Utilising real-time ship data to reduce fuel consumption and carbon emissions

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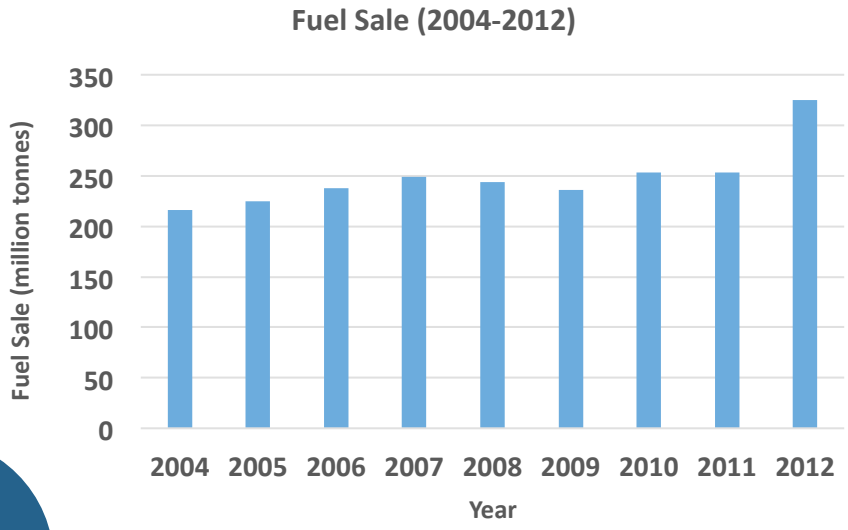
Shipping Industry Overview

- Shipping is the life blood of the global economy and responsible for the carriage of around 90% of trade.
- The world's commercial fleet consists of around 90,000 vessels.
- In 2014, total global cargo carried 9.84 billion ton, an increase of 3.4% from 2013.



The fuel demand estimated ***to double by 2030*** due to the increase in transport demand.

Source: Third IMO GHG Study 2014 and Global Marine Fuel Trend 2030

Ship Emissions

- Average annual totals of 20.9 million and 11.3 million tonnes for NOx (as NO_2) and SOx (as SO_2) from all shipping. (2007-2011)
- NOx and SOx emissions from all shipping represent about 15% and 13% of global totals.
- Responsible for 3% of global CO_2 emissions

Increase co_2 emissions 50%- 250% by 2050, depending on economic growth and global energy demand

- Combustion emissions of SOx, NOx, PM, CO and NMVOCs are correlated with fuel consumption patterns, with some variability according to properties of combustion across engine types, fuel properties, etc.

Source: Third IMO GHG Study 2014

Fuel consumption reduction methods

Operational

Weather routing **1-4%**
Autopilot upgrade **1-3%**
Speed reduction **10-30%**

Auxiliary power

Efficient pumps, fans **0-1%**
High efficiency lighting **0-1%**
Solar Panel **0-3%**

Aerodynamics

Air lubrication **5-15%**
Wind engine **3-12%**

Thrust efficiency

Propeller polishing **3-8%**
Propeller upgrade **1-3%**
Prop/rudder retrofit **2-6%**

Engine efficiency

Waste heat recovery **6-8%**
Engine control **0-1%**
Engine common rail **0-1%**
Engine speed de-rating **10-30%**

Hydrodynamics

Hull cleaning **1-10%**
Hull coating **1-3%**
Water flow optimisation **1-4%**

Source: International Council on Clean Transportation (ICCT, July 2013)

ECO Speed Project

The main aim is to identify the economical ship speed for the vessel by analysing the ship real-time data.

The OSV Specifications

Main Engines	2 x MAK 8M25C 2500kW
Shaft Generator	2 x 1440 kW
Auxiliary Engines	3 x 585 kW
Emergency Generator	1 x 200 kW
Bow Thruster	2 x Berg 800 kW
Stern Thruster	2 x Berg 800 kW
Propeller	2 x CPP

ECO Speed Development Process

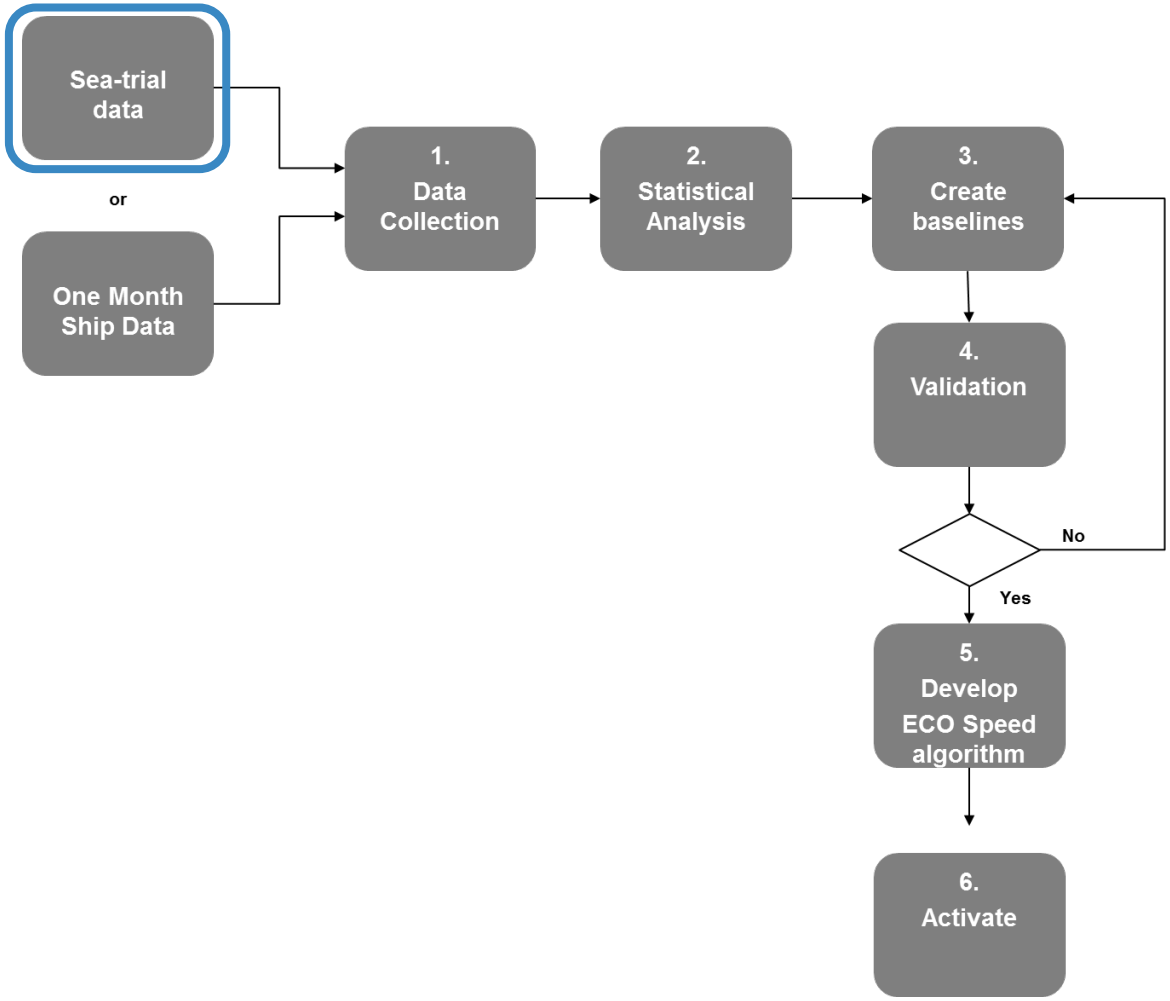
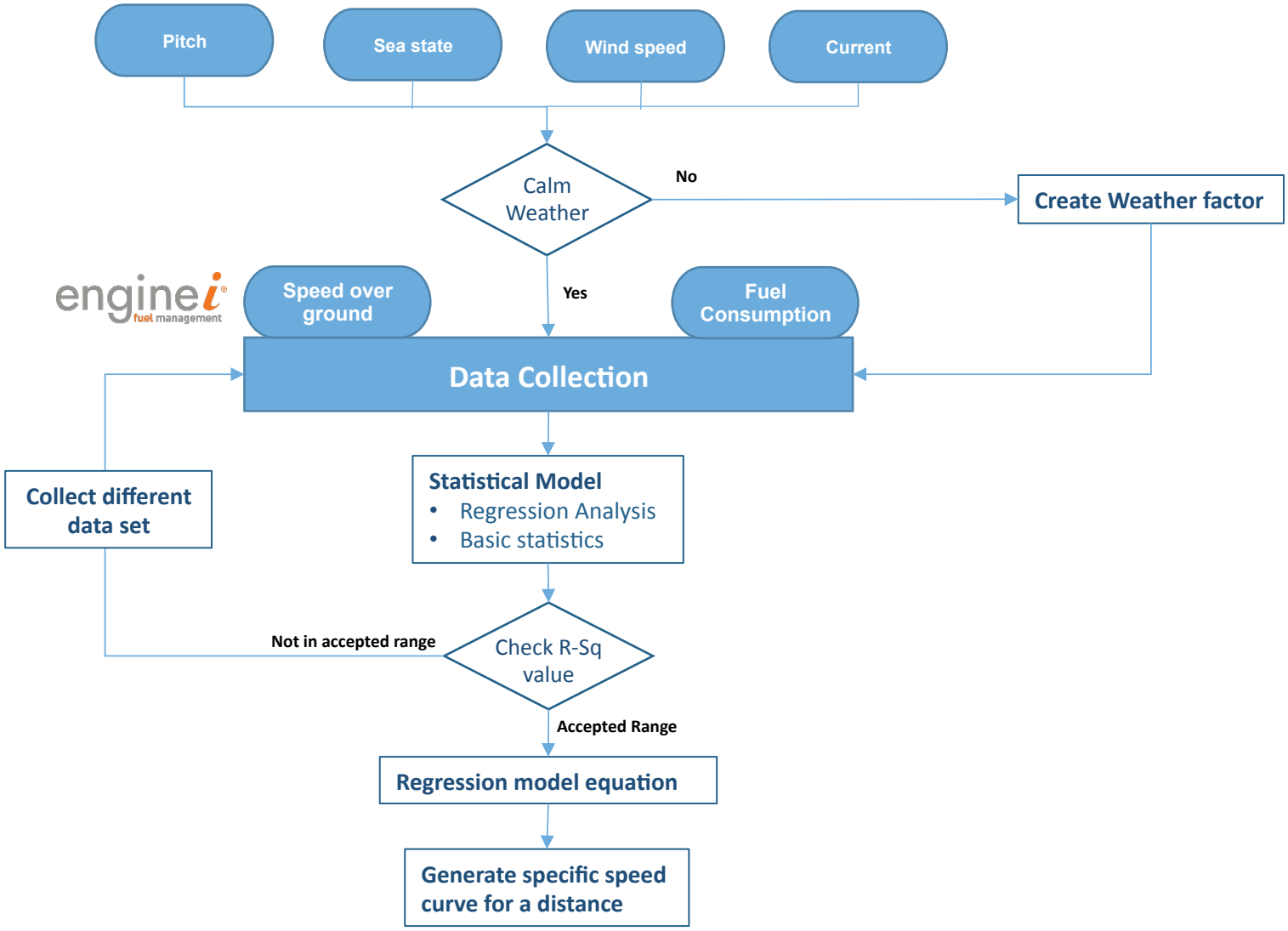
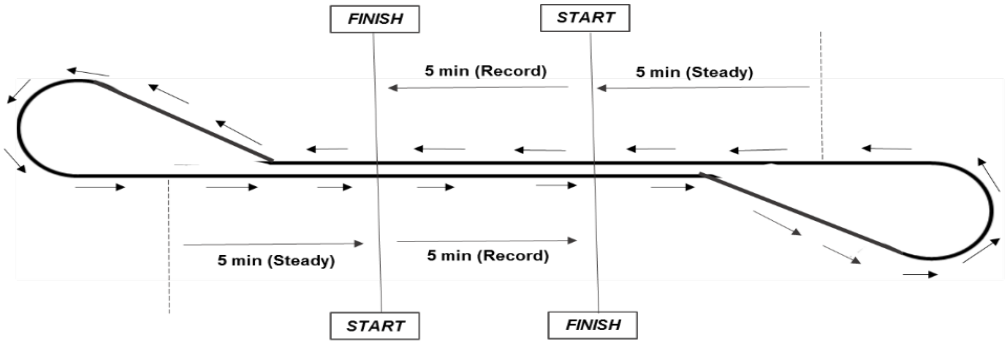


Figure: ECO Speed development process

Data Analytic Model



The OSV sea-trial



Pitch (%)	Avg. SOG (kn)	FC (kg/min)
95	12.13	13.75
85	11.24	11.23
75	10.57	8.92
60	9.02	6.41
57	8.5	5.99
50	7.78	5.43
35	5.99	4.55
25	4.52	4.10
10	2.23	4.20

Table: The OSV Sea-Trial (Full Engine Speed)

Regression Analysis

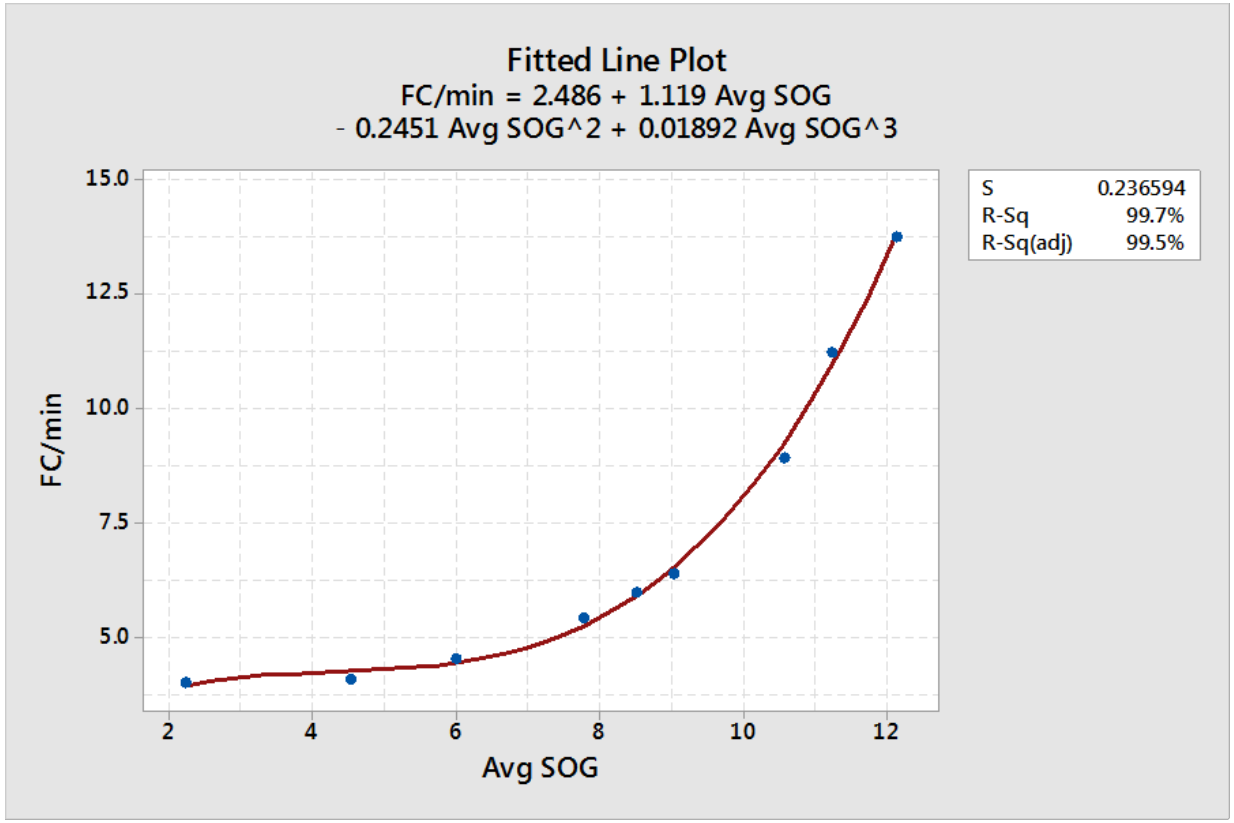


Figure : Regression model

Fuel Con. vs Speed

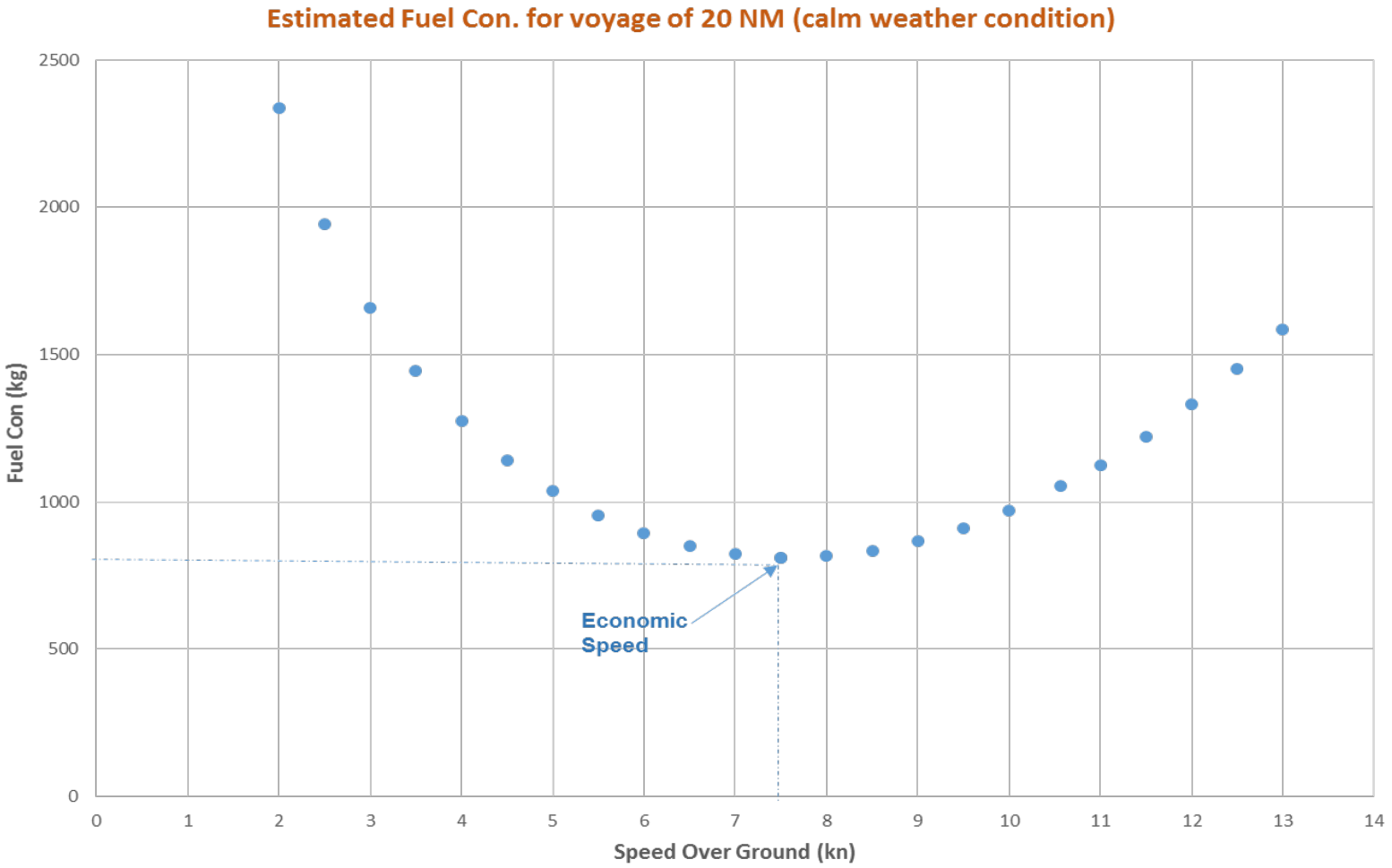


Figure: The estimated fuel consumption for different speed using regression equation

Speed Over Ground (kn)	Estimated Fuel Con/ min	Distance of 20 NM taken, Time (Hr)	Fuel Con-kg	Additional Fuel Consumed from ref. optimum speed, Fuel Con-Diff	Time Diff (min)	Fuel Con- Diff %
3.5	4.21	5.71	1443.85	632.09	182.86	77.87
4	4.25	5.00	1275.38	463.62	140.00	57.11
4.5	4.28	4.44	1141.95	330.19	106.67	40.68
5	4.32	4.00	1036.44	224.68	80.00	27.68
5.5	4.37	3.64	954.34	142.58	58.18	17.56
6	4.46	3.33	892.62	80.86	40.00	9.96
6.5	4.60	3.08	849.22	37.46	24.62	4.61
7	4.80	2.86	822.63	10.87	11.43	1.34
7.5	5.07	2.67	811.76	0.00	0.00	0.00
8	5.44	2.50	815.80	4.04	-10.00	0.50
8.5	5.91	2.35	834.11	22.35	-18.82	2.75
9	6.50	2.22	866.21	54.45	-26.67	6.71
9.5	7.22	2.11	911.72	99.96	-33.68	12.31
10	8.09	2.00	970.32	158.56	-40.00	19.53
10.57	9.27	1.89	1052.79	241.03	-46.47	29.69
11	10.32	1.82	1125.86	314.10	-50.91	38.69
11.5	11.71	1.74	1222.43	410.67	-55.65	50.59
12	13.31	1.67	1331.34	519.58	-60.00	64.01
12.5	15.13	1.60	1452.46	640.70	-64.00	78.93
13	17.18	1.54	1585.69	773.93	-67.69	95.34

Economical Speed (Datum)

Crew Speed

Tolerance and Accuracy

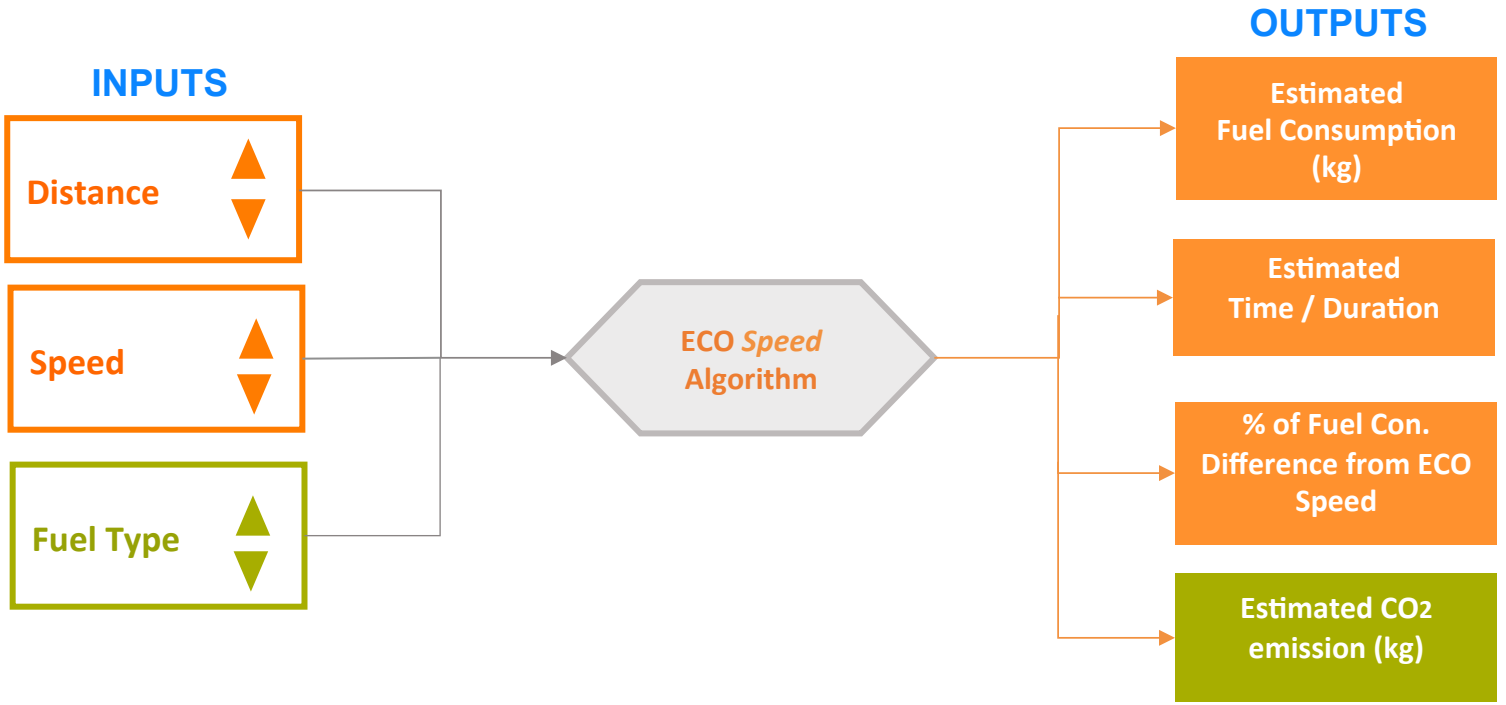
Item	Tolerance/Limits
Differences in time recorded by separate timing devices over a trial run	0.25%
Difference in total revolutions from separate revolution counters for a run	0.25%
Difference in RPM for each run from means for each speed point	0.20%
Difference in RPM of any shaft of multi-screw ship from the mean for a run provided the rated RPM for all shafts is the same	0.20%

Table: Trial tolerances and limits.

The ship performance parameters involve measurement of many fluctuating quantities. Each comes with an element of uncertainty. The accuracy of the optimum speed around 3% to 5%.

Source: SNAME Guide for Sea Trials (2015)

ECO Speed Model



ECO v1.1.vi

ECO Speed Demo

Calm Weather Conditions

Operator Inputs

Distance (NM)

0 10 20 30 40 50 60 70 80 90 100

Speed Over Ground (kn)

0 1 2 3 4 5 6 7 8 9 10 11 12

Fuel Type

HFO

Output

Estimated Fuel Consumption

2017.03 [kg]

Estimated Duration

6 hours, 37 minutes

Fuel Con. vs. Vessel Run at ECO Speed

0 %

Estimated CO2 Emission

6281.82 [kg]

engine*i*
fuel management

Summary

Applying the ECO Speed option enables a vessel to:

- ❑ **Achieve on-time arrival**
- ❑ **Improve decision-making**
- ❑ **Increase operational predictability**
- ❑ **Optimise time spent in Emissions Control Areas (ECA)**
- ❑ **Monitor the vessel performance based on speed modelling**


Thank You