. (2022). Investigating the Influences of Smart Port Practices and Technology Employment on Port Sustainable Performance: The Egypt Case. *Journal Name*.
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- 3 Balci G, Surucu-Balci E (2021) Blockchain adoption in the maritime supply chain: examining barriers and salient stakeholders in containerized international trade. *Trans Res Part e: Log Trans Rev* 156:102539





# Thank You

Any Questions?