Forecasting International Movements of Reusable Supply Chain Platforms

MIT Supply Chain MANAGEMENT

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Motivation / Background

Inter-Regional Flows
(2011-2017)

US to CA

Forecasted Data

CA to US
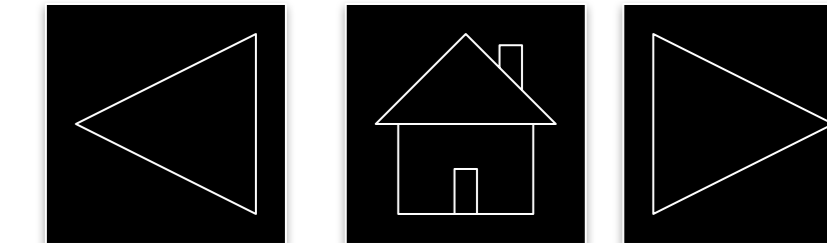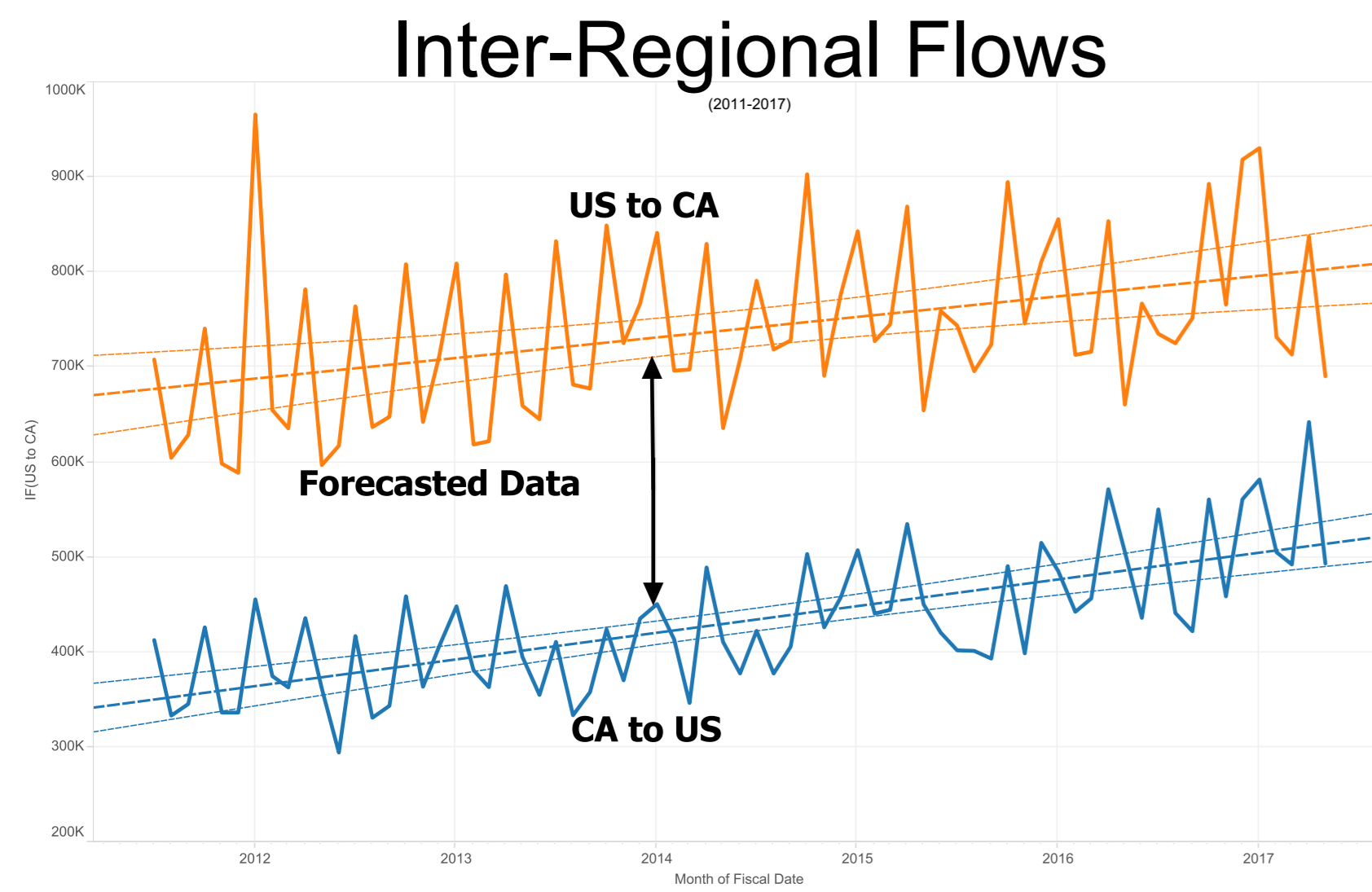
Company XYZ is seeking to improve the forecasting accuracy of inter-regional flows
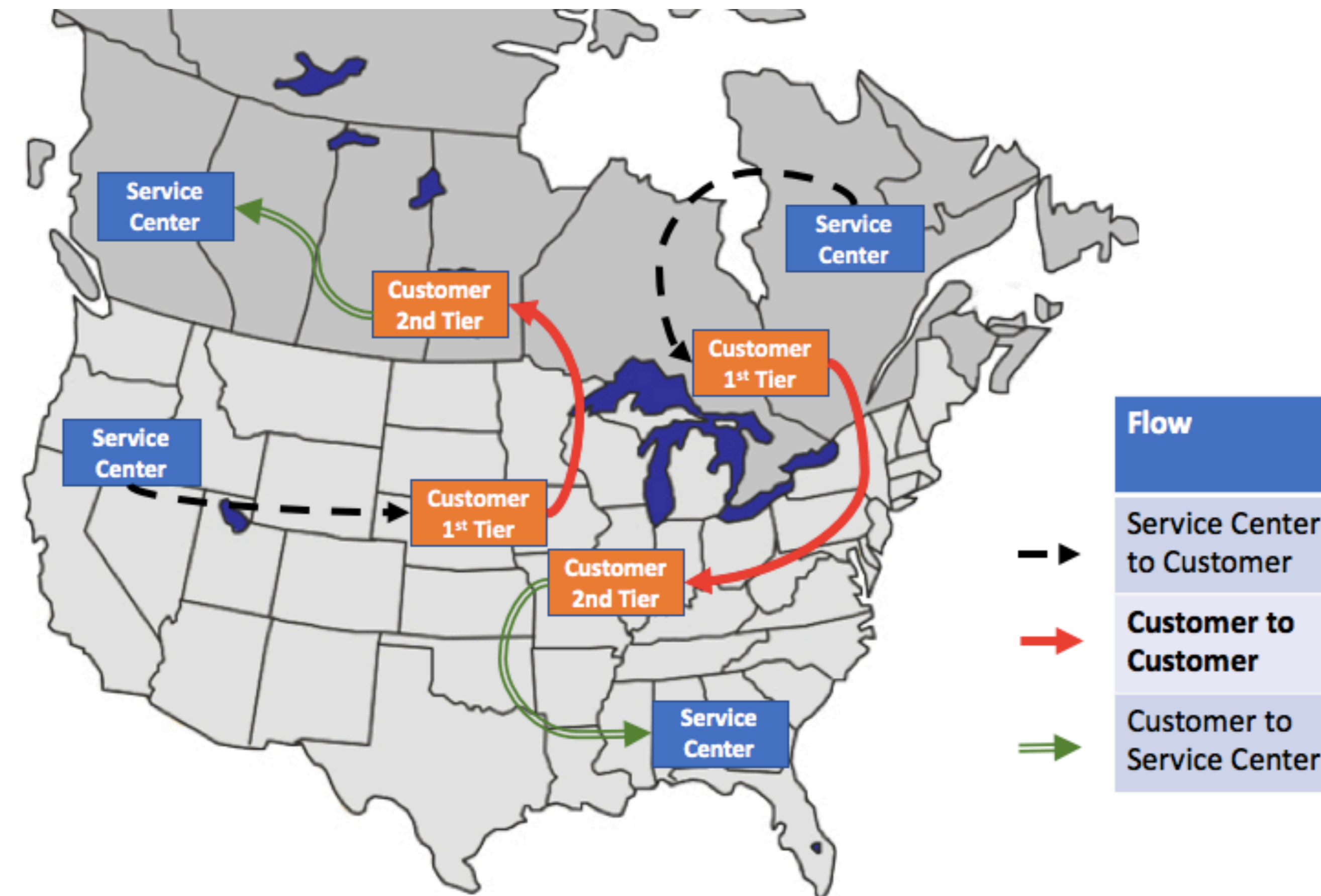
Key Questions

Can inter-regional flows be accurately forecasted utilizing traditional time series methodologies?

- Will accuracy improve by incorporating exogenous variables such as:
  - Labor Rates, Fuel Rates
  - Inter Regional Trade Growth Rates, Sector Growth Rates
- Will forecasting accuracy improve by utilizing returnable transport item aggregate returns

Relevant Literature

- Shmueli, G., Patel, N. R., & Bruce, P. C. (2016). Data Mining for Business Analytics: Concepts, Techniques, and Applications in JMP. John Wiley & Sons.

- Peng, W.-Y. and C.-W. Chu (2009). "A comparison of univariate methods for forecasting container throughput volumes." Mathematical and Computer Modelling 50(7): 1045-1057.

- Elia, V. and M. G. Gnoni (2015). "Designing an effective closed loop system for pallet management." International journal of production economics 170: 730-740

Flow

⇢	Service Center to Customer
→ (red)	Customer to Customer
→ (green)	Customer to Service Center

Service Center

Customer 2nd Tier

Customer 1st Tier

Customer 1st Tier

Customer 2nd Tier

Service Center

Service Center

Service Center

Approach

- Develop different Time Series Forecasting Models and compare their Accuracy using **MAPE** and **RMSE**

  - Utilizing Historical Data

    - Holt-Winter Model

    - Simple Exponential, Double Exponential, $\hat{X}_{Et,t+1} = \alpha X_{Et} + (1-\alpha)\,\hat{X}_{Et-1,t}$

    - Least Squares Regression, $\hat{Y}_{UStoCA} = a_0 + a_1 t + \sum_{i,j=1}^{12} b_i t_j$ where $t_j = \{Jan|Feb|Mar|\ldots.|Dec\}$

    - Regression with Simple Exponential, $\hat{Y}_{deltaXS} = \hat{Y}_{UStoCA} - \hat{Y}_{CAtoUS} + \hat{X}_{Et}$

    - Box-Jenkins ARIMA – (Autoregressive Integrated Moving Average)

- Utilizing Historical & Exogenous Macro Variables

  - Econometrics

Initial Results

Regression with Simple Exponential Smoothing

Forecast Vs. Actual

Initialization   Training   Validation

Actual
Forecast
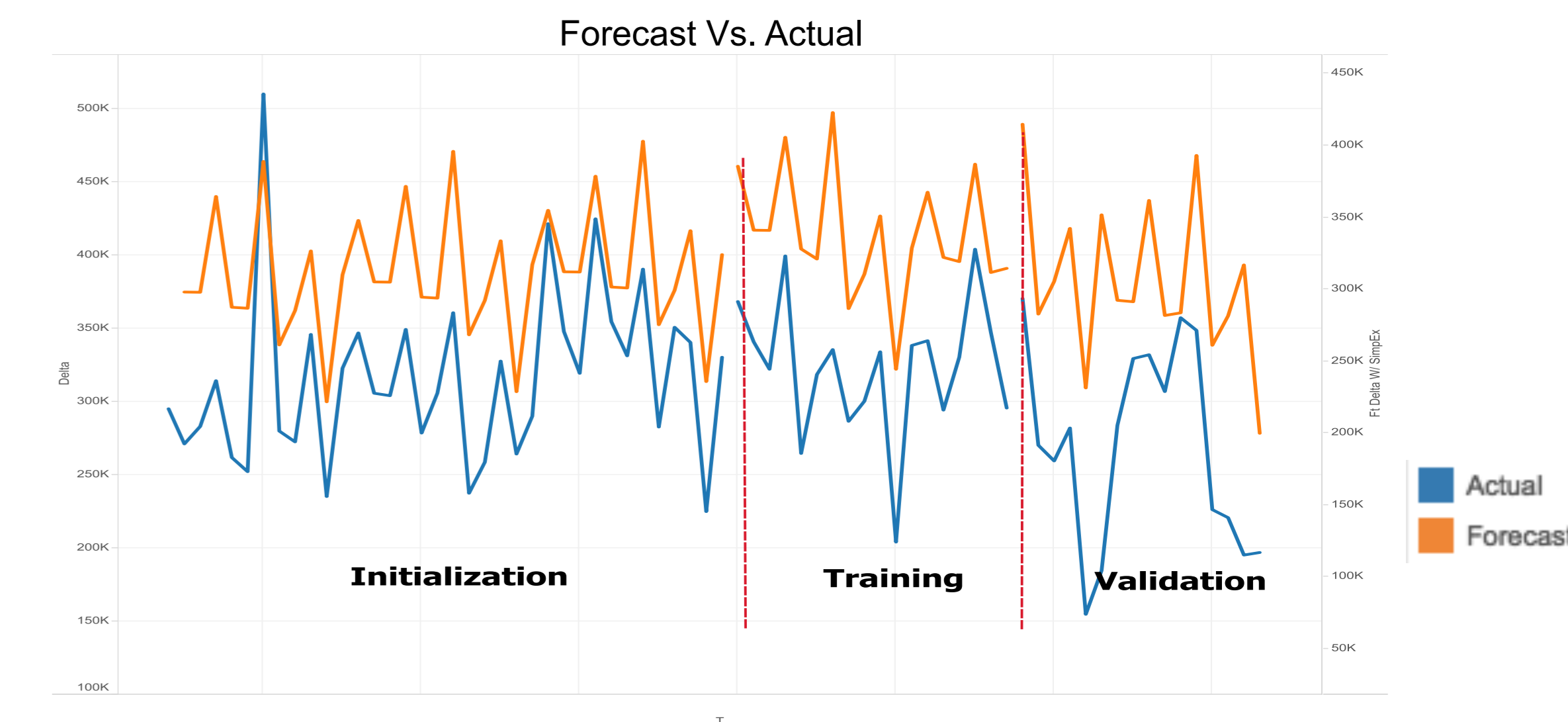
MAPE	Training	Validation
Regression with Simple Exponential	**6.5%**	**15.1%**
Regression - Combined Models	7.0%	17.8%
MA(4)	18.0%	
Holt-Winter - On Delta	9.4%	20.5%
Naïve	21.5%	

Expected Contribution

This thesis will:

- Create and evaluate several different forecasting strategies to propose application in a closed loop supply chain setting

- Improve forecasting accuracy for our research partner firm, allowing for better business planning and execution

- Identify macro variables influencing Cross Border Movements of Reusable Supply Chain Platforms

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