# Agenda

- Business problem and benefits
- Introduction to the data
- Methodology
- Modelling
- Results
- Business impact and recommendation
- Conclusion
- Way forward

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Business problem

- About 90% of shipments are through sea routes
- Geographical bottle necks, port traffic, weather conditions are some of the factors affecting accurate arrival of shipments
- Companies want to know ETAs of their shipments to plan subsequent activities

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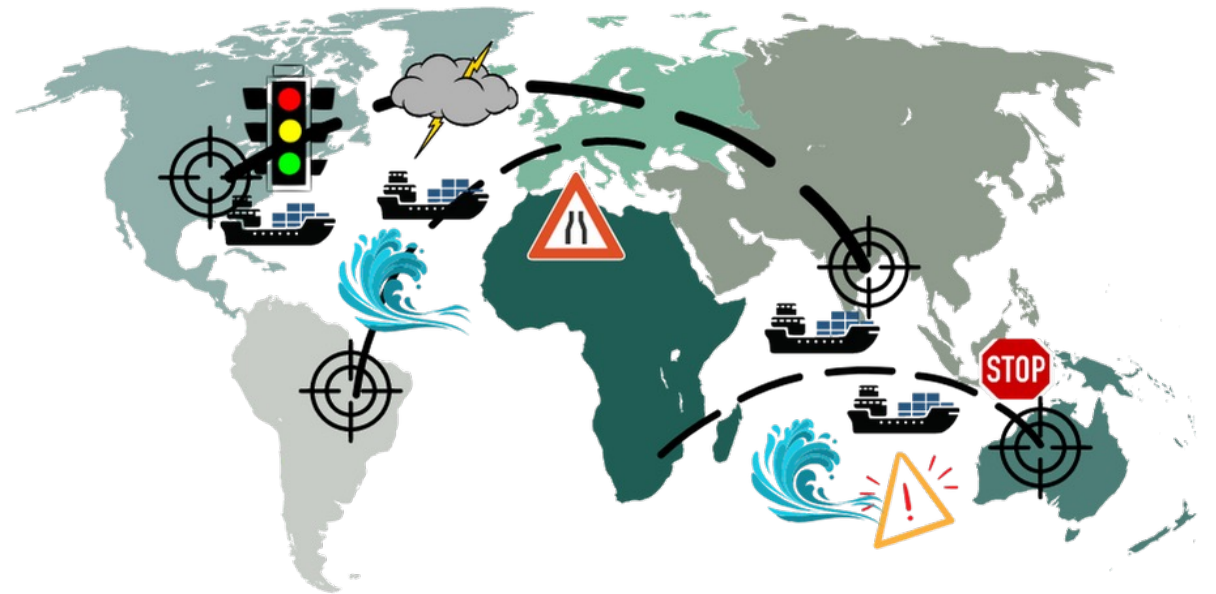
- Multiple ETAs from multiple carriers. What is the single source of truth that a planner can work with?

VESSELS   **CARRIERS WITH ETA**   **SUPPLY CHAIN DISRUPTION**

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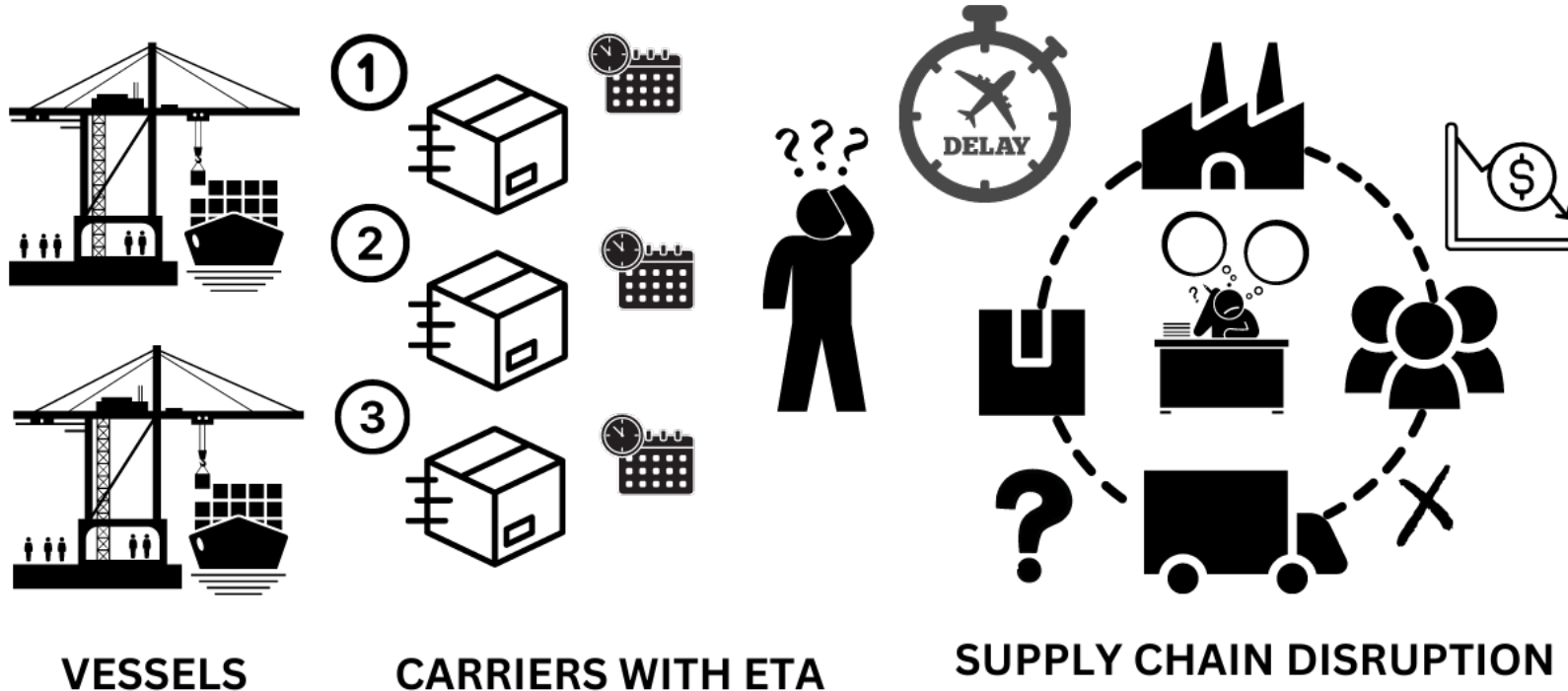
Business benefits

Improved customer satisfaction

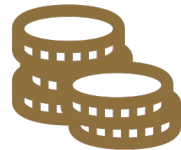Better estimated ETAs can help businesses plan and make end items available to customers on time

Improved resource allocation

Accurate ETAs can help businesses plan their resources more effectively

Increased revenue and profits

When customer satisfaction increases, businesses are more likely to see increased revenue and profits
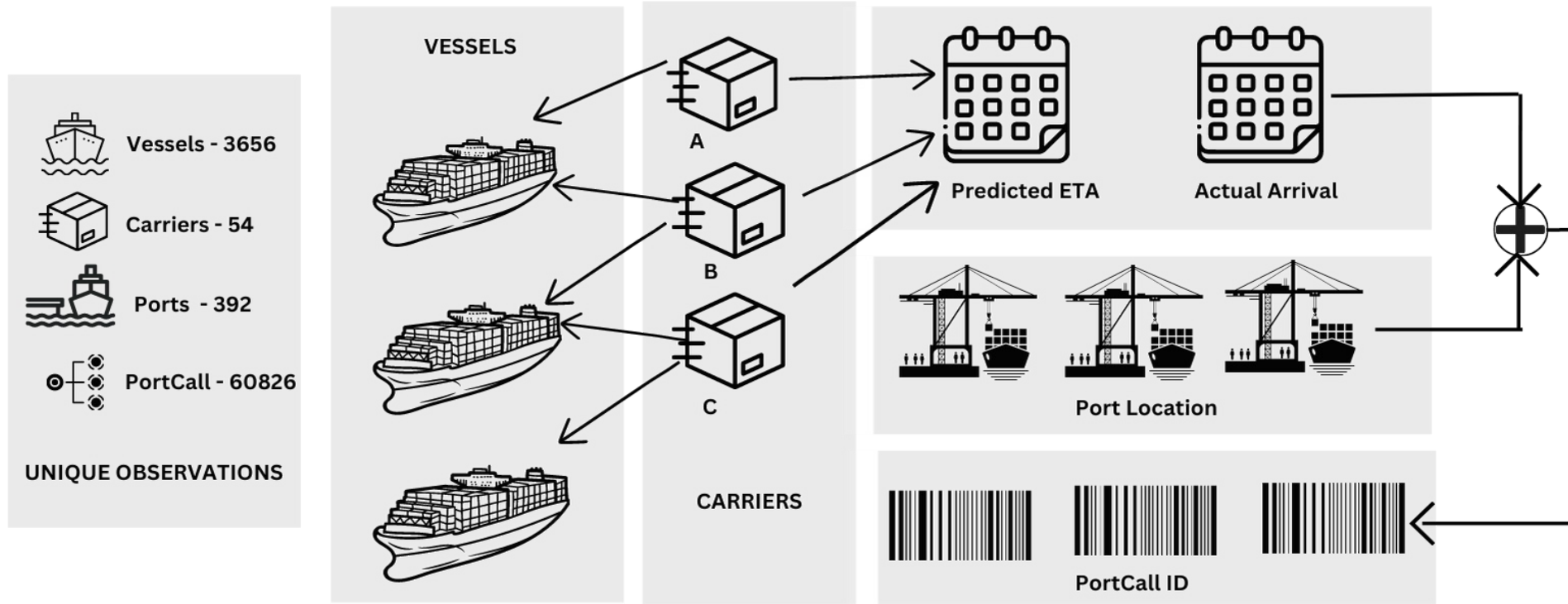
Better cost management

Accurate ETAs can allow companies to plan resources for last mile shipment from port resulting in better cost management

Competitive advantage

By providing accurate ETAs and improving customer satisfaction, businesses can gain a competitive advantage in their market

- A port call refers to the arrival of a vessel (ship) at a port
- Various carriers provide their estimated time of arrival (Predicted ETA) for the vessel, although this ETA may change multiple times

Problem solving methodology
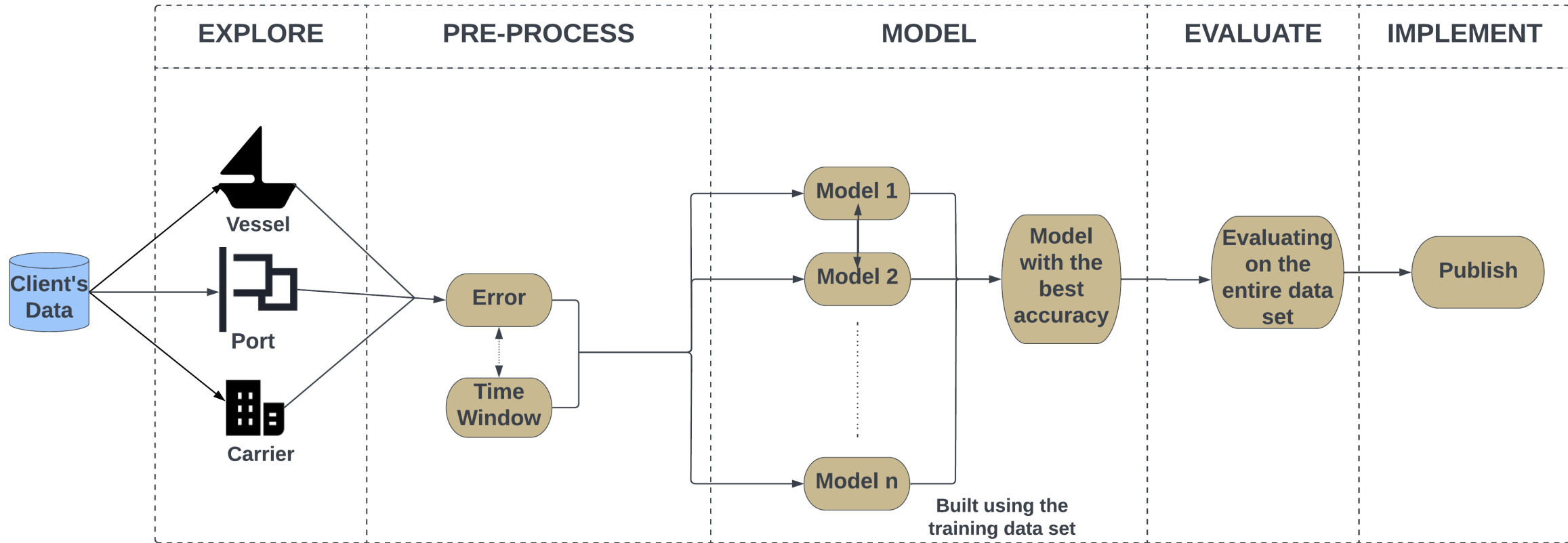
Pre-modelling steps

Data partitioning

Training data – 70%	Test data – 30%

Model inputs

Carrier/time window accuracies	Carrier/time window errors	Weightage

Model output

New days to be added to pred_created on date	New ETA

Evaluation metric

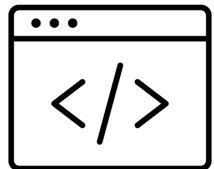| No. of times new ETA is within +/- 24 Hrs. of actual vessel arrival	MAPE	MAE	Adj. R sq.

Modelling

Using Linear regression to predict based on the prediction created time

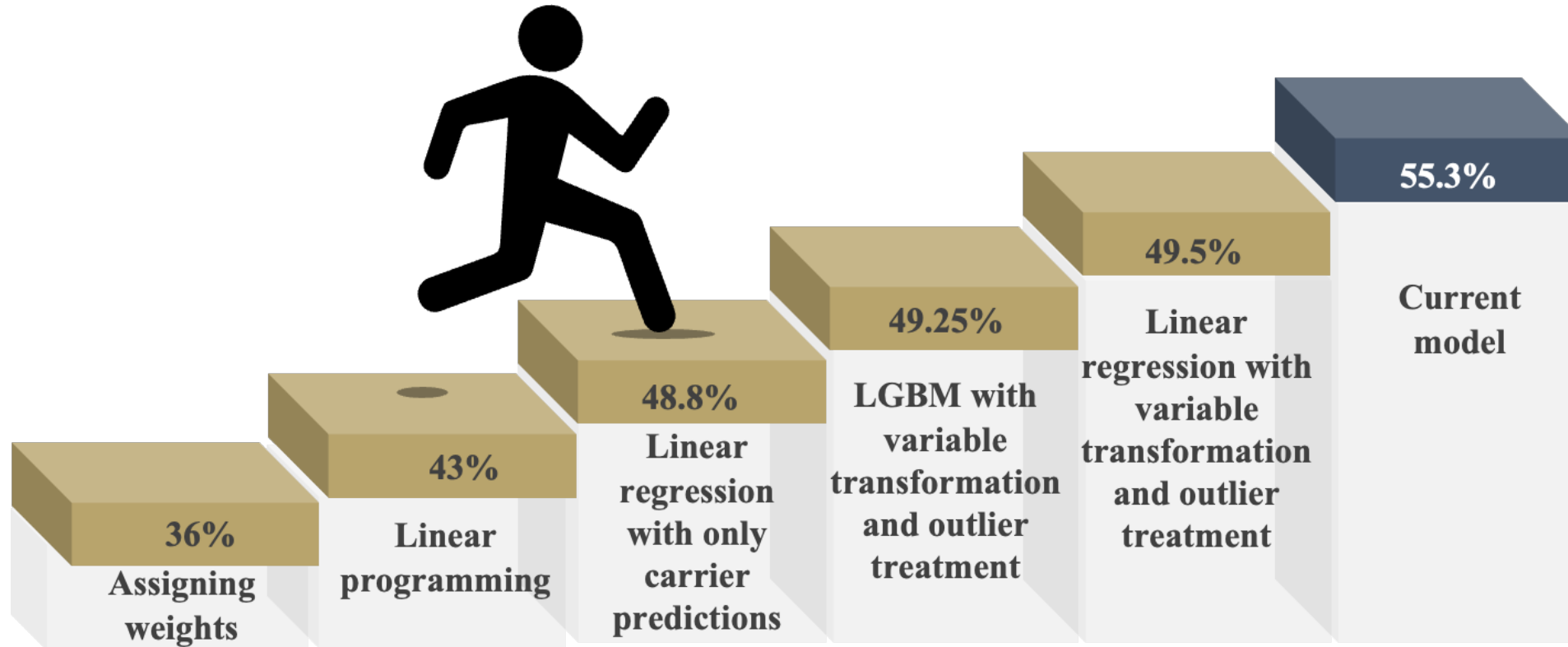Assigning weights to the predictions based on previous accuracies

Lazy predict to understand which model is best

Linear programming to optimize the error

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Modelling (cont.)

As data at hand was large, the following models were tried using data for only **1 port**
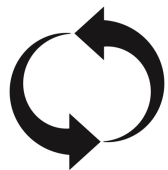
36%
Assigning weights

43%
Linear programming

48.8%
Linear regression with only carrier predictions

49.25%
LGBM with variable transformation and outlier treatment

49.5%
Linear regression with variable transformation and outlier treatment

55.3%
Current model
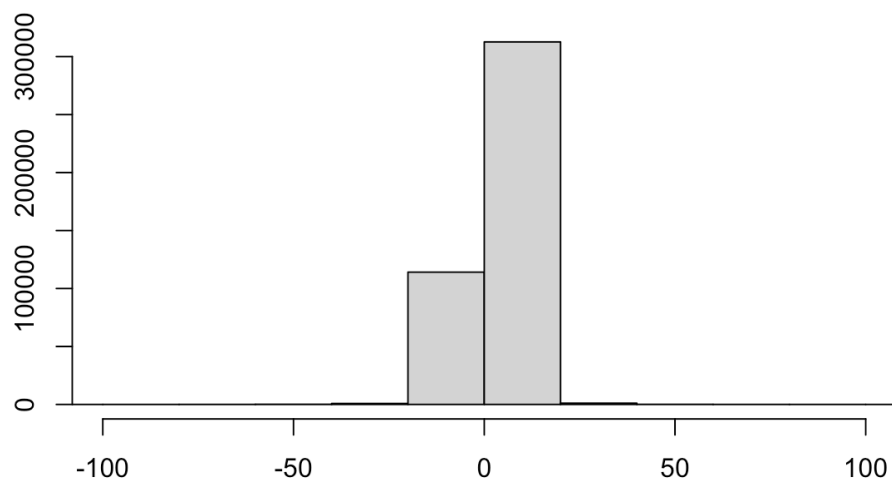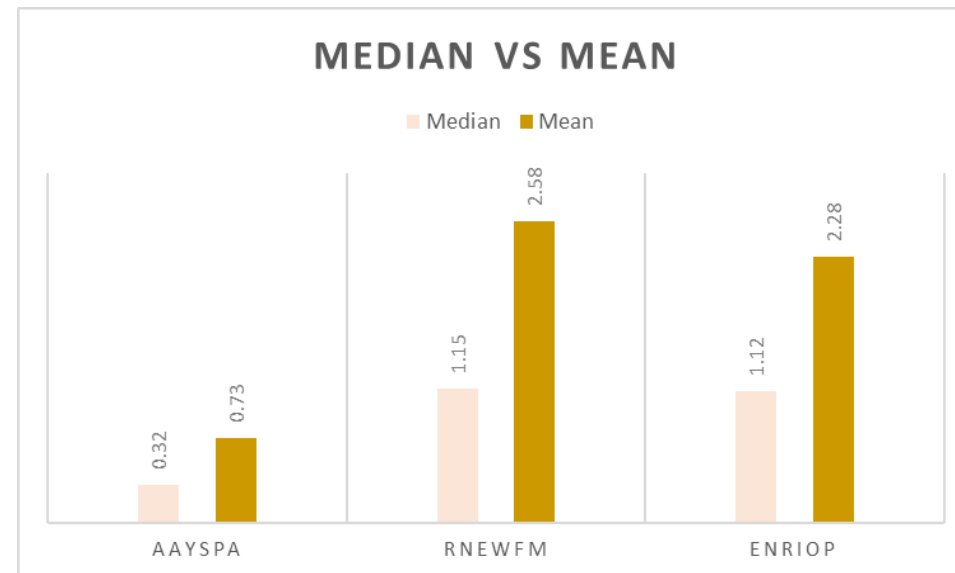
Final Model

Median error

Use of accuracy metric

Accuracy = 40%

Records
1
2
3
4
5
6
7
8
9
10

Correct predictions
= Days*40%

Incorrect predictions
= (Days + Error)*60%

New days to be added to prediction created on date

New ETA

3% accuracy improvement

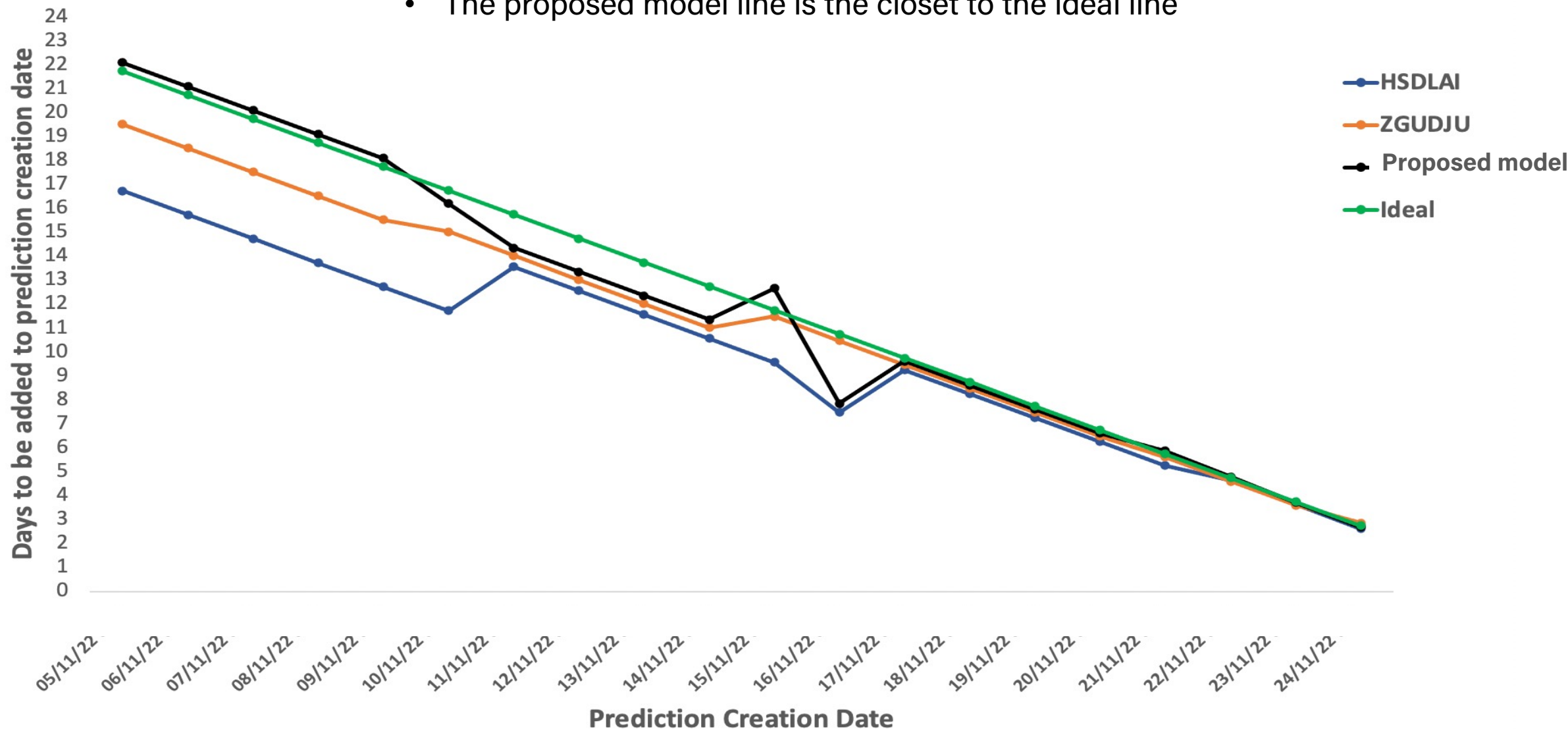| pred_created on	HSDLAI			ZGUDJU			Proposed Model		
	ETA	error	accuracy	ETA	error	accuracy	ETA	error	accuracy
04/11/22 0:00	21/11/22 17:30	5.013194444					23/11/22 17:46	3.00186332	0
05/11/22 0:00	21/11/22 17:30	5.013194444	0	24/11/22 12:30	2.221527778	0	27/11/22 2:16	-0.3524915	1
06/11/22 0:00	21/11/22 17:30	5.013194444	0	24/11/22 12:30	2.221527778	0	27/11/22 2:16	-0.3524915	1
07/11/22 0:00	21/11/22 17:30	5.013194444	0	24/11/22 12:30	2.221527778	0	27/11/22 2:16	-0.3524915	1
08/11/22 0:00	21/11/22 17:30	5.013194444	0	24/11/22 12:30	2.221527778	0	27/11/22 2:16	-0.3524915	1
09/11/22 0:00	21/11/22 17:30	5.013194444	0	24/11/22 12:30	2.221527778	0	27/11/22 2:16	-0.3524915	1
10/11/22 0:00	21/11/22 17:30	5.013194444	0	25/11/22 0:30	1.721527778	0	26/11/22 4:58	0.53536522	1
11/11/22 0:00	24/11/22 13:30	2.179861111	0	25/11/22 0:30	1.721527778	0	25/11/22 8:22	1.39326286	0
12/11/22 0:00	24/11/22 13:30	2.179861111	0	25/11/22 0:30	1.721527778	0	25/11/22 8:22	1.39326286	0
13/11/22 0:00	24/11/22 13:30	2.179861111	0	25/11/22 0:30	1.721527778	0	25/11/22 8:22	1.39326286	0
14/11/22 0:00	24/11/22 13:30	2.179861111	0	25/11/22 0:30	1.721527778	0	25/11/22 8:22	1.39326286	0
15/11/22 0:00	24/11/22 13:30	2.179861111	0	26/11/22 11:30	0.263194444	1	27/11/22 15:58	-0.9229681	1
16/11/22 0:00	23/11/22 11:30	3.263194444	0	26/11/22 11:30	0.263194444	1	23/11/22 20:11	2.9008789	0
17/11/22 0:00	26/11/22 6:00	0.492361111	1	26/11/22 11:30	0.263194444	1	26/11/22 14:41	0.13004557	1
18/11/22 0:00	26/11/22 6:00	0.492361111	1	26/11/22 11:30	0.263194444	1	26/11/22 14:41	0.13004557	1
19/11/22 0:00	26/11/22 6:00	0.492361111	1	26/11/22 11:30	0.263194444	1	26/11/22 14:41	0.13004557	1
20/11/22 0:00	26/11/22 6:00	0.492361111	1	26/11/22 11:30	0.263194444	1	26/11/22 14:41	0.13004557	1
21/11/22 0:00	26/11/22 6:00	0.492361111	1	26/11/22 14:30	0.138194444	1	26/11/22 21:01	-0.1334904	1
22/11/22 0:00	26/11/22 15:19	0.104166667	1	26/11/22 14:30	0.138194444	1	26/11/22 18:53	-0.0450258	1
23/11/22 0:00	26/11/22 15:00	0.117361111	1	26/11/22 14:30	0.138194444	1	26/11/22 17:06	0.0297224	1
24/11/22 0:00	26/11/22 15:00	0.117361111	1	26/11/22 20:30	-0.111805556	1	26/11/22 16:13	0.06644414	1
Accuracies	**40.0%**			**50.0%**			**71.4%**		

- The proposed model has significant accuracy improvement over the existing model

Performance across different ports

MODEL PERFORMACE ACROSS ALL THE PORTS

■ Worse ■ Same ■ Better

- Worse: 28%
- Same: 18%
- Better: 54%
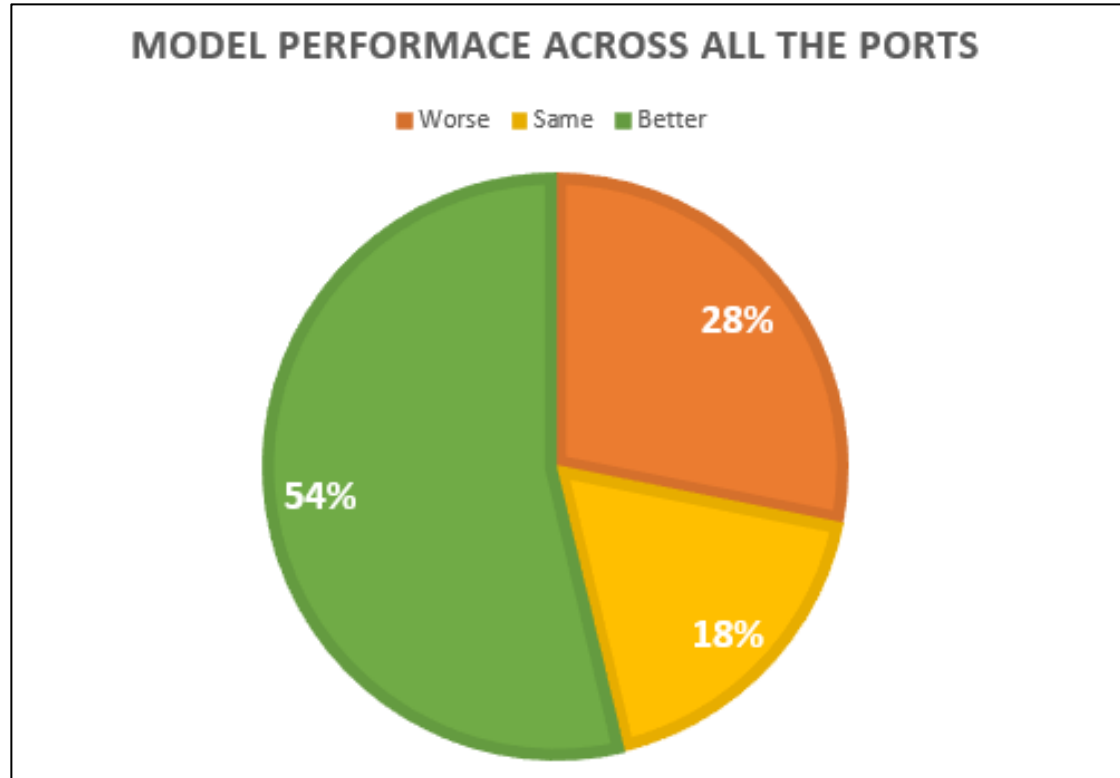
➢ The proposed model performs better than or as good as the existing carrier predictions for 72% of the port locations

➢ For 28% of the ports model accuracy is poor with average difference of 7.7% and standard deviation of 9.7% from the carrier prediction accuracies

➢ Avoid using the proposed model for these ports: MYKCH, GNCKY, NZPOE, ITVCE, KYGEC, TNSFA, MXPGO, ESLPA

➢ Top 10 ports where accuracy improvement > 15%: BZBZE, FRMTX, GPPTP, LYMRA, ITAOI, TRYAR, USILM, RUNVS, SESTO, SXPHI

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Performance across different time windows
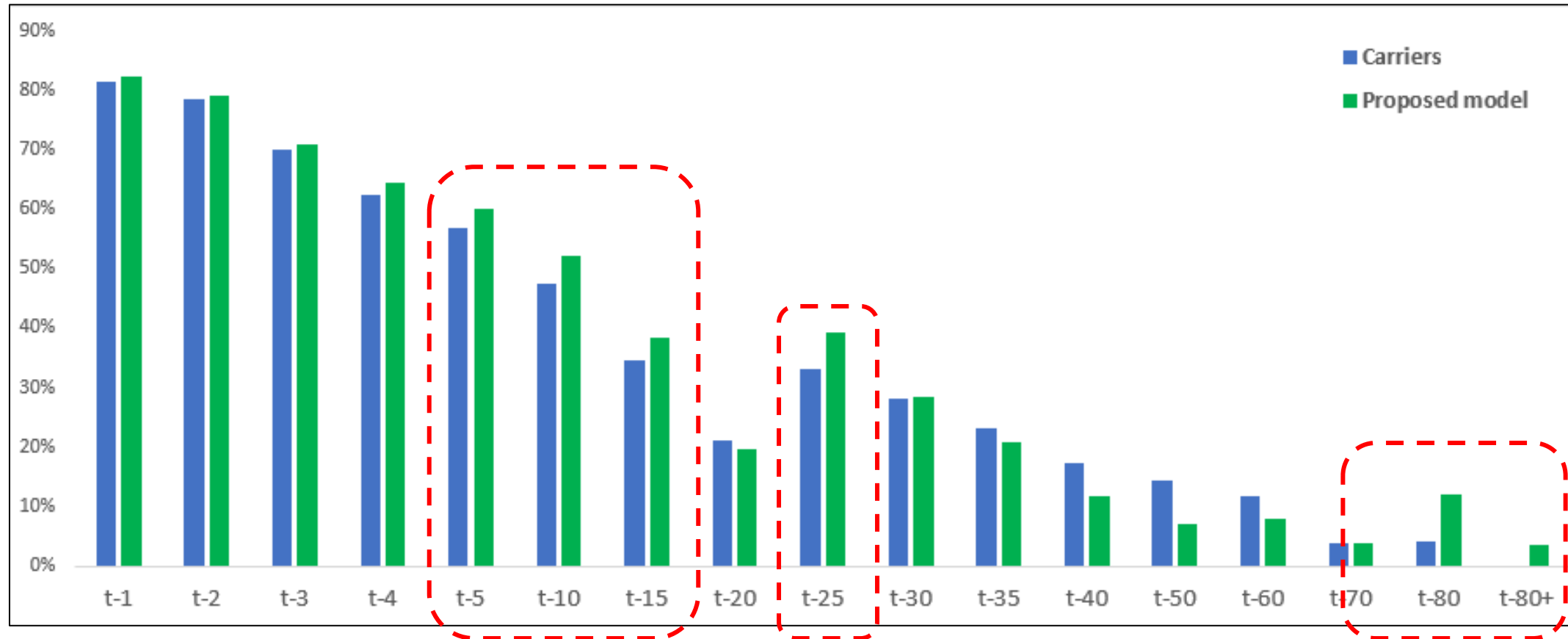
> The proposed model can be utilized the best from time windows t-15 till t-5, which is a critical time for planning activities further down the supply chain

Business impact & recommendation

Use the prediction model from time windows t-5 to t-15

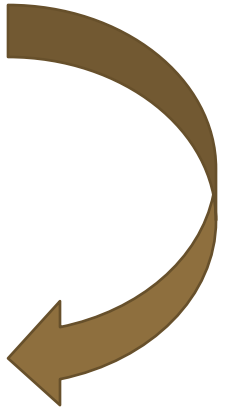Average accuracy improvement of up-to 6% achievable in this segment

Impact

Customer	Monthly revenue (Millions)
GE Healthcare	$ 158

$ (158/30) X 6 Millions saved in 100 days

Up-to ~ $ 0.3 Million daily savings

Real time implementation steps

Real-time prediction process

Data collection

- Take all the historic data, keep updating weekly/monthly

Determination of accuracy and median error

- Feed the data to the R code and get accuracies and median errors for all carrier/window pairs

Updating main data file

- Using VLOOKUP, map these accuracies and errors in the main excel data file

Prediction of ETA

- Consider the latest prediction out of all the available carrier prediction

- Calculate ETA using below formula:

  New Days = (%accuracy * days) + (1 - %accuracy) * (days + median error)

  New ETA = Pred_created_on + New Days

Documentation
Creation of a Standard Operating Procedure detailing steps to input carrier predictions, weights and error factors to get the vessel arrival prediction
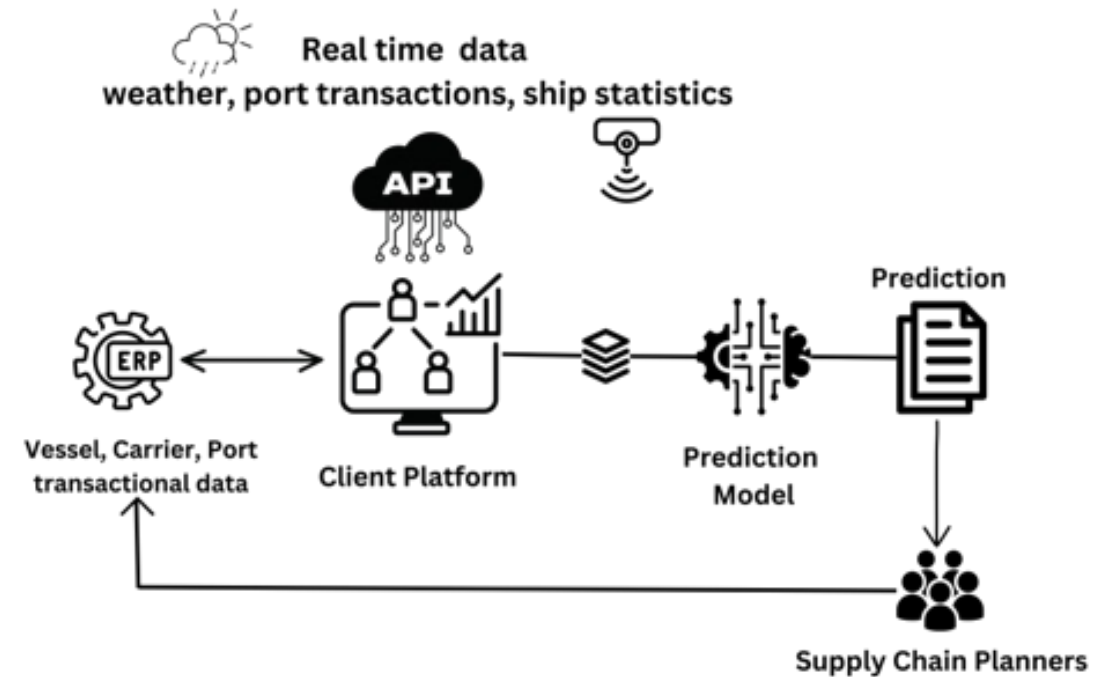
Code
The excel and R-files shared with ready, fully functional code to generate required parameters

Integration with client system
Using the Data Transfer Tools (DTL) the solution can be deployed making it user-friendly for the client to get the predictions via just one click

Provide confidence
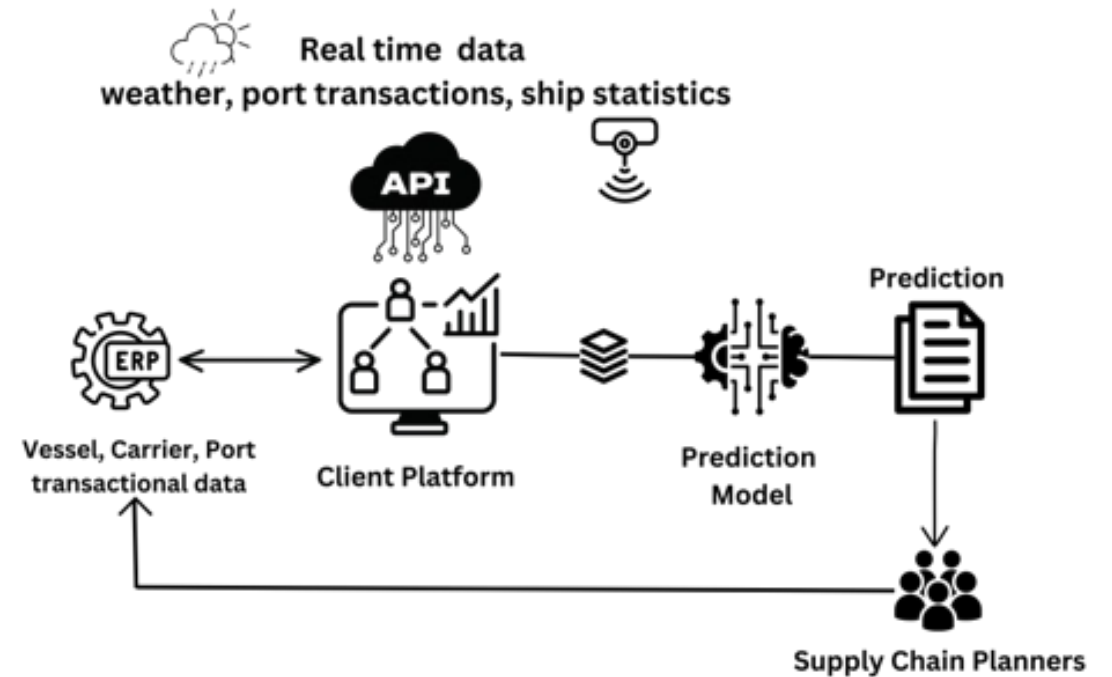Develop a method to provide ETA with % confidence

Vessel impact
Exploring impact of vessel routes and capacity on carrier predictions

Additional data
Sourcing additional real-time data like weather on particular vessel routes

Real time data
weather, port transactions, ship statistics

API

Vessel, Carrier, Port transactional data

Client Platform

Prediction Model

Prediction

Supply Chain Planners

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Conclusion

Increased operational efficiency

Better ETA enables efficient planning, reduction in idle times and improved resource utilization

Better overall accuracy

Overall improvement by 3% over current carrier predictions

Cost impact

Savings in cost of downstream activities

Reliability

Client company can provide a single reliable ETA at any given point of time

THANK YOU

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