

# Time Series Analysis of Automotive Industry During Surge Events: Past, Present, and Future

## Past, Present, and Future



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### Introduction & Motivation

#### What is the Knudsen Institute?

The Knudsen Institute is a nonprofit applied research organization that seeks to expand the understanding of manufacturing from a holistic perspective. Its mission is to identify and develop technology, workforce, & policy solutions through applied research and outreach that allows the US manufacturing capacity of small and medium sized manufacturers to be identified, evaluated, and integrated into the US Defense Industrial Base as rapidly as possible in a surge environment and to do so at scale.

#### Motivation

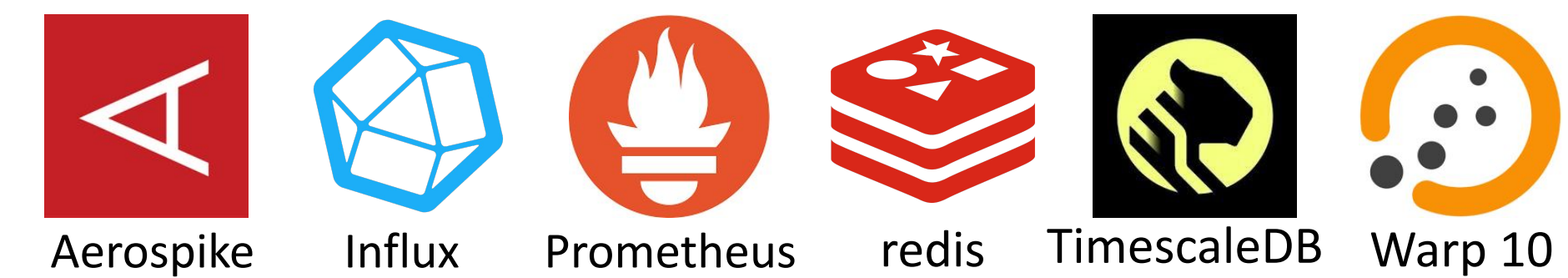
We aim to utilize time series analysis techniques, databases, visualization technologies to analyze trends in the automotive industry during disruptions in the supply chain.



### Findings / Solutions

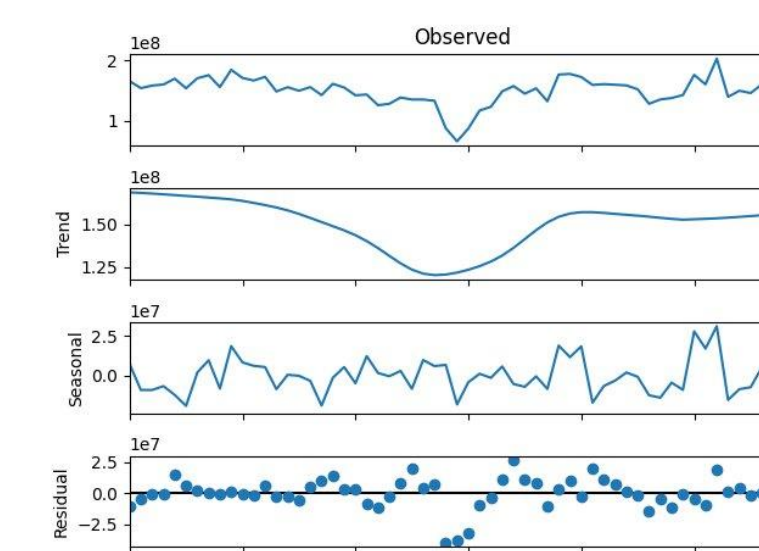
#### Data Engineering:

- Explored the workflow of the data storage pipelines for commodities import data
- Created scripts to initialize databases, upload, and query data. Also designed schemas for the date to fit in each database.
- Redis ultimately chosen due to its simple querying and NoSQL architecture

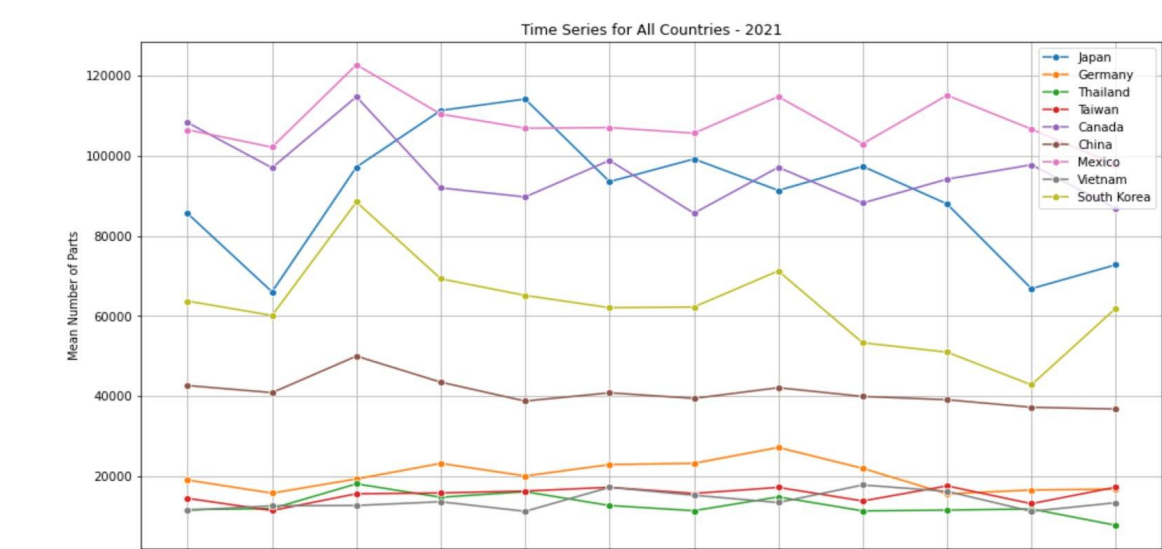


#### Data Science:

- Cleaned dataset to be utilized for time series analysis purposes
- Performed time series decomposition, dynamic time warping, and ARIMA modeling to understand the past, present, and future of surge events



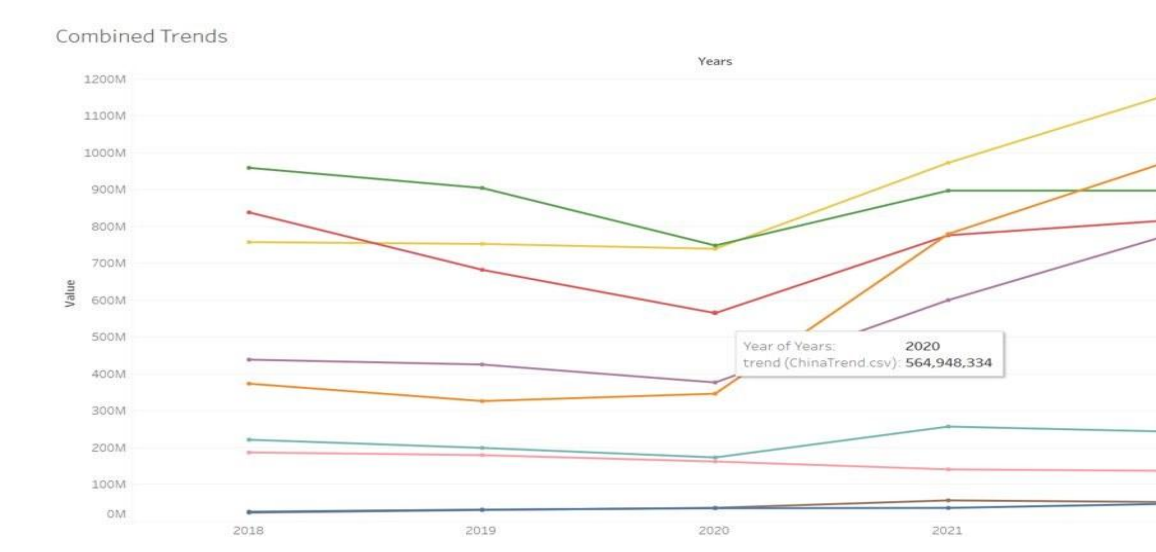
Time Series Decomposition



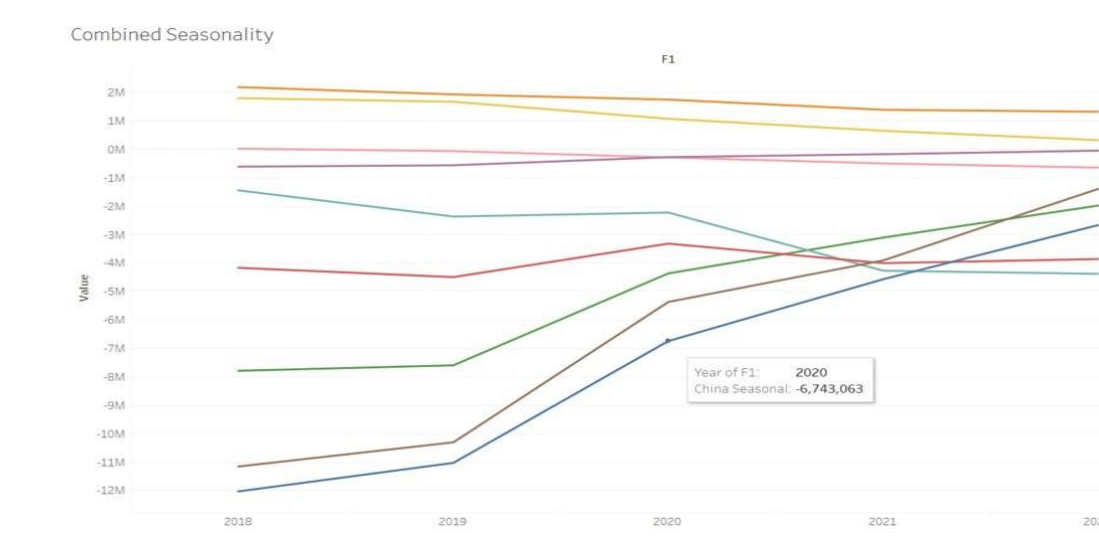
Multiplot Analysis

#### Data Visualization:

- Made use of Tableau initially to display data from the data science team.
- Created visualizations for trends, seasonality, and residual element of the commodities import data using Dash and Plotly due to customization and research interests



Combined Trends



Combined Seasonality

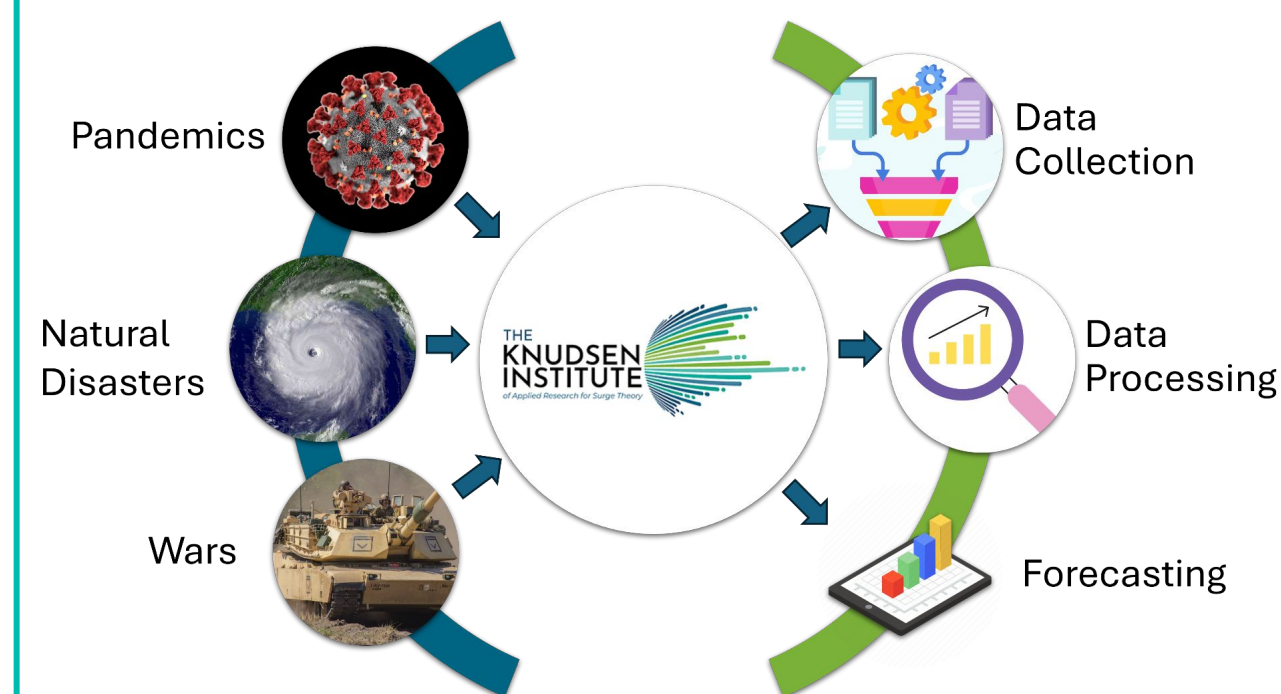
### Objectives

**Data Science:** Perform exploratory data analysis on the time series data

**Data Engineering:** Preliminary development of data pipelines and data storage

**Data Visualization:** Investigate different UI/UX for data visualization and implement dashboard

### Research Methodology



Used time series decomposition models (additive, STL) to extract trend, season, and remainder components from time series data.

Explored databases (InfluxDB, Timescale DB, Aerospike DB, Redis, etc.) for storing and querying time series data, and evaluated the pros and cons of each database.

Tested different dashboard options (Python, Power BI, Tableau) for visualizing data before choosing Dash.

### References/Acknowledgements

#### Special Thanks

Mentors - Richard Leu, Bhairav Singh, Kevin Alexander

Data Mine Staff - Nicholas Rosenorn

### Conclusion

#### Achieved

- Deeper understanding of time series analysis and surge events
- Successfully built a dashboard to visualize surge events, past, present, and future

#### Future plans include

- Moving the project from a local machine to the cloud for remote access
- Storing additional time series data from other years
- Enabling the dashboard to sync with real time data