SCS

جامعة جدة
University of Jeddah

Department of Information Systems & Technology
College of Computer sciences & Engineering

SMART CONTAINER SOLUTIONS

Team Members

Yousef Alnumani
Abdulrahman Alghamdi
Mishari Abdulla
Ghazi Makkawi
Abdulrahman Alorabi

Supervised By :
Dr. Mohammd Algamdi

TABLE OF CONTENTS

01- INTRODUCTION

02- PROBLEM DEFINITION

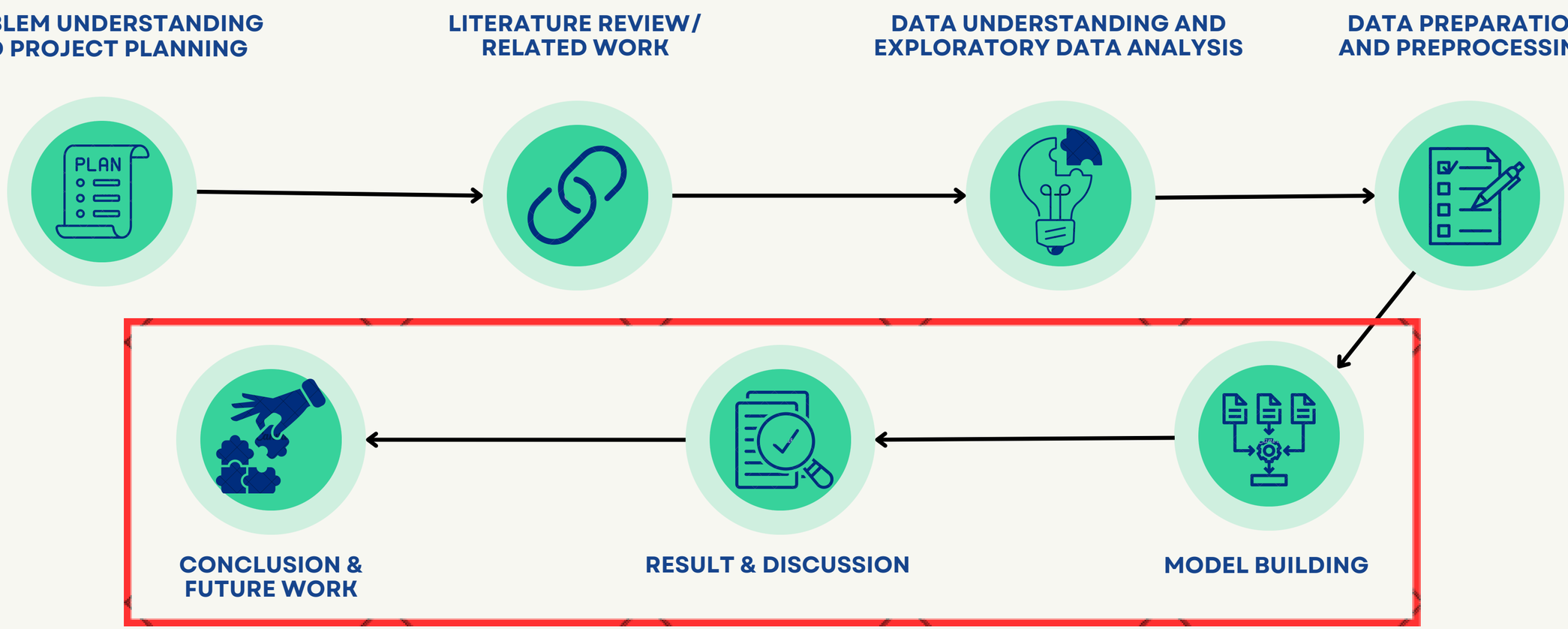
Challenges in port operations, such as container delays and inefficient space utilization, increase costs, requiring innovative and less sensor-based solutions.

SCS

03- PROPOSED SOLUTIONS

SCS solution leverages AI and ML to predict ship arrivals and optimize container flow using existing data, enhancing efficiency without extensive sensor deployment.

04- PROJECT PROGRESS


PROBLEM UNDERSTANDING AND PROJECT PLANNING
PLAN
LITERATURE REVIEW/ RELATED WORK
DATA UNDERSTANDING AND EXPLORATORY DATA ANALYSIS
DATA PREPARATION AND PREPROCESSING
MODEL BUILDING
RESULT & DISCUSSION
CONCLUSION & FUTURE WORK

05- DATASET OVERVIEW

SCS

SHIP TABLE

- Tracks ship specifications and schedules

CONTAINER TABLE

- Details logistics for each container

CUSTOMS CLEARANCE TABLE

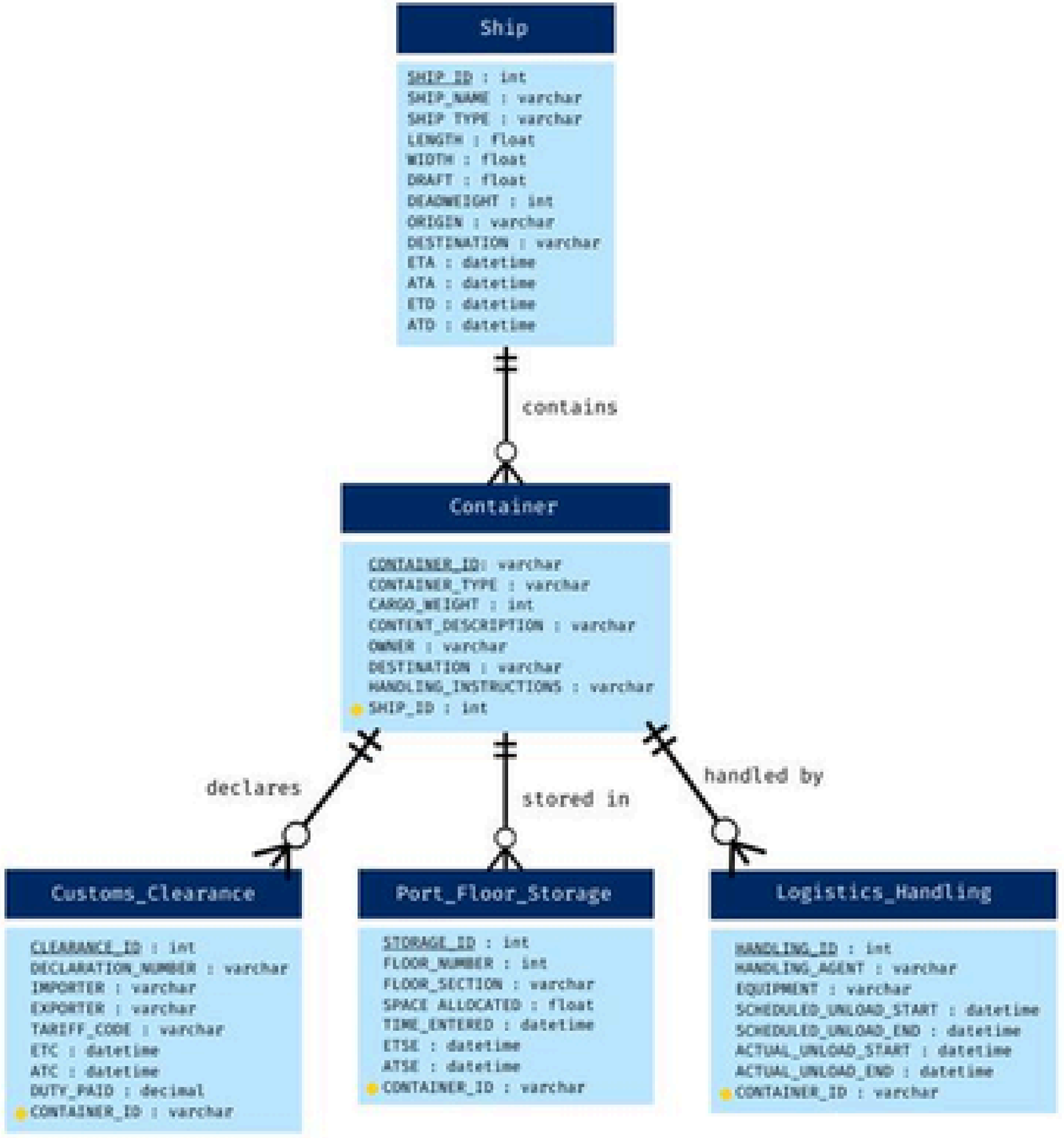
- Records customs processing

STORAGE TABLE

- Manages container storage locations

LOGISTICS HANDLING TABLE

- Tracks handling operations


Ship
SHIP_ID : int
SHIP_NAME : varchar
SHIP_TYPE : varchar
LENGTH : float
WIDTH : float
DRAFT : float
DEADWEIGHT : int
ORIGIN : varchar
DESTINATION : varchar
ETA : datetime
ATA : datetime
ETD : datetime
ATD : datetime
contains
Container
CONTAINER_ID: varchar
CONTAINER_TYPE : varchar
CARGO_WEIGHT : int
CONTENT_DESCRIPTION : varchar
OWNER : varchar
DESTINATION : varchar
HANDLING_INSTRUCTIONS : varchar
SHIP_ID : int
declares
stored in
handled by
Customs_Clearance
CLEARANCE_ID : int
DECLARATION_NUMBER : varchar
IMPORTER : varchar
EXPORTER : varchar
TARIFF_CODE : varchar
ETC : datetime
ATC : datetime
DUTY_PAID : decimal
CONTAINER_ID : varchar
Port_Floor_Storage
STORAGE_ID : int
FLOOR_NUMBER : int
FLOOR_SECTION : varchar
SPACE_ALLOCATED : float
TIME_ENTERED : datetime
ETSE : datetime
ATSE : datetime
CONTAINER_ID : varchar
Logistics_Handling
HANDLING_ID : int
HANDLING_AGENT : varchar
EQUIPMENT : varchar
SCHEDULED_UNLOAD_START : datetime
SCHEDULED_UNLOAD_END : datetime
ACTUAL_UNLOAD_START : datetime
ACTUAL_UNLOAD_END : datetime
CONTAINER_ID : varchar

	SHIP_ID	SHIP_NAME	SHIP_TYPE	LENGTH	WIDTH	DRAFT	DEADWEIGHT	ORIGIN	DESTINATION_x
1	C100003	Summers and Sons	General Cargo	237.91	24.41	10.5	68773	Kentborough	Jeddah Islamic Port

	ETA	ATA	ETD	ATD	CONTAINER_ID	CONTAINER_TYPE	CONTAINER_DIMENSI	CARGO_WEIGHT	CONTENT_DESCRIPTI
1	2023-01-01 00:00:00	2022-12-31 19:00:00	2023-01-02 19:00:00	2023-01-03 12:00:00	C123456	20 ft	25.5	12000	High-quality goods

	OWNER	DESTINATION_y	HANDLING_INSTRUC	FLOOR_NUMBER	FLOOR_SECTION	SPACE_ALLOCATED	TIME_ENTERED	ETSE	ATSE
1	XYZ Corporation	Jeddah Islamic Port	Handle with care	3	A	25.5	2022-12-31 19:00:00	2023-01-02 19:00:00	2023-01-03 12:00:00

ATSE	HANDLING_ID	HANDLING_AGENT	EQUIPMENT	SCHEDULED_UNLOAD	SCHEDULED_UNLOAD	ACTUAL_UNLOAD_ST/	ACTUAL_UNLOAD_EN	WEATHER
2023-01-03 12:00:00	11799946	Romero-Mason	Forklift	2022-12-31 19:00:00	2022-12-31 21:00:00	2022-12-31 19:05:00	2022-12-31 21:05:00	Clear

06- MODEL BUILDING

01.

DATA PREPARATION

Since real-world data was not readily available, we generated a simulated dataset that mimicked port operations, including daily ship arrivals and container handling times.

02.

DATA CLEANING AND PREPROCESSING

- Datetime Conversion
- Handling Time Calculation
- Missing Value Treatment
- Feature Engineering

03.

MODEL INITIALIZATION

- Time series algorithms analyze temporal data to uncover trends, seasonality, and patterns, enabling accurate forecasting with models like RNN, Prophet, or LSTMs

MODEL APPLICATION

DAILY SHIP ARRIVALS MODEL APPLICATION

The goal of this model was to predict the number of daily ship arrivals based on historical data.

CONTAINER HANDLING TIME MODEL APPLICATION

This model aimed to predict the average daily container handling time at the port, based on historical handling data.

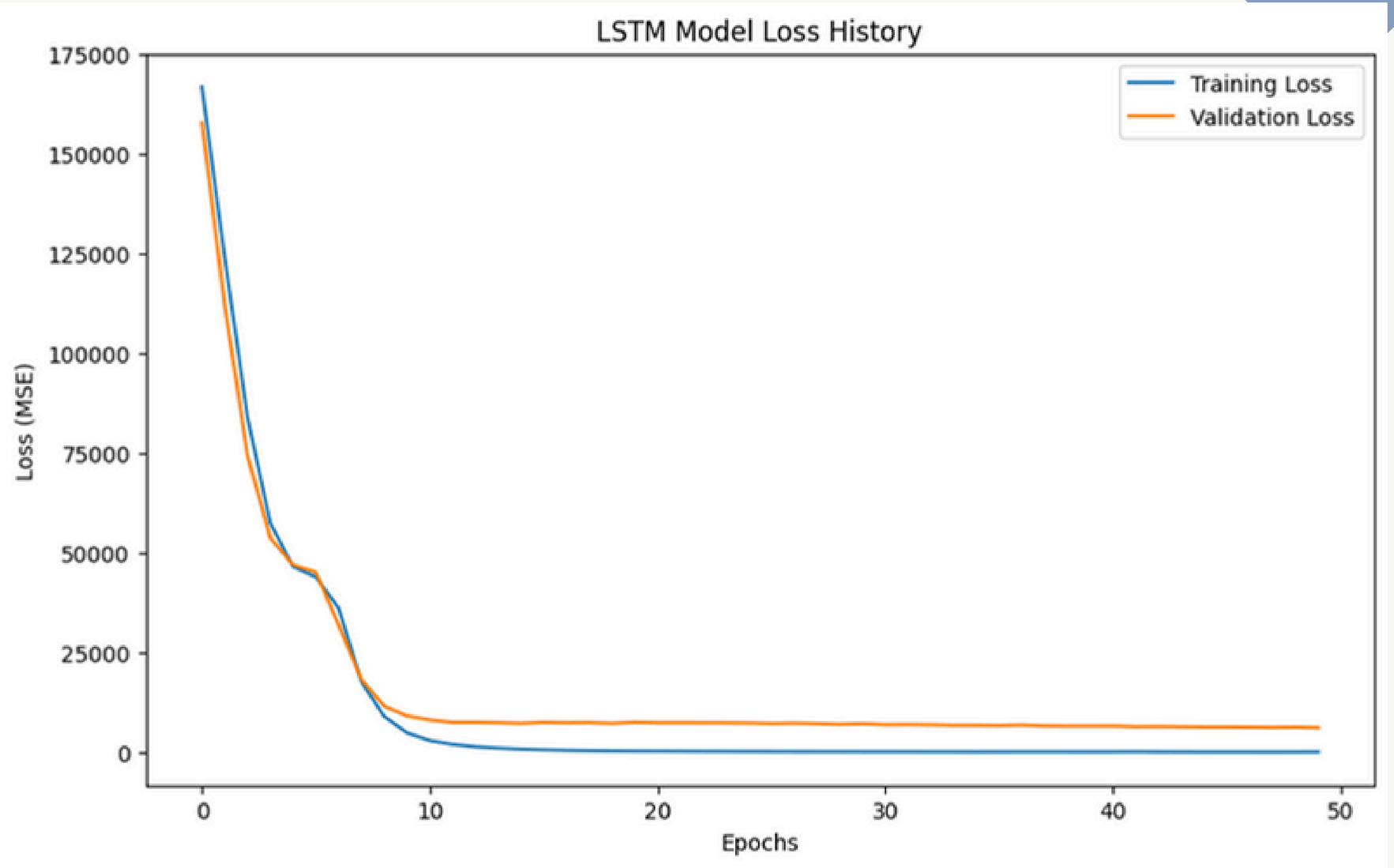
07- RESULTS & DASHBOARD

Model	Long-term dependency	Gradient flow	Complexity of patterns	Training speed	Scalability to big data
RNN Model	Poor	Issues with vanishing	Limited	Fast	Low
GRU Model	Good	Improves	Moderate	Faster than LSTM	Moderate
LSTM Model	Excellent	Superior	High	Slower than GRU	High

EVALUATION RESULTS FOR DAILY SHIP ARRIVALS MODEL

LSTM MODEL:

- MAE: 2.28
- RMSE: 2.77
- Accuracy: 87.52%



SCS

EVALUATION RESULTS FOR CONTAINER HANDLING TIME MODEL

PROPHET MODEL:

MAE

0.045 hours

RMSE

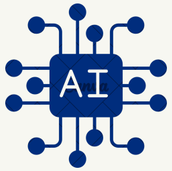
0.071 hours

SCS

DEMO

08- CONCLUSION & FUTURE WORK

PROJECT SUCCESS



01.

Developed AI-driven models for port management.

02.

Enhanced port operations by predicting ship arrivals and container handling times.

03.

Supports Saudi Vision 2030 by optimizing logistics.

LIMITATIONS

01.

DATA ACCESS

Reliance on synthetic data due to the unavailability of real-world data.

02.

MODEL SELECTION

- RNN model faced challenges in capturing complex patterns.
- LSTM model chosen for better sequential data handling.

03.

TECHNICAL CHALLENGES

- High computational power required for large datasets.
- Rented a dedicated server to ensure smooth operation.

FUTURE WORK

01.

REAL-WORLD DATA INTEGRATION

Collaborate with port authorities for access to actual data.

02.

ADVANCED TECHNIQUES

Integrate real-time data (e.g., port maintenance, port congestion).

03.

EXPANDED SCOPE

- Include predictive maintenance and risk assessment.
- Develop comprehensive tools for resource optimization and risk management.

REFERENCE

[1] National Industrial Development and Logistics Program. (2019). "Saudi Vision 2030." Retrieved April 30, 2024, from https://www.vision2030.gov.sa/ar/vision-2030/vrp/national-industrial-development-and-logistics-program/
[2] "TIDALIS." TIDALIS, 11 Apr. 2024, https://tidalis.com/
[3] "Dubai Technologies." Dubai Technologies, 15 Jan. 2024, https://dt.ae/
[4] "One Port." One Port, 24 Mar. 2024, https://www.oneport.com/hk/index.html
[5] "Grieg Connect." Grieg Connect, 30 Jan. 2024, https://griegconnect.com/products/port/
[6] "Dswi." Dswi, 8 Apr. 2024, https://www.dswius.com/
[7] "Port of Amsterdam." Port of Amsterdam, 19 Feb. 2024, https://myport.portofamsterdam.com/arrivals/
[8] "Most Common Types of Containers." TecContainer, 2 Apr. 2024, https://www.teccontainer.com/blog/most-common-types-of-containers/
[9] "Information About Container Ships." International Chamber of Shipping, 5 Mar. 2024, https://www.ics-shipping.org/explaining/ships-ops/container-ships/
[10] "Maritime Operational Terms." American Association of Port Authorities, 28 Feb. 2024, https://www.aapa-ports.org/advocating/content.aspx?ItemNumber=21500
[11] "Saudi Ports Authority (MAWANI)." Saudi Ports Authority (MAWANI), 20 Jan. 2024, https://mawani.gov.sa/
[12] "International Maritime Organization (IMO)." International Maritime Organization, 17 Apr. 2024, https://www.imo.org/

ANY QUESTIONS ?