

Forecast Enhanced Inventory Management

Utilizing Demand Sensing Techniques to Optimize Stocking



Mitchell E. Daniels, Jr.
School of Business



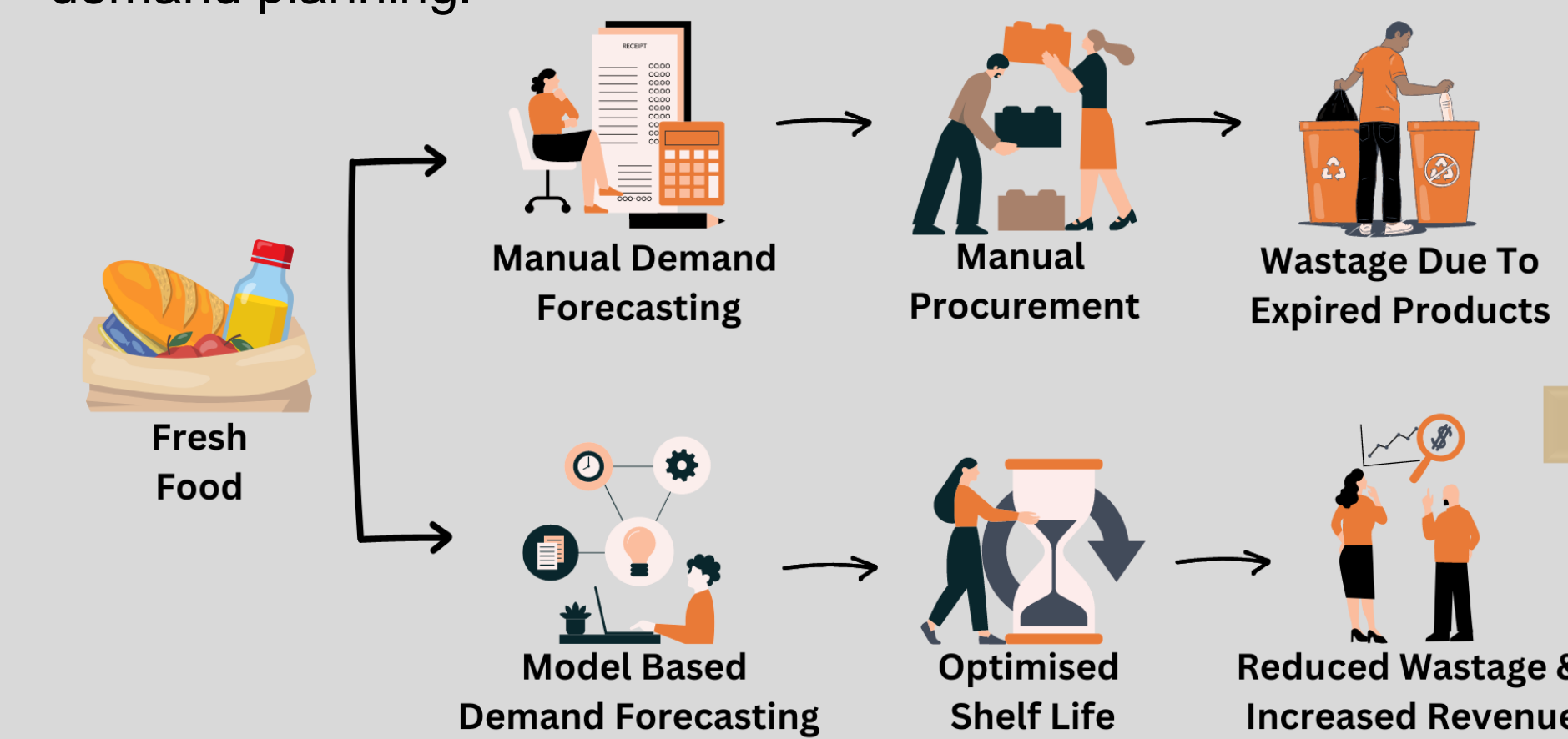
Guided By: Matthew A. Lanham

gbhawark@purdue.edu; karthikl@purdue.edu; kulka105@purdue.edu;
narayad@purdue.edu; prakasv@purdue.edu; lanhamm@purdue.edu

BUSINESS PROBLEM FRAMING

Leading retail store chains, recognize that a superior shopping experience is key to business growth. Demand forecasting for their fresh food service helps streamline inventory and demand planning while reducing wastage of perishable items.

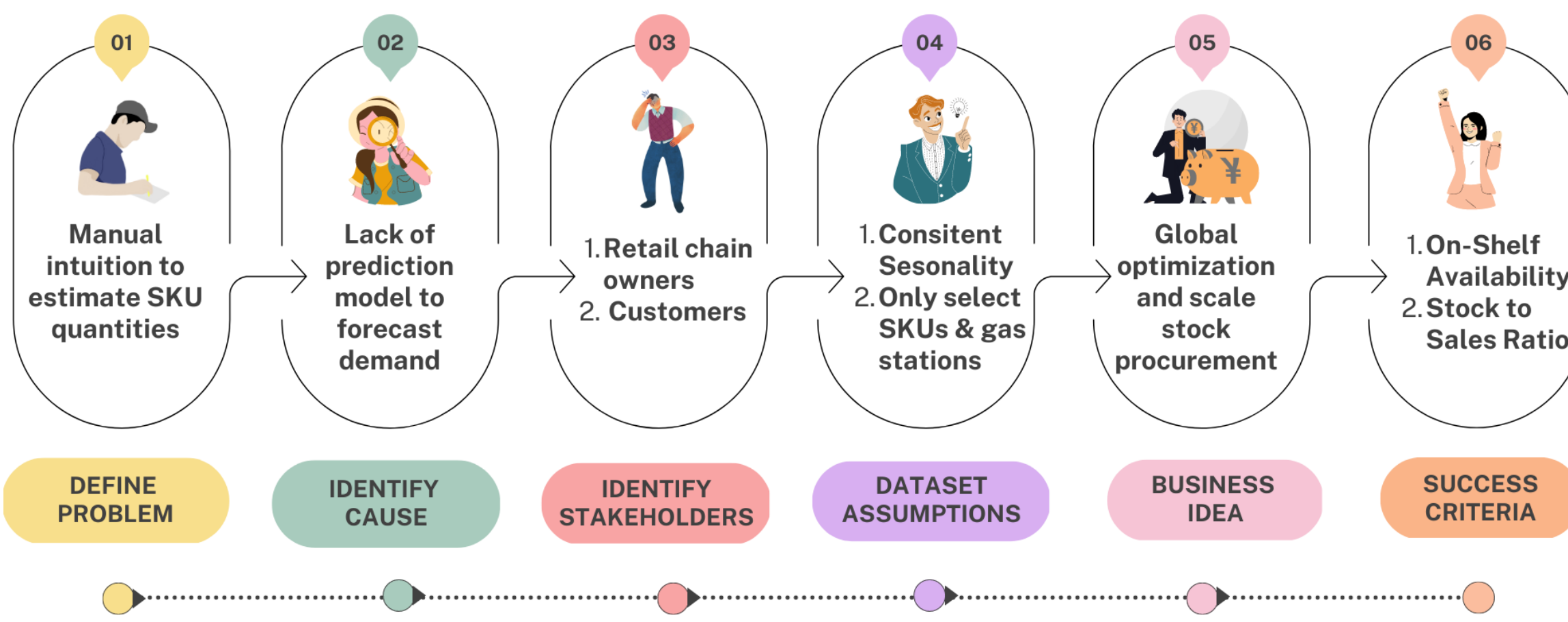
However, the effectiveness of existing inventory management system is limited by a manual recommendation of order quantity for the finished product in the Fresh Food Service. The inclusion of Digital Order Book (DOB) will improve demand planning.



To address this challenge, this solution seeks to develop an innovative solution that leverages advanced analytics to incorporate product-level demand forecasting into the DOB. It will enable store teams to accurately plan their inventory and reduce financial losses resulting from overstocking and wastage.

By leveraging data-driven insights, this analytics tool-kit aims to optimize their operations and deliver a superior shopping experience to their customers.

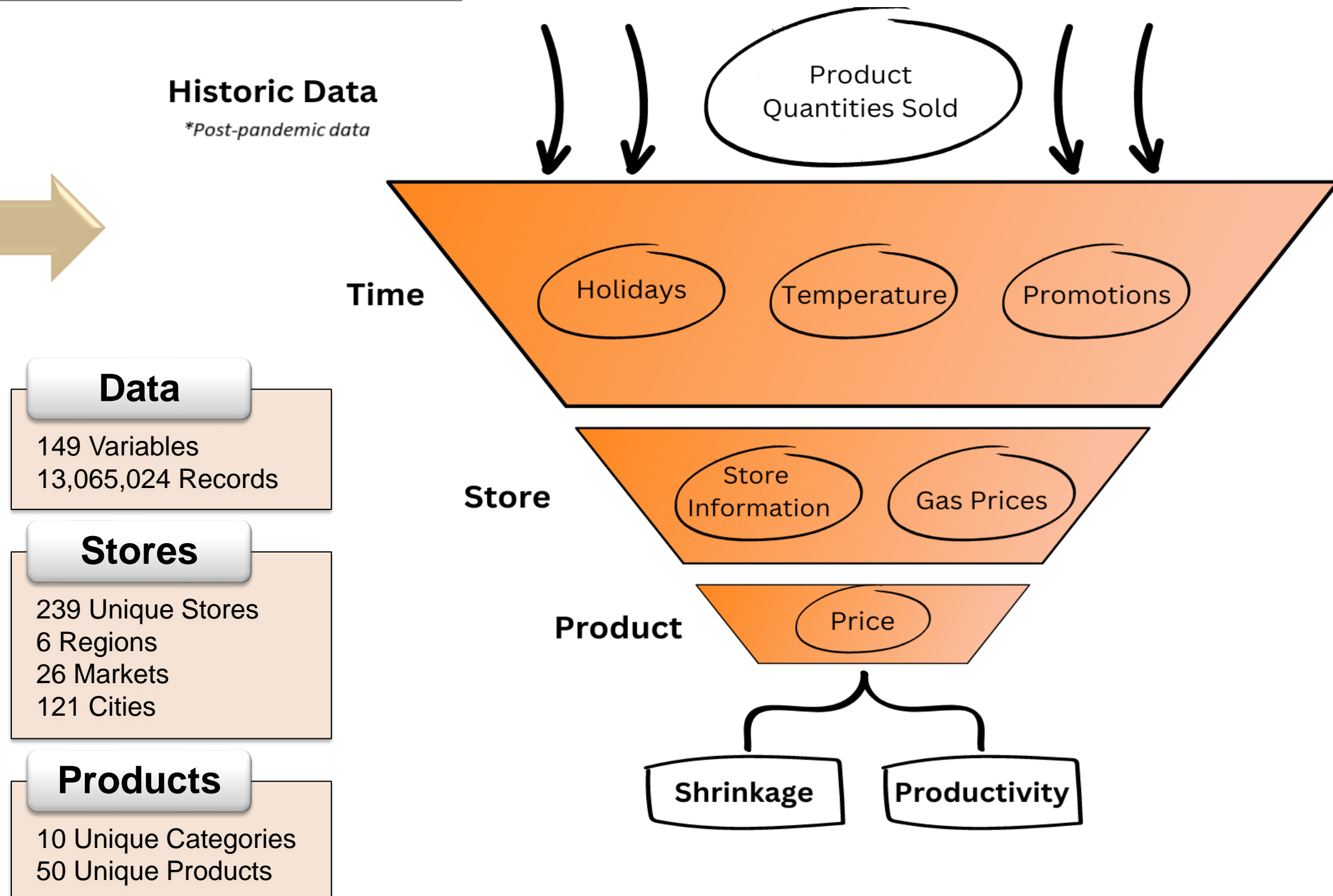
ANALYTICS PROBLEM FRAMING



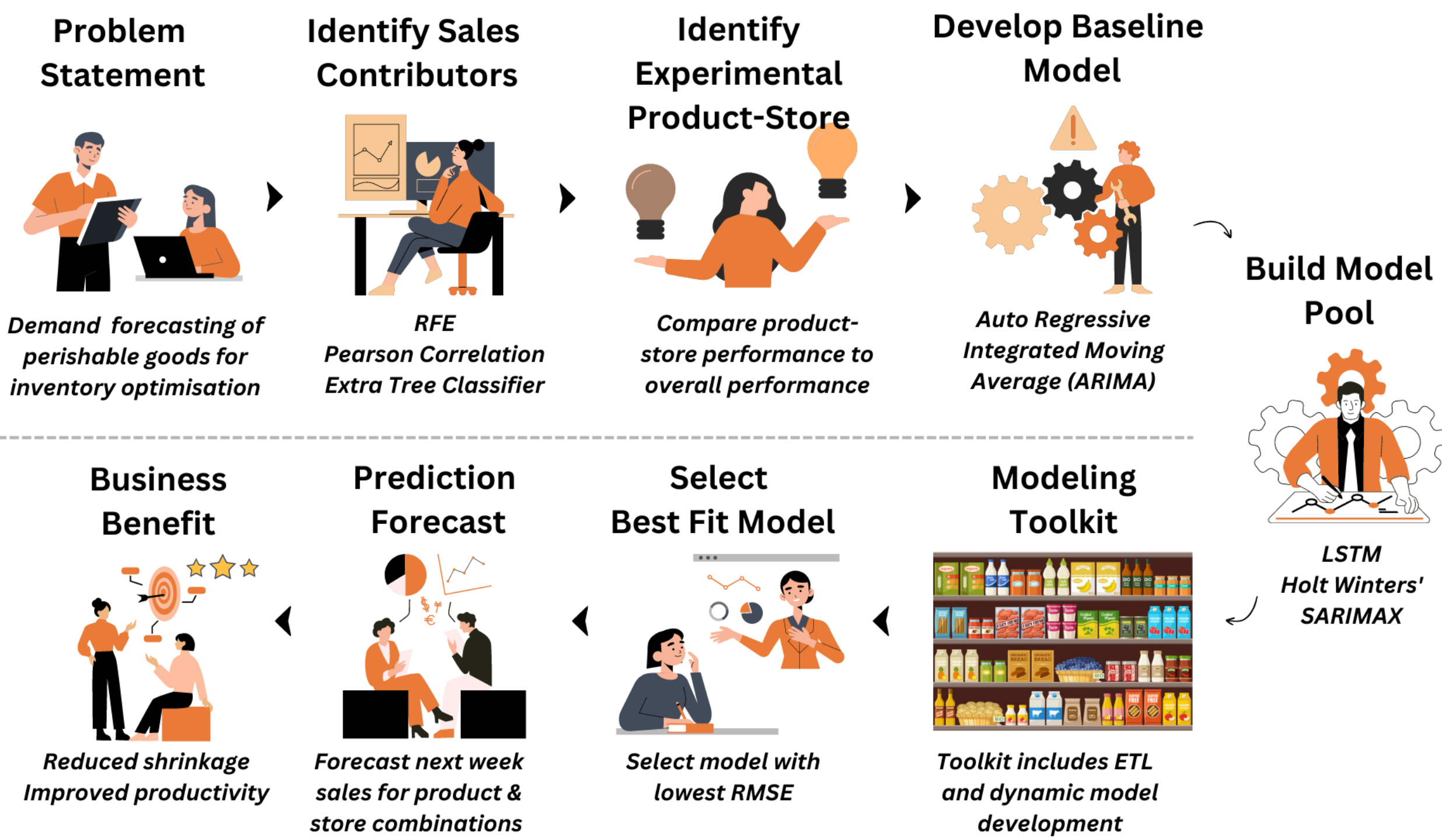
Legacy processes for inventory management are often manual, time-consuming, and error-prone, resulting in suboptimal inventory levels and wasted resources in contrast to an automated system.

- Sophisticated end-to-end analytics toolkit** – Data ETL, modelling and forecasting pipelines provide a one-stop solution that delivers fast and reliable inventory.
- Leveraging advanced analytics and machine learning algorithms** - Ensures real-time insights into demand patterns, enabling store teams to make well-informed decisions and optimizes inventory.
- Improved employee efficiency and consistent shelf availability** - Retailers can deliver a superior shopping experience, drive business growth and reduce shrinkage.

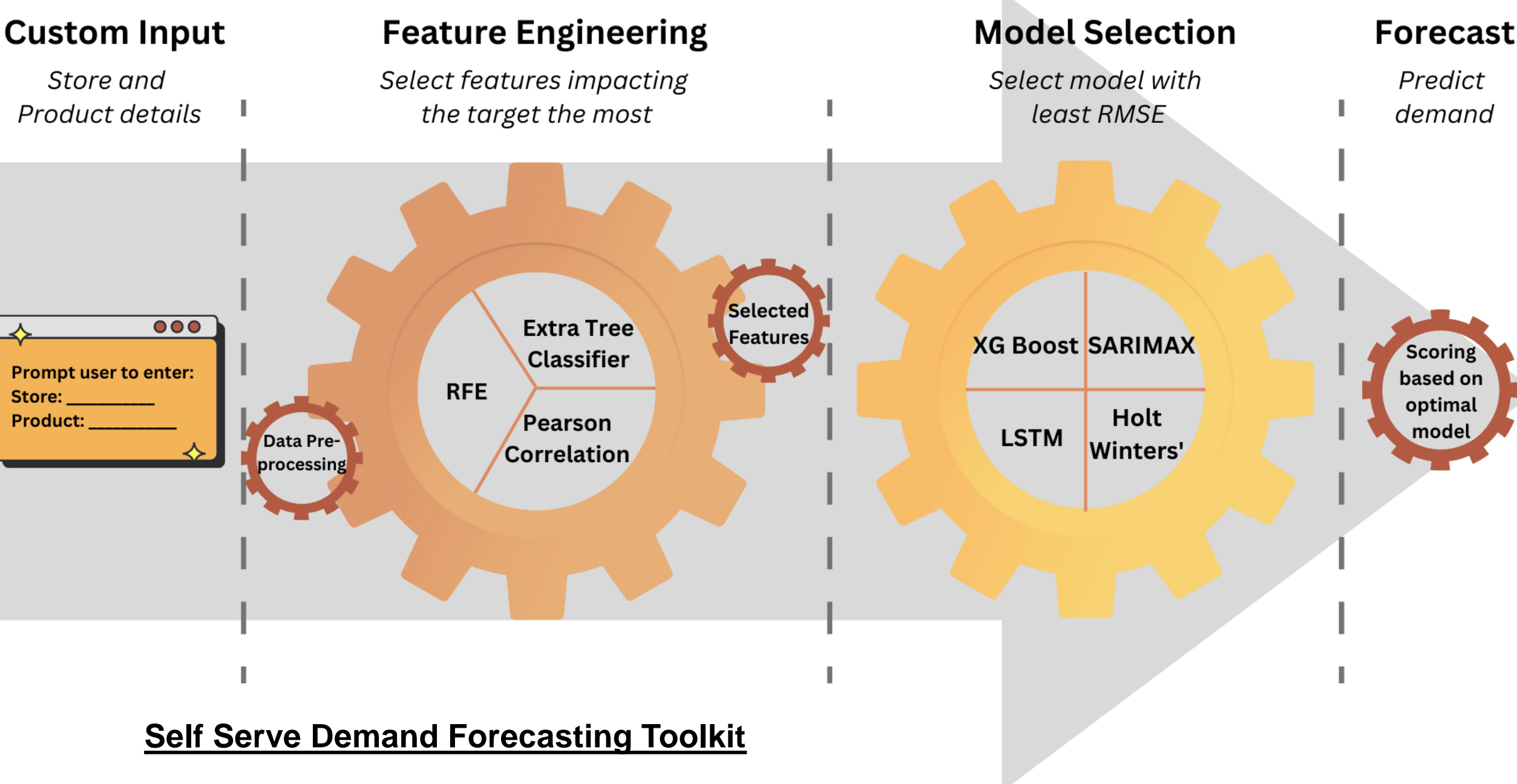
DATA



METHODOLOGY



MODEL BUILDING



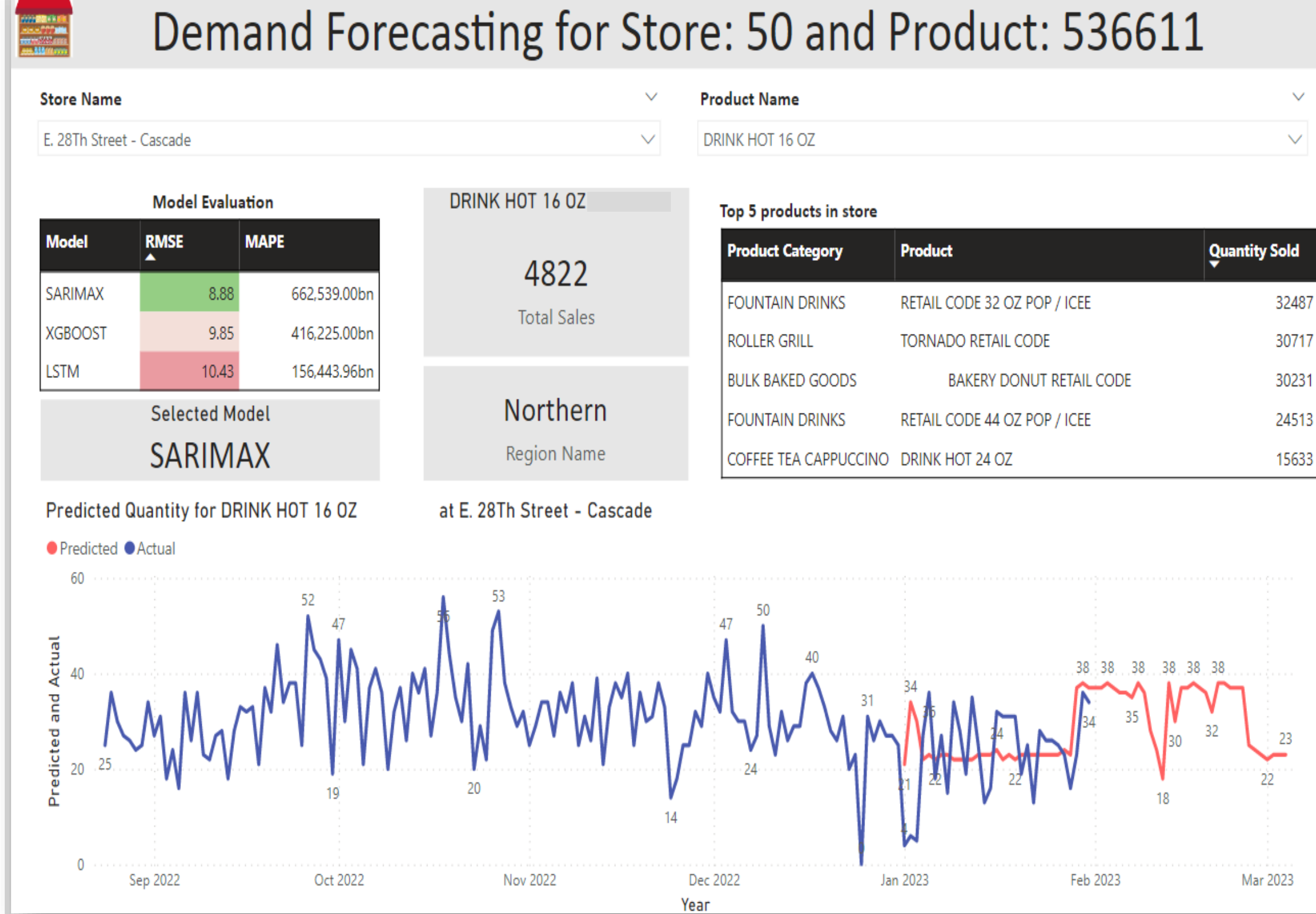
The purpose of this tool is to dynamically select important features for a given combination of product and store to forecast demand for future inventory to avoid wastage of perishable goods and ensure on-shelf availability.

- When executed across the entire dataset, **XgBoost** contributes to **69.43%** of the frequency for total best performing models based on RMSE values followed by **SARIMAX** at **24.91%** and **LSTM** at **5.65%**.
- However, all models are retained in the toolkit as every combination behaves differently in terms of demand trends and store regions.

AREAS OF IMPROVEMENT

- Improve the iterations and epochs for better fit.
- Use exogenous variables such as daily footfall, shop size, promotional data, product assortment, vehicles visiting the gas station.
- Larger number of data points will lead to a more reliable forecast

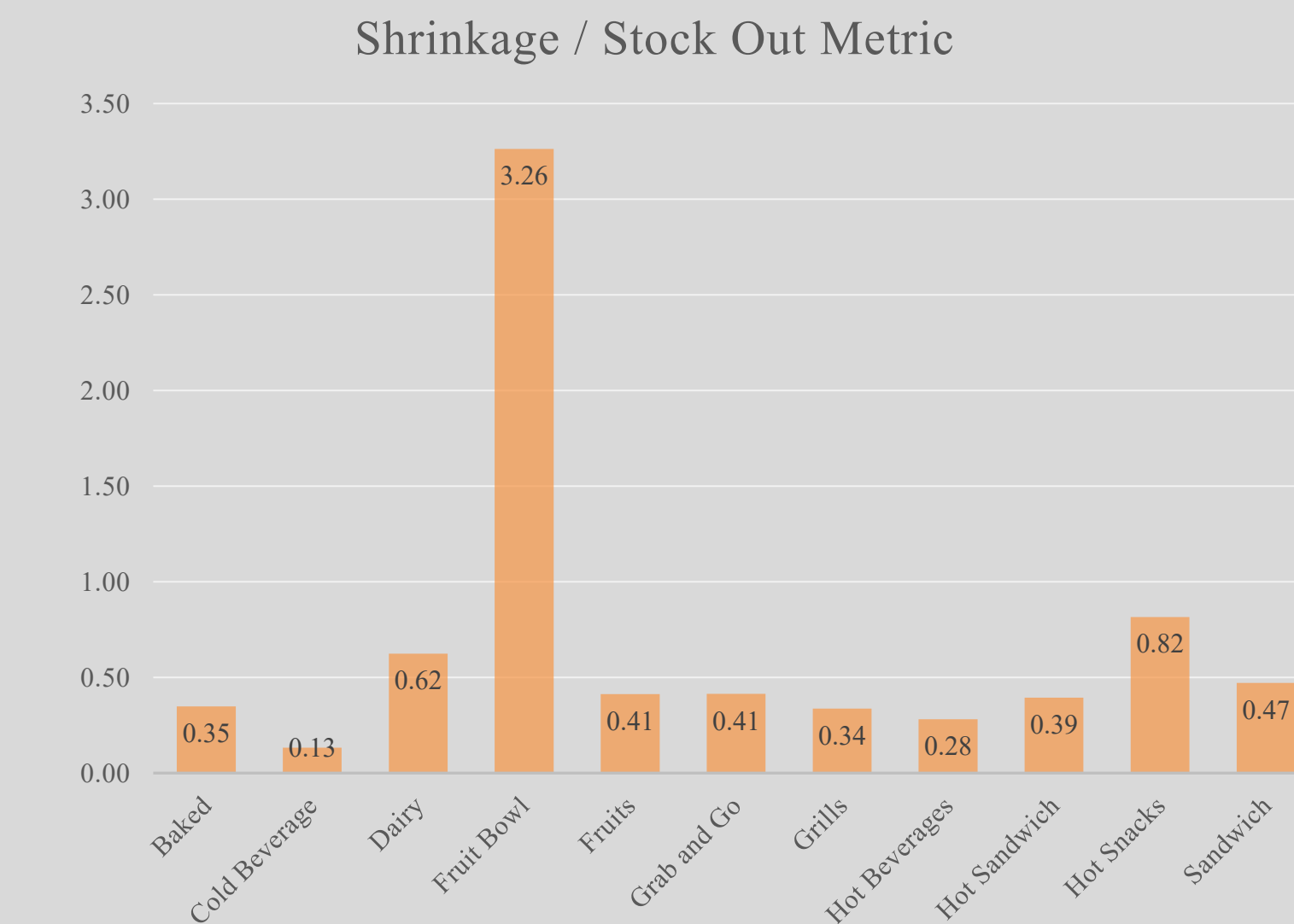
DEPLOYMENT & LIFE CYCLE MANAGEMENT



IMPACT

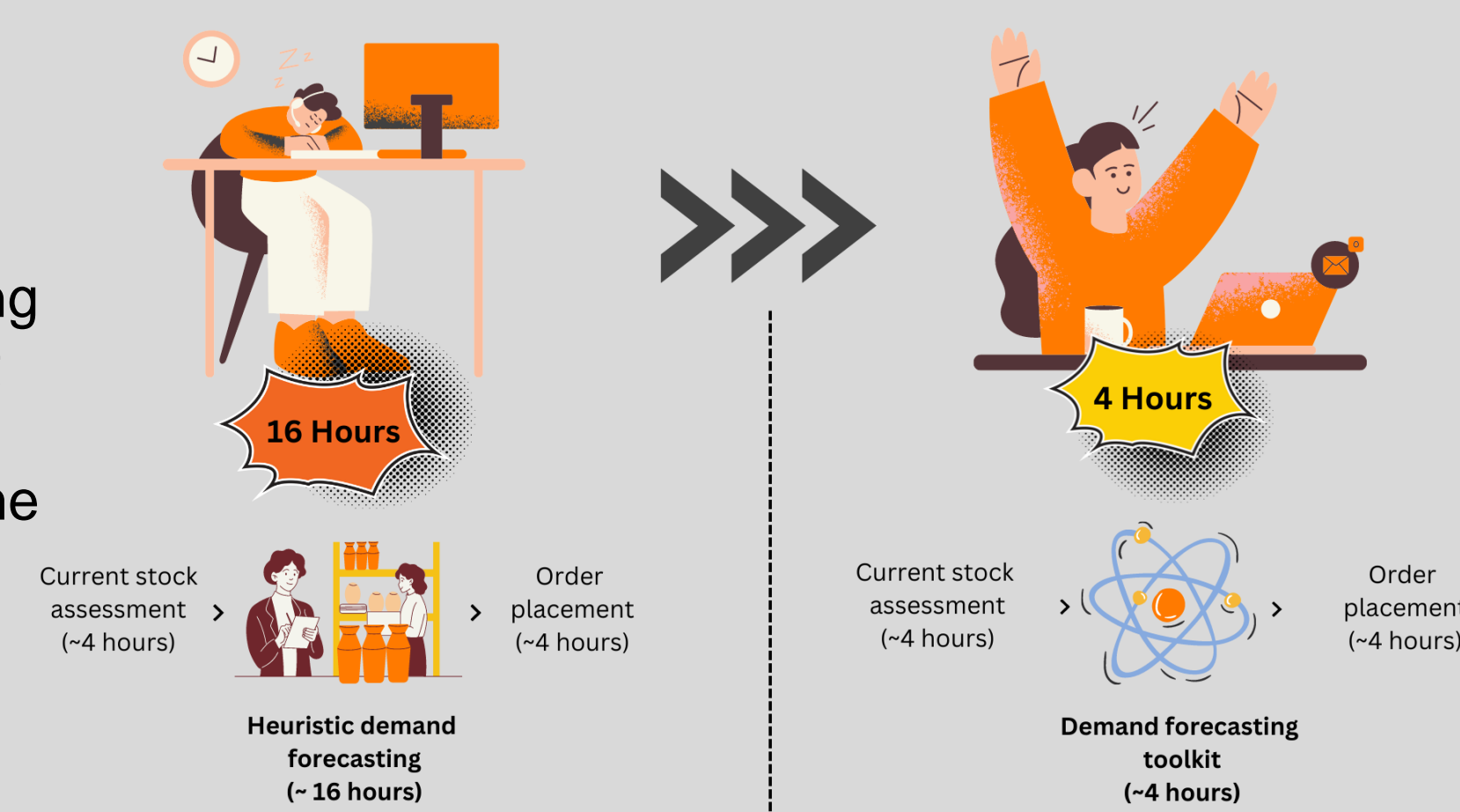
Optimized shrinkage:

- Percentage of inventory that is lost due to spoilage or expiration
- Value of spoiled inventory/the total value of inventory on hand



Improved productivity:

- Reduced time spent on planning order placement
- Increase in availability of time spent for non-inventory processes.



ACKNOWLEDGEMENTS

We would like to thank our industry partner for their guidance and support on this project and Purdue MS BAIM program for partially funding this work.