

# Introduction

## Aramco

- Global company with a significant presence in the energy and chemicals sector
- Contributes significantly to the country's revenue and infrastructure development

## Financial Highlights

- 45.6% growth in net income from 110.0 billion to 161.1 billion in 2022
- Caused by higher crude oil prices, increased sales volume, improved profit margins for refined products

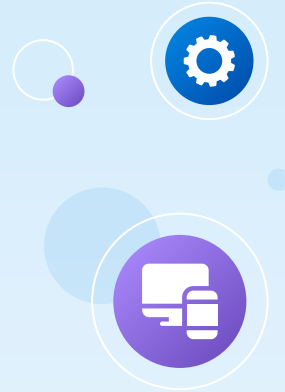
## Operational Highlights

- Maintain an average hydrocarbon production of 13.6 million barrels of oil equivalent/day
- 99.9% reliability in delivery of crude oil



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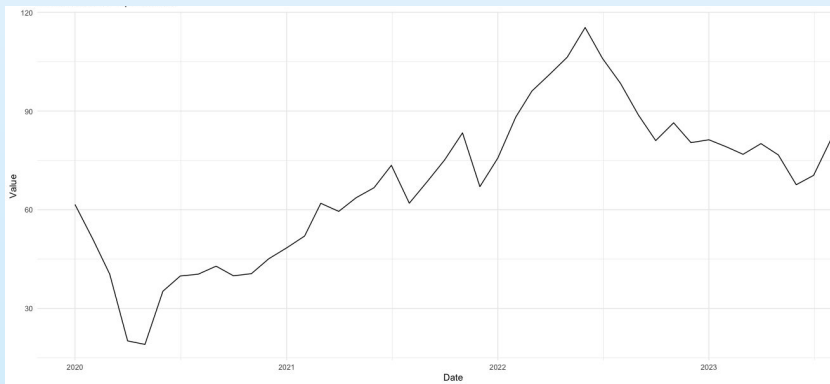
## Key issues

- 19% drop in net income in the first quarter of 2023
- Due to increase in oil production coupled with a drop in demand
- Affected by various factors such as economic outlook and inventory levels
- Recent emphasis on climate change, Aramco has pledged to reduce oil production, which affects profits.
- Identify the amount of oil required and reduce oil production to just below the required demand to drive up the price and compensate for revenue lost due to decrease in oil production.

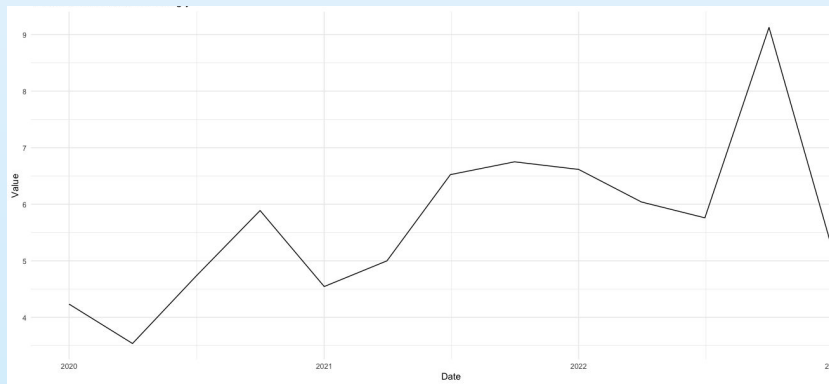
# Problem Statement/Purpose

- Aramco faces challenges in optimising its oil production and distribution due to fluctuations in global oil demand.
- Caused by economic conditions, geopolitical events, and inventory levels. To enhance its decision-making processes, we aims to develop a machine-learning model that forecasts monthly oil demand.

# Data Exploration



*Plot of Monthly Price of Crude Oil*

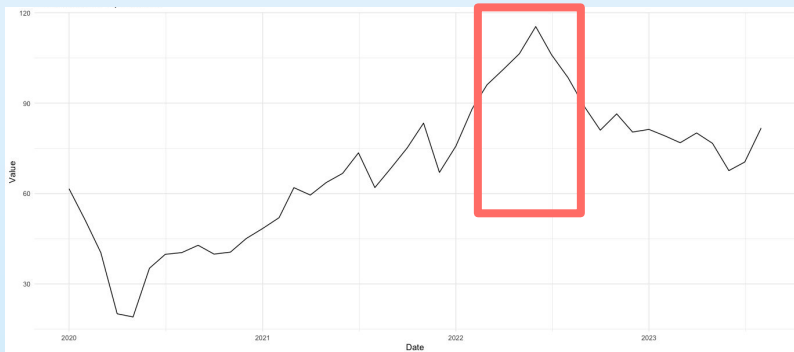


*Plot of Average Rating of News Headlines*

The sentiment analysis of geopolitical events is conducted using LLM (GPT-3.5) because it possesses a deeper understanding of the events than merely examining words in news headlines.

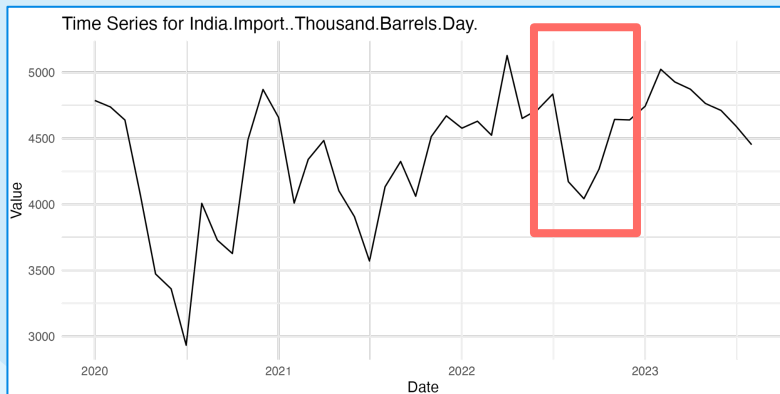
The similarity between Crude Oil prices and Geopolitical events trends indicates that sentiment towards oil is a reliable predictor of oil prices.

# Data Exploration

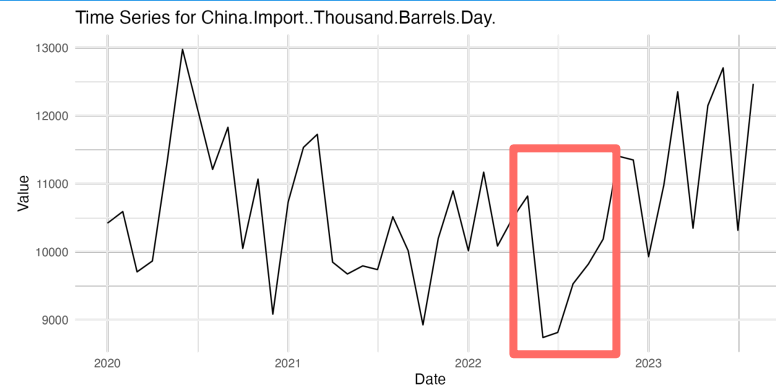


*Plot of Monthly Price of Crude Oil*

- Russia-Ukraine war (Feb-2022) spiked oil prices, impacting India and China's imports.
- China's imports dropped in April 2022; India's decreased July-September 2022.
- High oil prices negatively impact trade and imports in large economies.

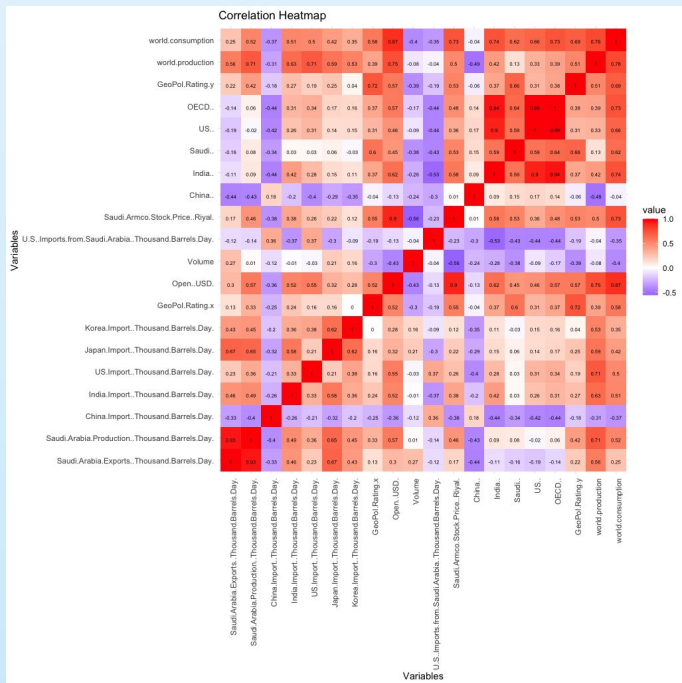


*Plot of Crude Oil Import by India*



*Plot of Crude Oil Import by China*

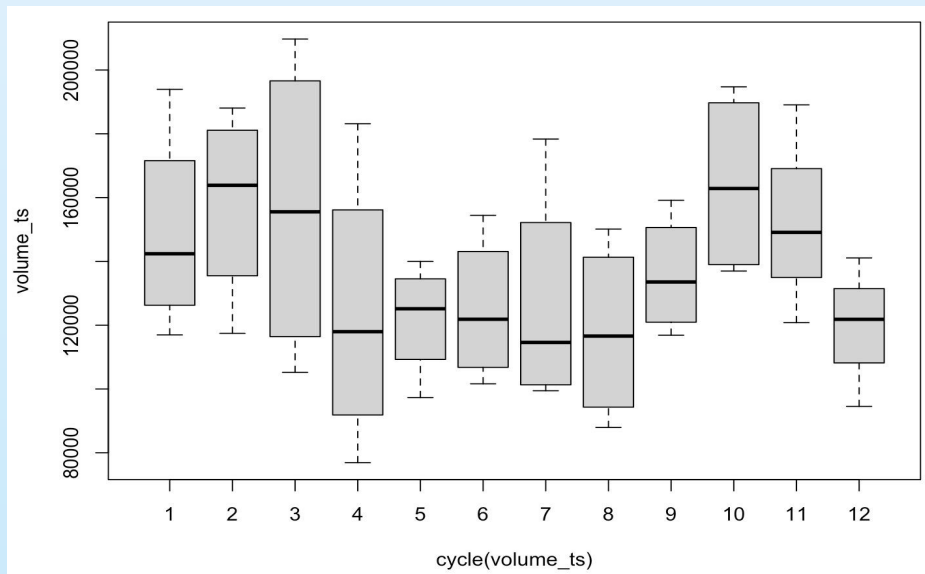
# Data Exploration



Heatmap of Correlation between Variables

- World consumption is highly correlated with India's GDP
- Price are Oil is correlated with and World Consumption and Saudi Aramco Stock price
- Saudi Arabia's GDP is highly correlated with Geopolitical Events
- Trade volume is negatively correlated to Oil prices and Saudi Aramco's stock price

# Data Exploration



Trade volume dipped between April and August

Decrease is caused by the OPEC+ agreement where they reduces the oil production

Reduced demand for oil in summer

Weak industrial activity



# Prediction Models

**Model used:** Linear Regression, Vector AutoRegression (VAR), Long Short-Term Memory model (LSTM)

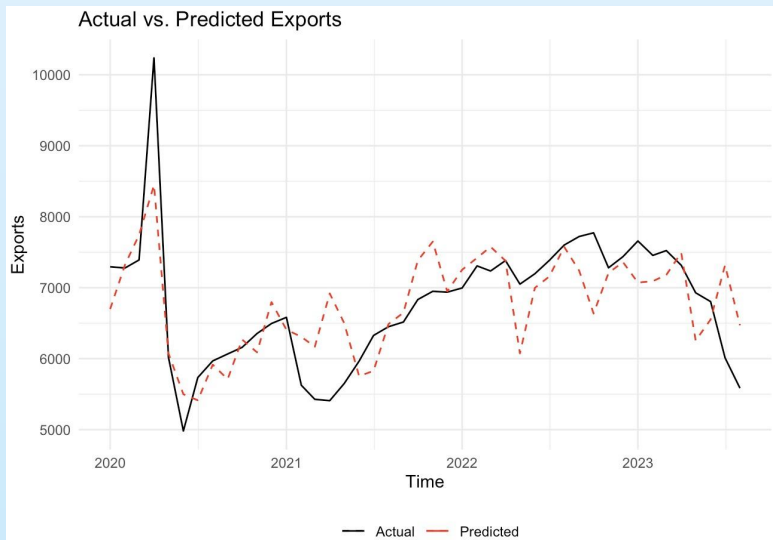
**Linear Regression:** A statistical method that models the relationship between a dependent variable and numerous independent variables by fitting a straight line to the data

**VAR:** Time series model that analyses how multiple variables interact with and affect each other over time

**LTSM:** A type of RNN that analyses complex patterns in the data, thus predicting future trends based on past trends

Saudi Arabia's Exports is used as a target or Y variable

# Prediction Models – Linear Regression



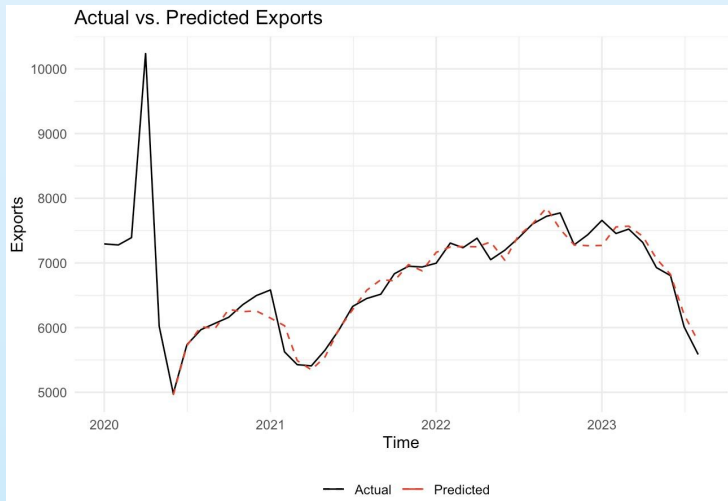
Independent variables (x-axis): Trading volume, Oil imports from China, Japan, India, US

Dependent variable (y-axis): Exports

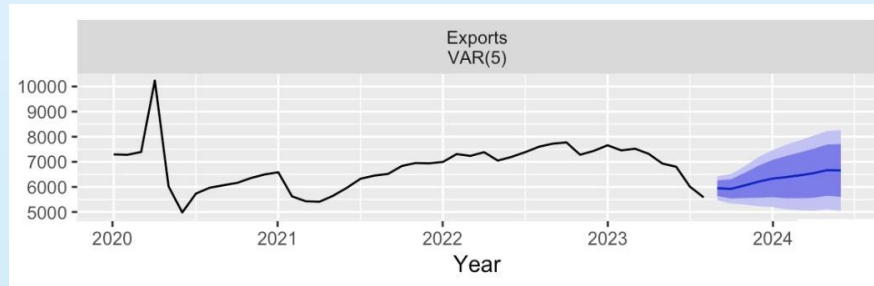
Significant spike not mirrored in the predictions, suggesting the presence of unmodeled factors.

*Prediction of Oil Export from linear regression model*

# Prediction Models – VAR



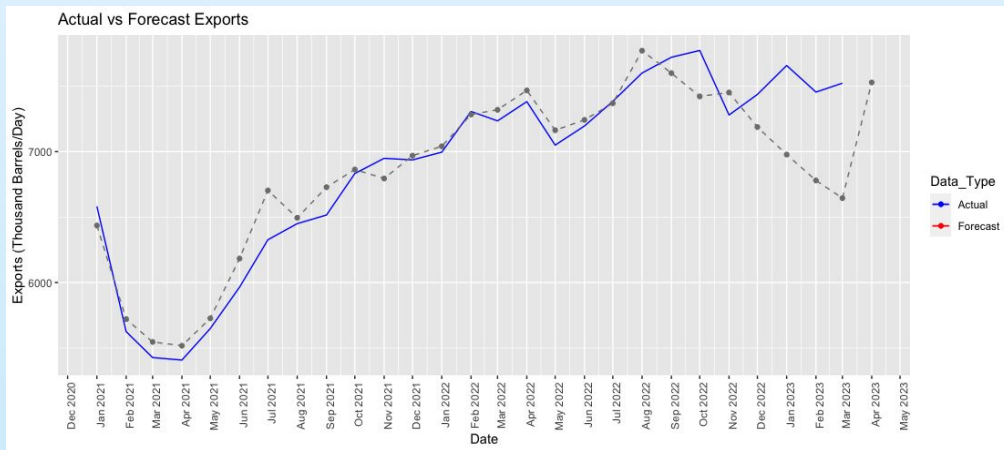
*Prediction of Oil Export from VAR(5) model*



*Oil Export Forecast from VAR(5) model*

Our model indicates that future oil export figures are closely linked to past values of trading volume, US imports from Saudi Arabia, and the historical export numbers themselves

# Prediction Models – LSTM



*Prediction of Oil Export from LSTM model*

The LSTM model can accurately predict the oil export of next month based on historical data from 2020.

With more data, the prediction accuracy could be enhanced.

## Application to business outcomes

**Increased  
operational  
efficiency**

**Reduced oil  
price  
volatility**

**Enhanced  
pricing and  
business  
decisions that  
achieve  
business goals**

## Operational efficiency

Smoother operations and increased operational efficiency → adjust factor inputs in advance

If predicted demand for a certain product changes significantly, diversion of resources is possible

Diversion of resources → production staff, distribution capacity can change in advance to meet the predicted oil demand

Minimal disruption to operations. Optimised storage & warehousing costs → minimise wastage, shortages & surpluses

## Stabilise oil prices

Oil and gas prices highly volatile, especially during economic uncertainty → shown to decrease firm profitability significantly

Excessive oil price volatility has a negative impact on the oil-dependent Saudi Arabian economy

Strong interest in maintaining high crude oil prices even if it requires production cuts

Anticipate changes in demand for oil and adjust its output to reduce oil price volatility to reap consistently high profits.

# Application to business outcomes

Predict future sales and cash flow more accurately and guide investment decisions accordingly.



Forecast operational costs → for future production planning and budgeting.



# Limitations



Over-reliance on historical data, without considering real-time data adequately



Models built on certain assumptions that might not be true in all scenarios



Limited consideration of other variables → energy & environmental policies, exchange rates, technological developments

# Tackling Limitations



Integrating additional input data and variables that that Aramco could have access to, which are not publicly available



Using feedback loops → experts can continuously validate predictions against actual outcomes and make necessary adjustments



Incorporating real-time data and conducting frequent scenario analysis and stress testing to determine its effectiveness

## Conclusion

- The application of predictive models to Aramco's business outcomes is promising. Accurate oil demand prediction can result in a range of positive outcomes
- The model can assist Aramco in stabilising oil prices, which is essential given the volatility of the oil and gas market
- Consistently high profits can be achieved by preempting changes in oil demand and adjusting output accordingly
- Aid Aramco in predicting future sales, cash flow, and operational costs, guiding investment decisions and production planning
- Essential to acknowledge the limitations of the model, as they do not account for all variables