VANDERBILT UNIVERSITY

TRANSRATER

PREDICT TRANSPORTATION COST EASIER

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Supported By *Global Operations Science & Analytics Team*

DHL Supply Chain - Excellence. Simply Delivered.

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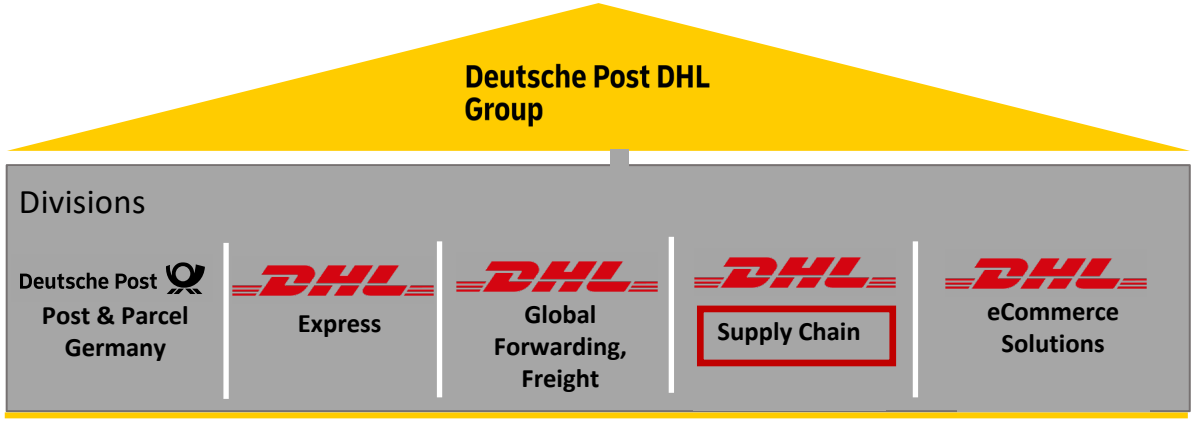
About DHL Supply Chain

DHL Supply Chain is a division of Deutsche Post DHL Group with a global network and an extensive logistics portfolio that deals with warehousing, transport and VAS for other companies



DHL Supply Chain is the

#1

Contract Logistics Provider

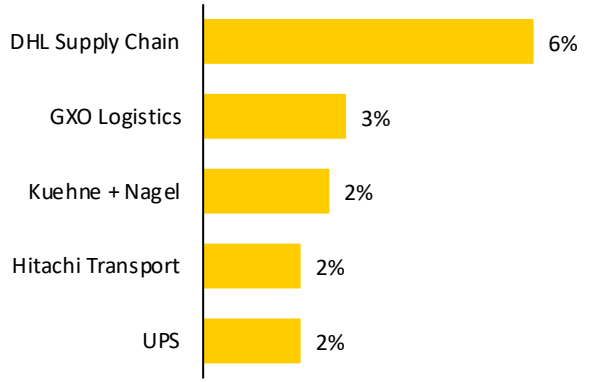
Managing Supply Chains to reduce complexities

50+
Countries Covered

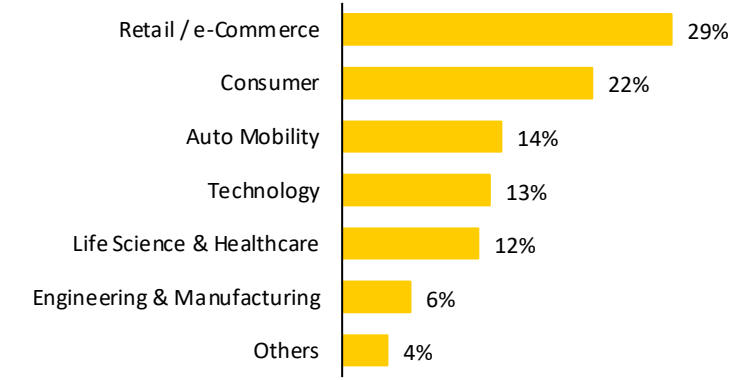
~160M
sq. footage of storage space

~ € 14bn
Revenue

Market Position



2021 Revenue Mix



Contents

Project Overview

DHL Transportation Solution Team quotes third-party companies contract prices or spot prices to find feasible transportation solutions for client's shipments

TruckLoad Shipment (TL)

Less-Than-TruckLoad Shipment (LTL)

Intermodal Shipment (Railway)

DHL Transport Solution Team:

- The team considers quoted price in different data frames as a benchmark to find lowest price
- The team will save quoted price and historical shipments in the database

With available historical shipment data and quoted price data:

A Learning models is asked to **predict future transportation rates** by inputting available shipment information and quoted price.

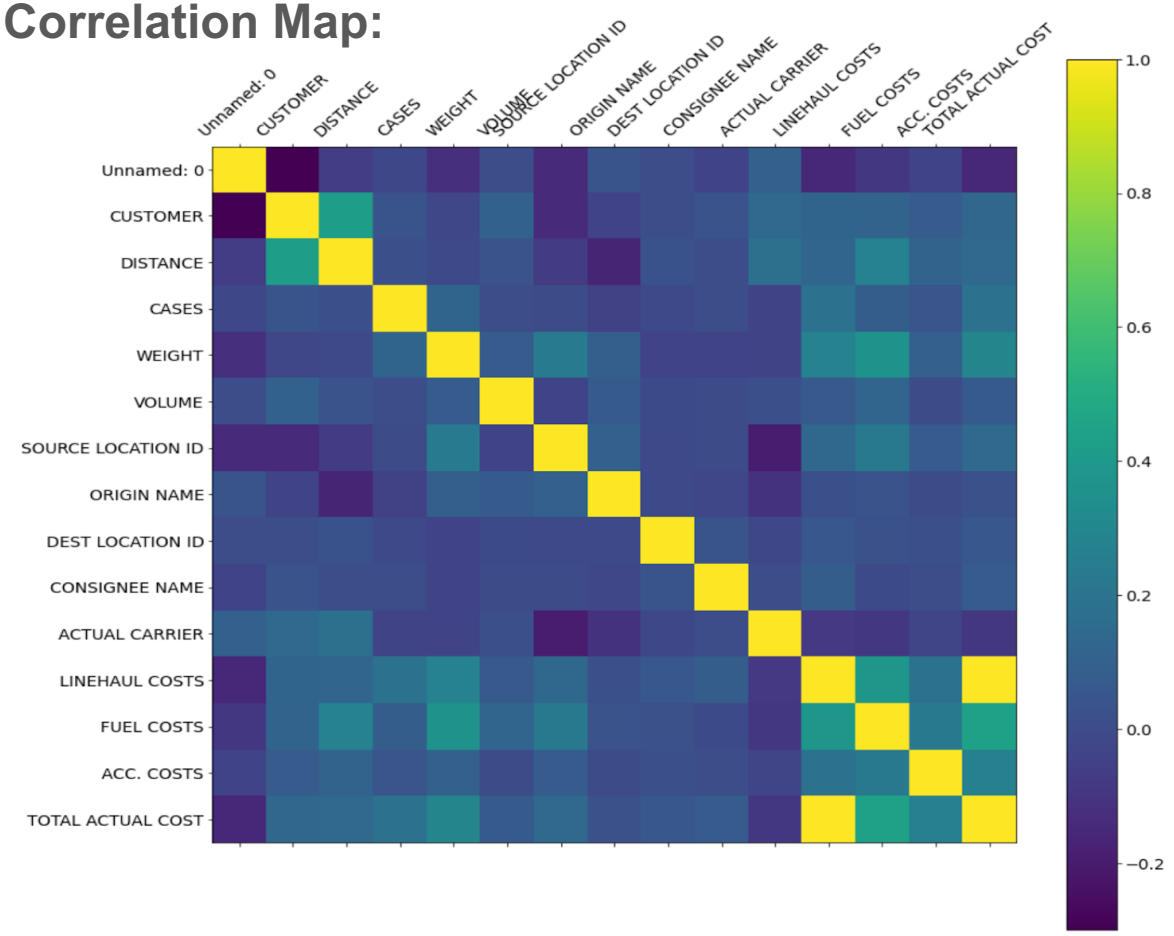
Data Description

Data is provided by DHL Operation and Analytics Team. All data is for study use and has be masked

Historical Shipment Data (MT_Data)
Description: The dataset includes 4 month historical shipment information
Column: 31
Rows: 4,963,508

Historical Quoted Price Data (DAT_Data)
Description: The dataset includes 4 month historical quoted price data information
Column: 40
Rows: 63,486

Correlation Map:



Exploratory Data Analysis

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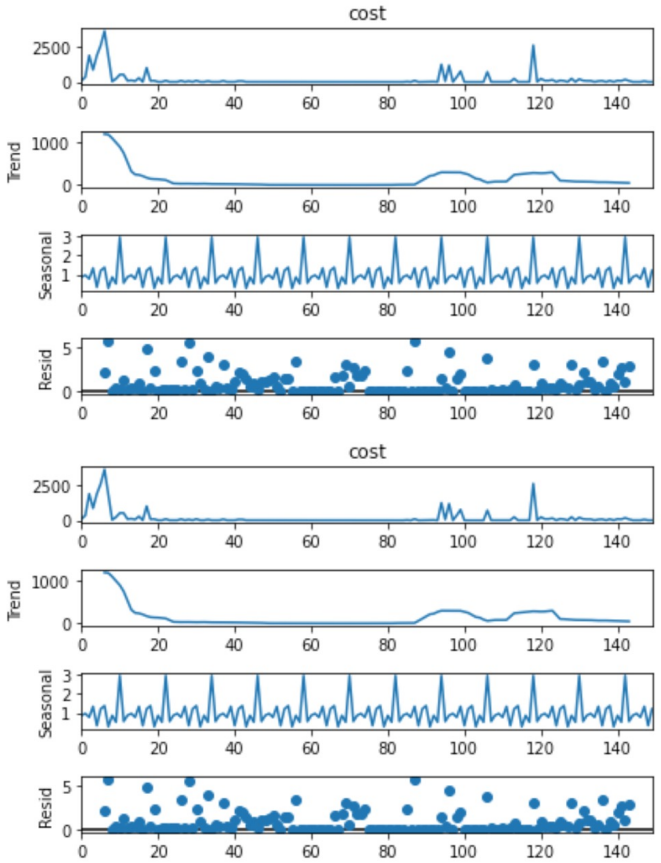
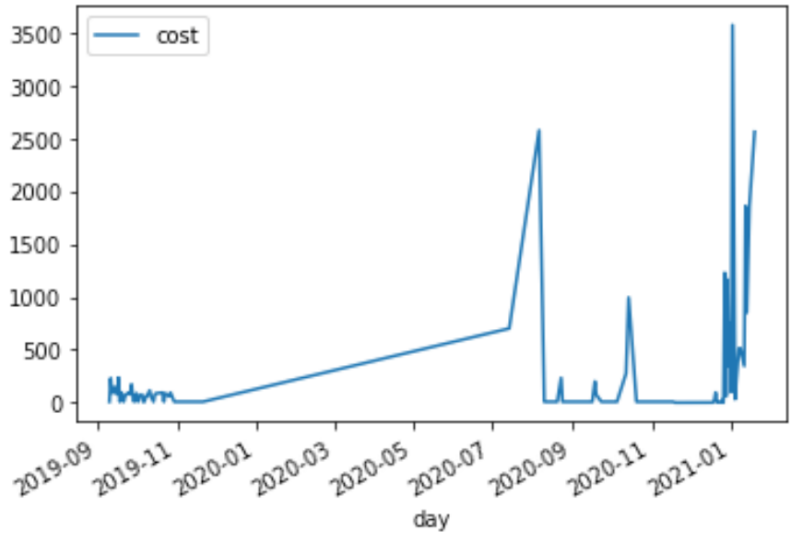


Augmented Dickey-Fuller Results

Test Statistic	-4.713
P-value	0.000
Lags	1

Trend: Constant
Critical Values: -3.48 (1%), -2.88 (5%), -2.58 (10%)
Null Hypothesis: The process contains a unit root.
Alternative Hypothesis: The process is weakly stationary.



Exploratory Data Analysis

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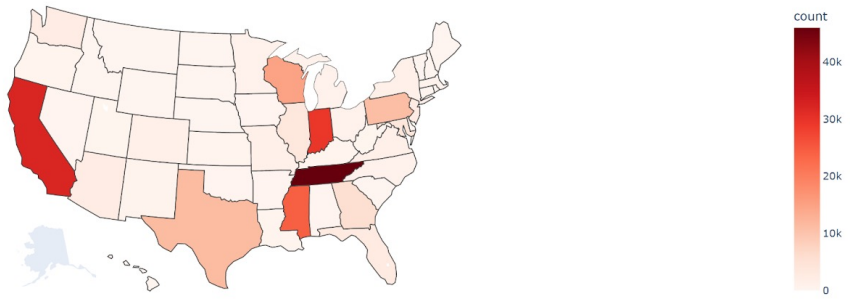
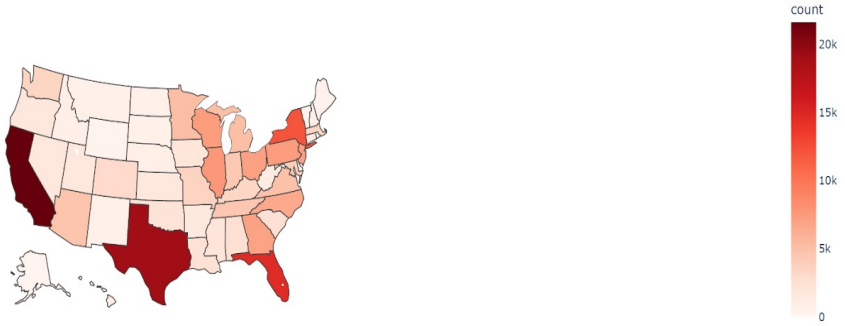
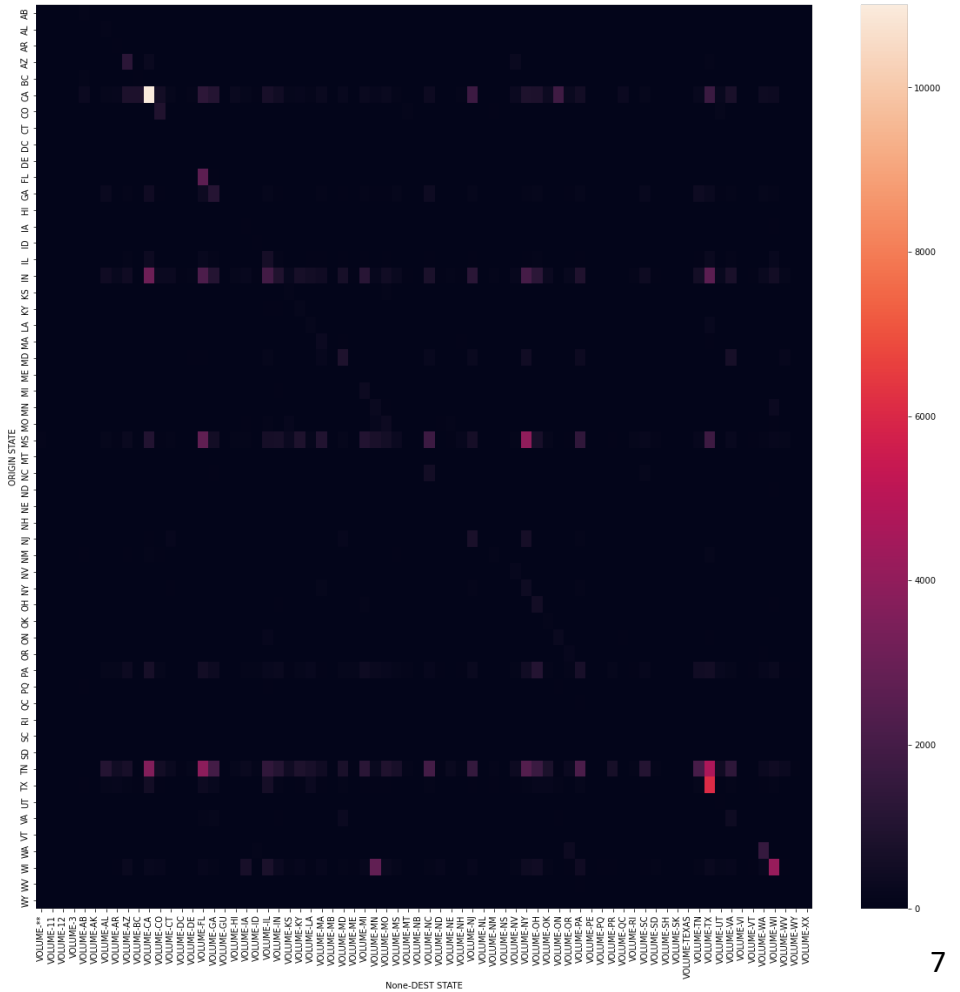
Shipment Map:

cases count of different origin state



cases count of different destination state





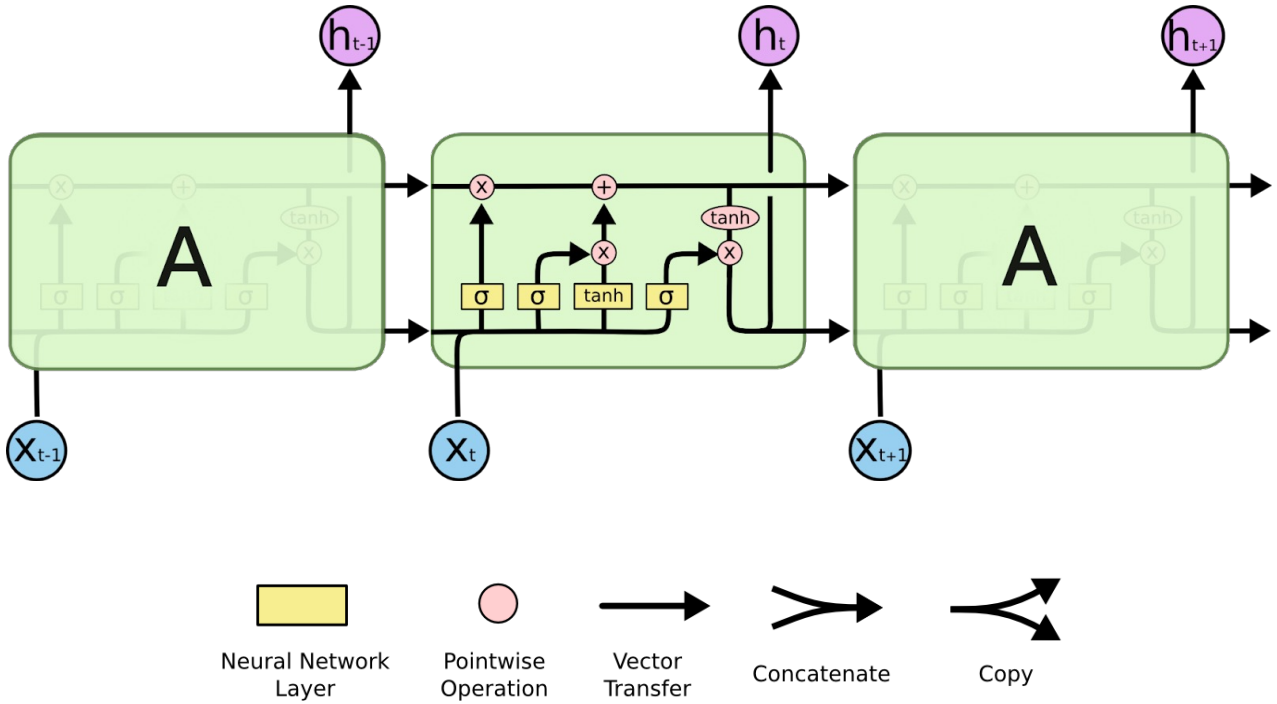
Data Cleaning

Data Cleaning is a critical working before we implementing model

STEPS	DESCRIPTION
Merge two datasets	Using Zip information and Appointed Shipping time as foreigner key to connect two tables
Narrow dataset by location	Collect records only for US and Canada Shipment
Splitting Raw Data	The original data is arranged into three for LTL, TL, and Railway datasets
Removing NA data	If a record has missing information in LINEHAUL COSTS , FUEL COSTS, ACC. COSTS, TOTAL ACTUAL COST, the record will be removed from model training.
Fix Zip related feature	Correctly zip into a correct US or Canada format
Correct Data	Compare Only keeps records whose shipment data is not later than quotes time
Splitting Raw Data	The original data is arranged into three for specific model training

Deep Learning Model Design

Based on the dataset, a Long Short-Term Memory Model is design for prediction



Good to carry both long term and short term info by:

- Cell state vector carrying memories
- Gates deciding to forget or not
- Tanh layers to process candidates

LSTM Model Building

We use PyTorch to build a class to to train a sample LSTM model

Step 1	Splitting Training data and Test data
Step 2	Building a Neural Network
Step 3	Setting Accuracy Measurement for Loss Calculation
Step 4	Setting Gradient Descent as Model Optimizer
Step 5	Building a Learning Epoch
Step 6	Record Test Error

Hyperparameter and Outcome	
Activation Function	ReLU
Hidden Layers	2
Hidden Layers Size	size of training row*2/3
Loss Measurement	SAMPE
Learning Epoch	1000

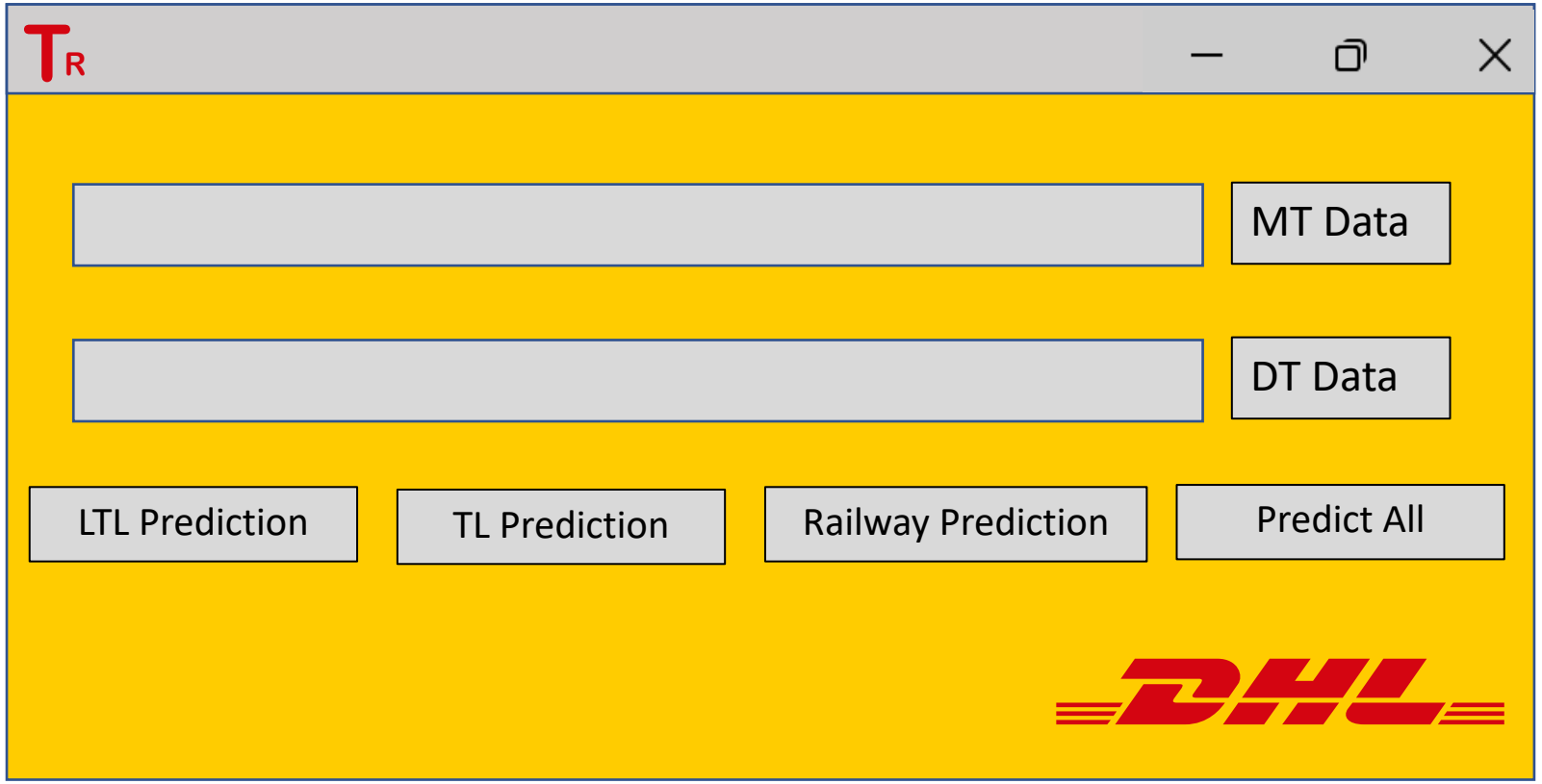
LSTM Model SMAPE Performance

TransRater will compare its SAMPE loss with DataRobot best model to evaluate its performance

	TRANSRATER PREDICT TRANSPORTATION COST EASIER	DataRobot
TL MODEL	0.3378606	Wait For Test
LTL MODEL	0.25428137	Wait For Test
Railway MODEL	0.33060297	Wait For Test

Next Step

TransRater has an User Interface to help Transportation Solution Teams predict transportation quoted price



Next Step

We use PowerBI to build a Dashboard for prediction visualization.

Building…