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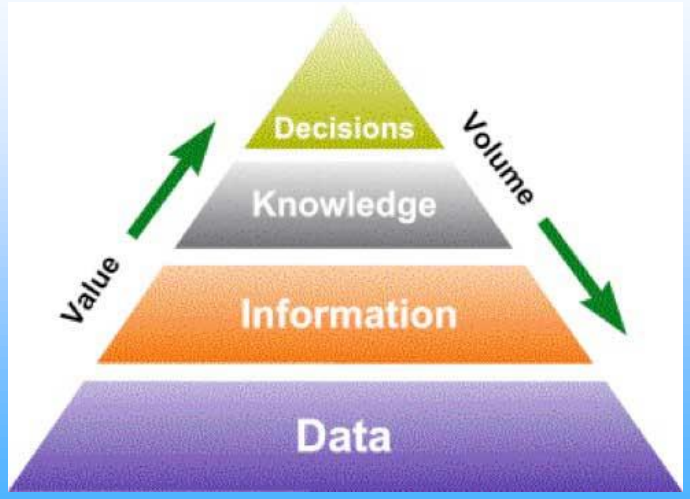


My research area is data mining. I have worked with a range of companies, including Master Foods, British Gas, ITV and Green Energy Options, on problems as diverse as mining text messages to X-Factor to predicting the yield of cocoa plants.

What is Big Data?

Statistics: collect data in a controlled environment

Clinical trials, smart meter experiments, lab experiments

Data Mining: create value from data collected for some other primary purpose

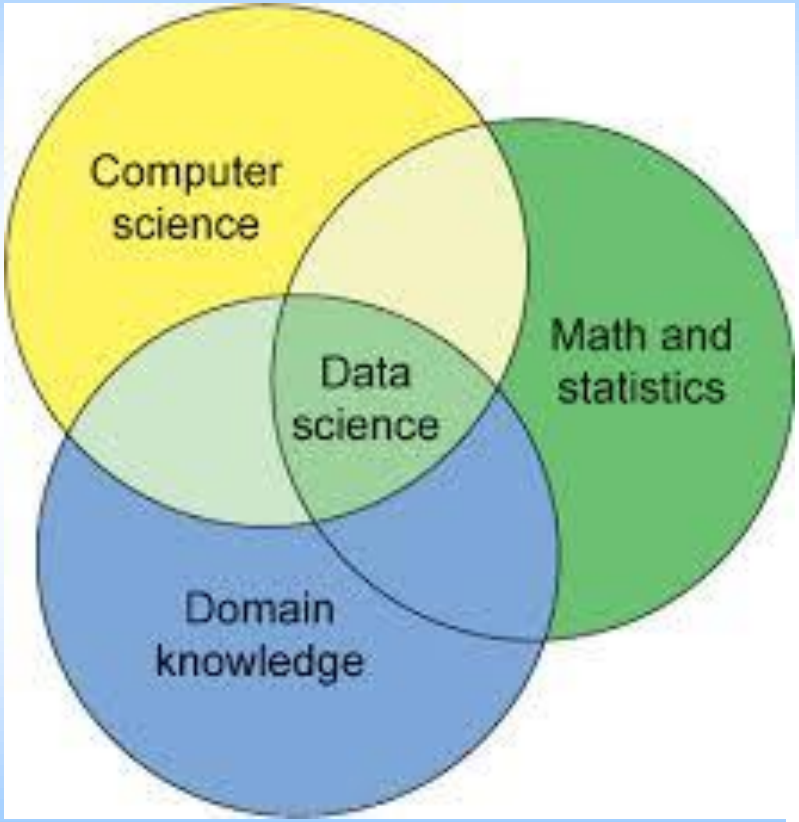
Medical images, smart meter trials, TV ratings

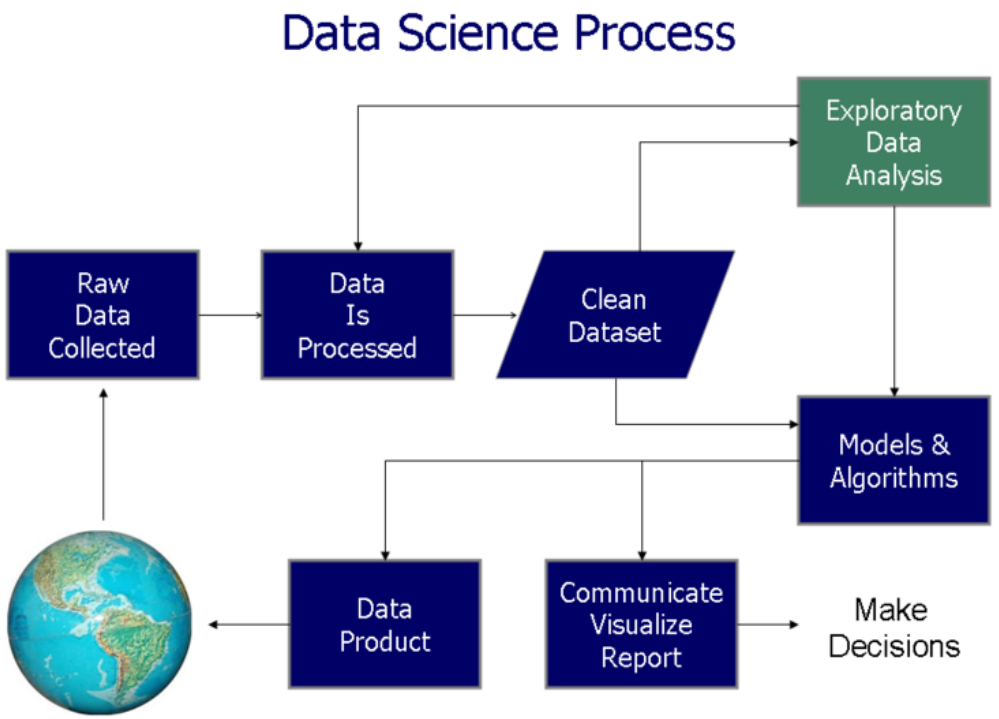
Big Data: collect all the data because there must be value in there somewhere!

Twitter, google, smart meter data, Opta index

Data Science

The study of big data is performed by people calling themselves **data scientists**





Key Issues in Utilising Big Data

1. What data to collect, how to collect it and where to store it?

relevance, sampling cost, sampling frequency, storage cost, persistence

2. What to do with it? What is the question? Where is the value?

Requires domain knowledge. The question guides the nature of the data collection.

Big Data for Offshore Wind

Some possible sources of data

- Wind turbine monitoring
- Supply chain management
- Marine operations

Where are the greatest gains for minimum effort?

Marine operations

- Staff data
- Equipment data
- Weather data
- Vessel data

Big Data for Marine Management

We (myself and three interns) spent the summer looking at whether big data can reduce the cost of wind farm operations and maintenance

Amine Hadjer is a student on the Energy Engineering MSc course at UEA.
Ian Weeks is a student on the Computer Science Mcmp course at UEA
Max Bloy is a student on the Computer Science BSc course at UEA

We interviewed six key individuals working in offshore operations and management roles and asked them how data and software could improve efficiency.

The clear message is that they would like more control over marine operations and felt there was huge scope for data analysis and decision support

“[we would like] anything that makes boat more fuel efficient"

“[vessels] use more fuel during push-on operations than during transit”

"We don't know what activity each vessel has been doing, we just know the amount of fuel"

"we don't know if one vessel was tied up and sitting there all day, and the other one was bouncing from turbine to turbine and hence used more fuel"

Fuel Use

A 150 turbine windfarm has an annual fuel bill of approximately **£2 million.**

Fuel Use: What would help reduce it?

Analytics and Data Mining

“a system that would aid understan… level of pu… a sea state“

" understanding the specifics of the vessel, …nst the …ay we used 500 litres more than we used this day"

Data Visualisation

“[we would like] a system where we sit in a control room and a … they are doing and fuel they are using at x amount of time“

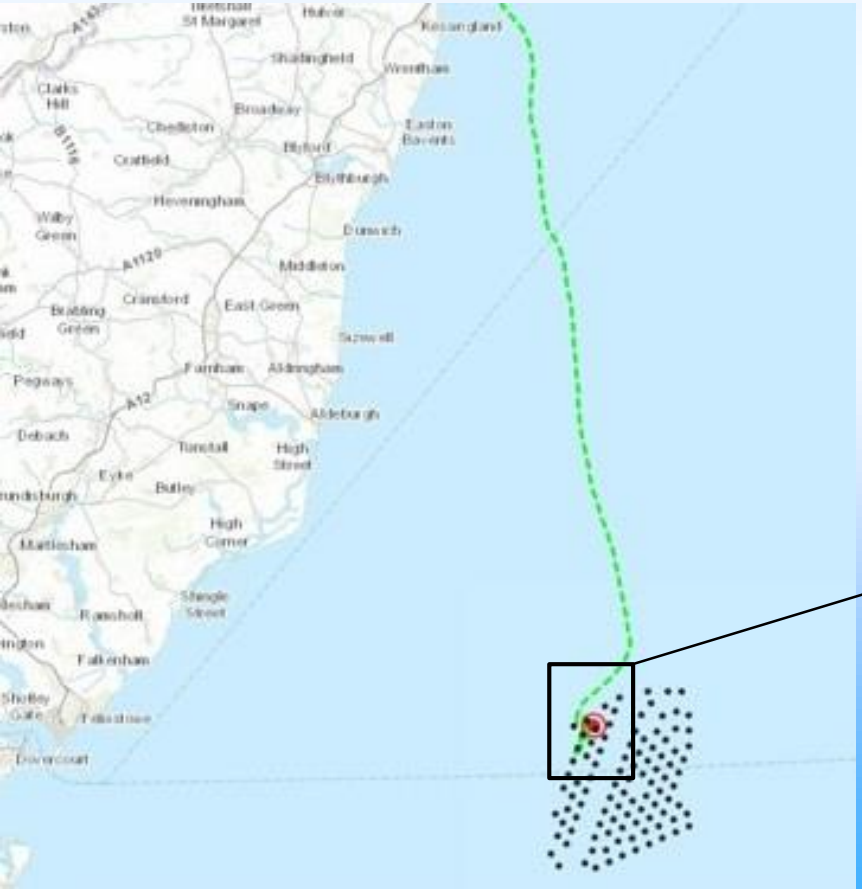
Even throttling back from 23 knots to 20 knots … if you … …nt

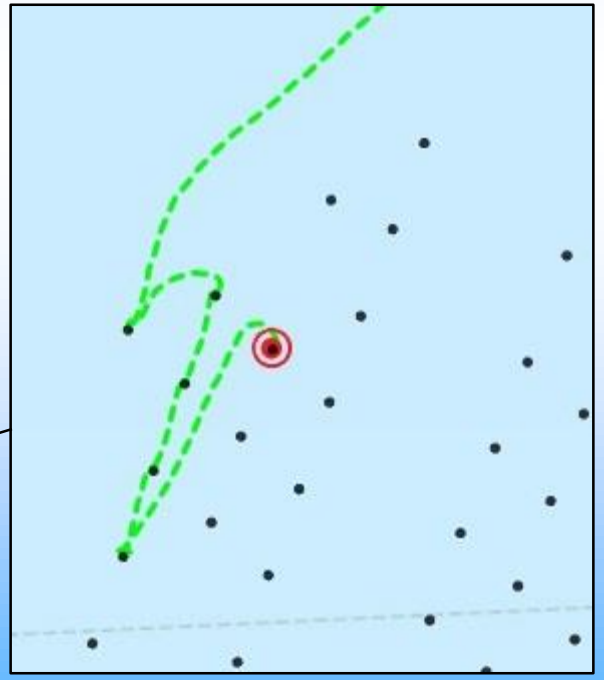
Decision Support

tell these boats to come back at a certain speed, for instance 18Kn”

Vessel Journey Simulation

- GIS Data from ArcGis
- Motion Data from VMMS: Vessel Motion Monitoring System (motion and GPS)
- Push-on forces from Intelligent Fender



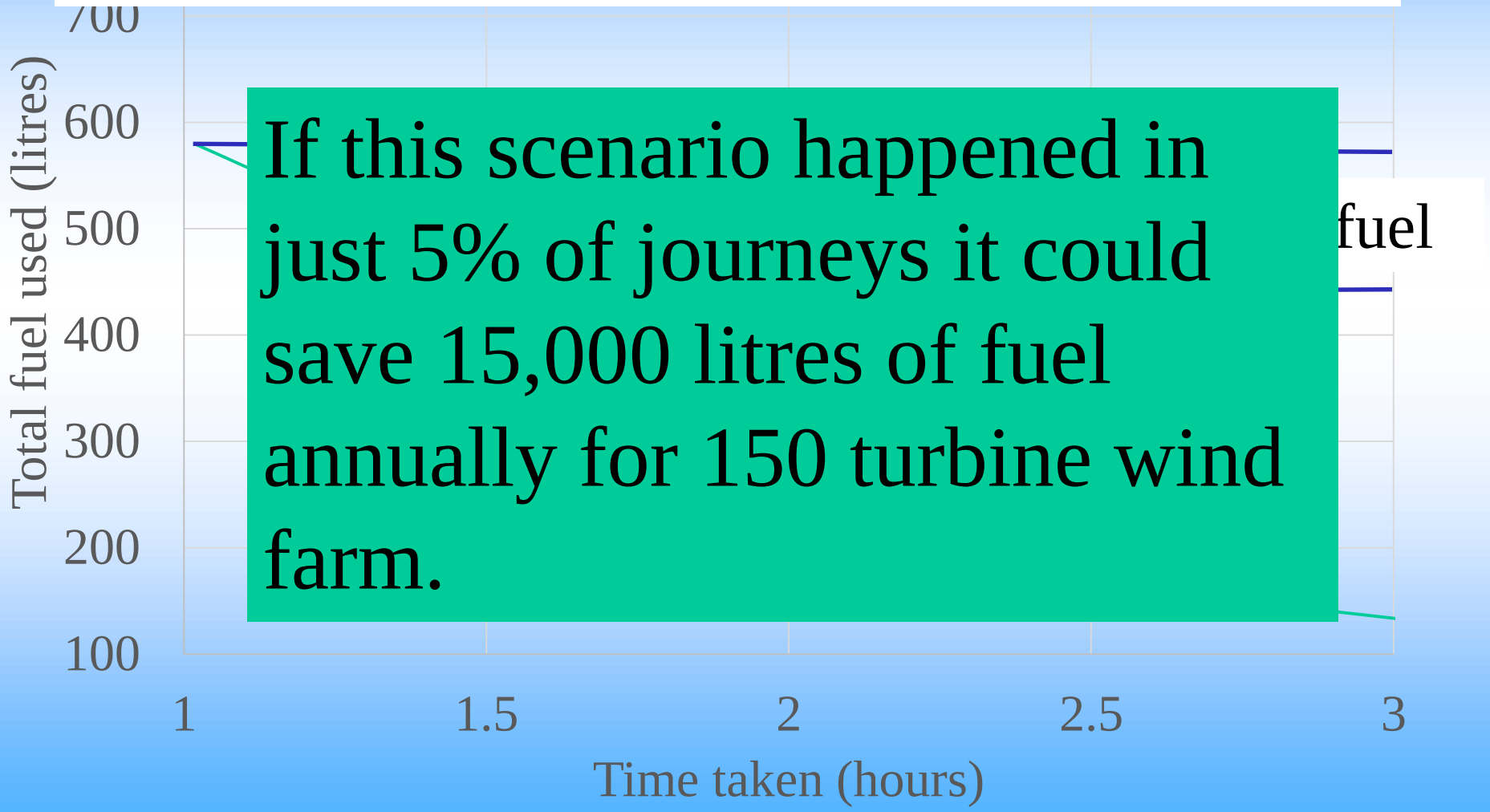


The potential for proactive management of sailing strategy

Suppose a vessel and staff are employed for an 8 hour day, but work on the turbine finishes after 5 hours. Currently the speed of return is up to the skipper, and there is a clear incentive to minimise time.

Fuel saving by increasing journey time by one hour

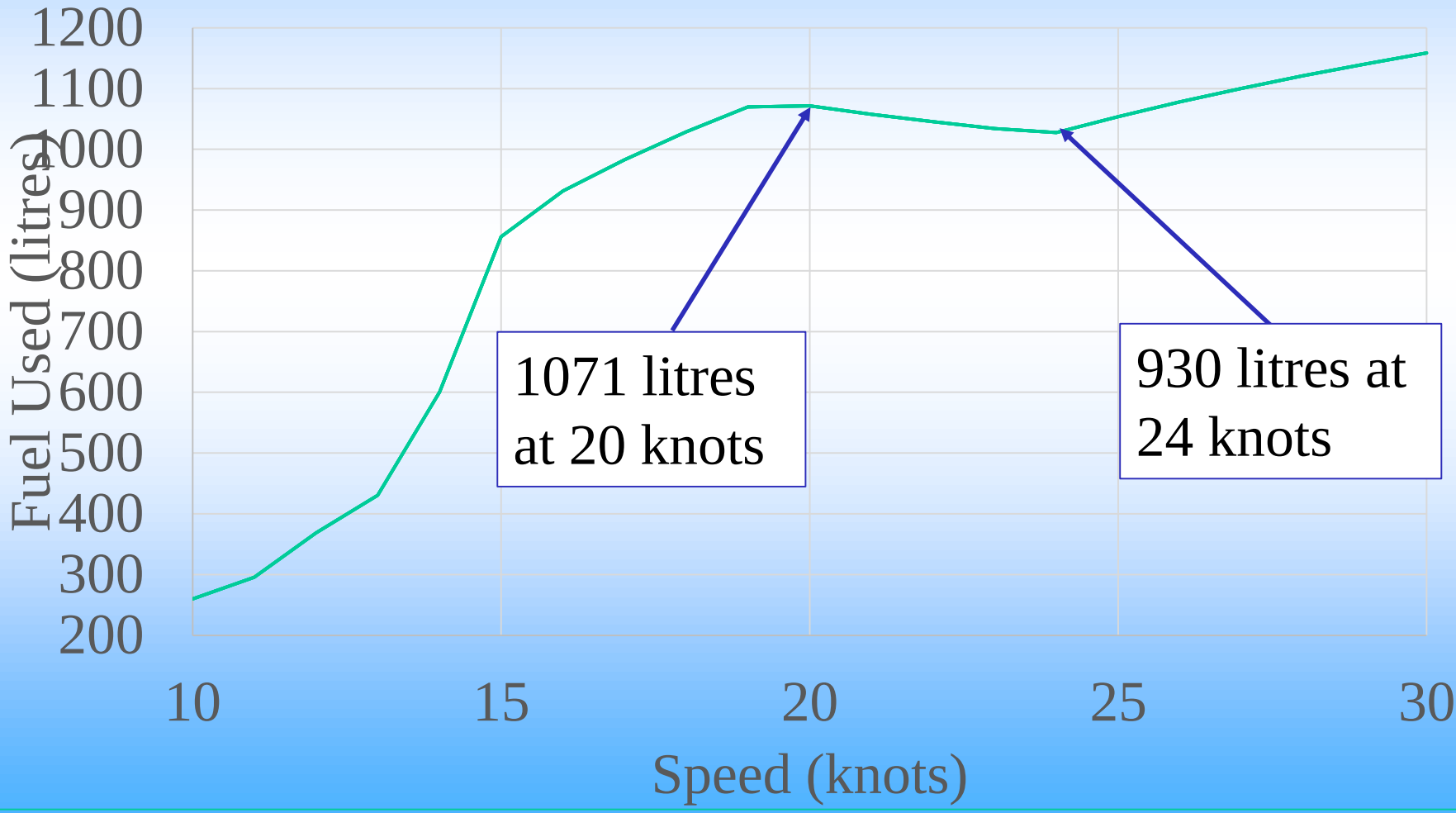
if the speed was reduced so that the journey takes an hour longer, about 150 litres of fuel would be saved.



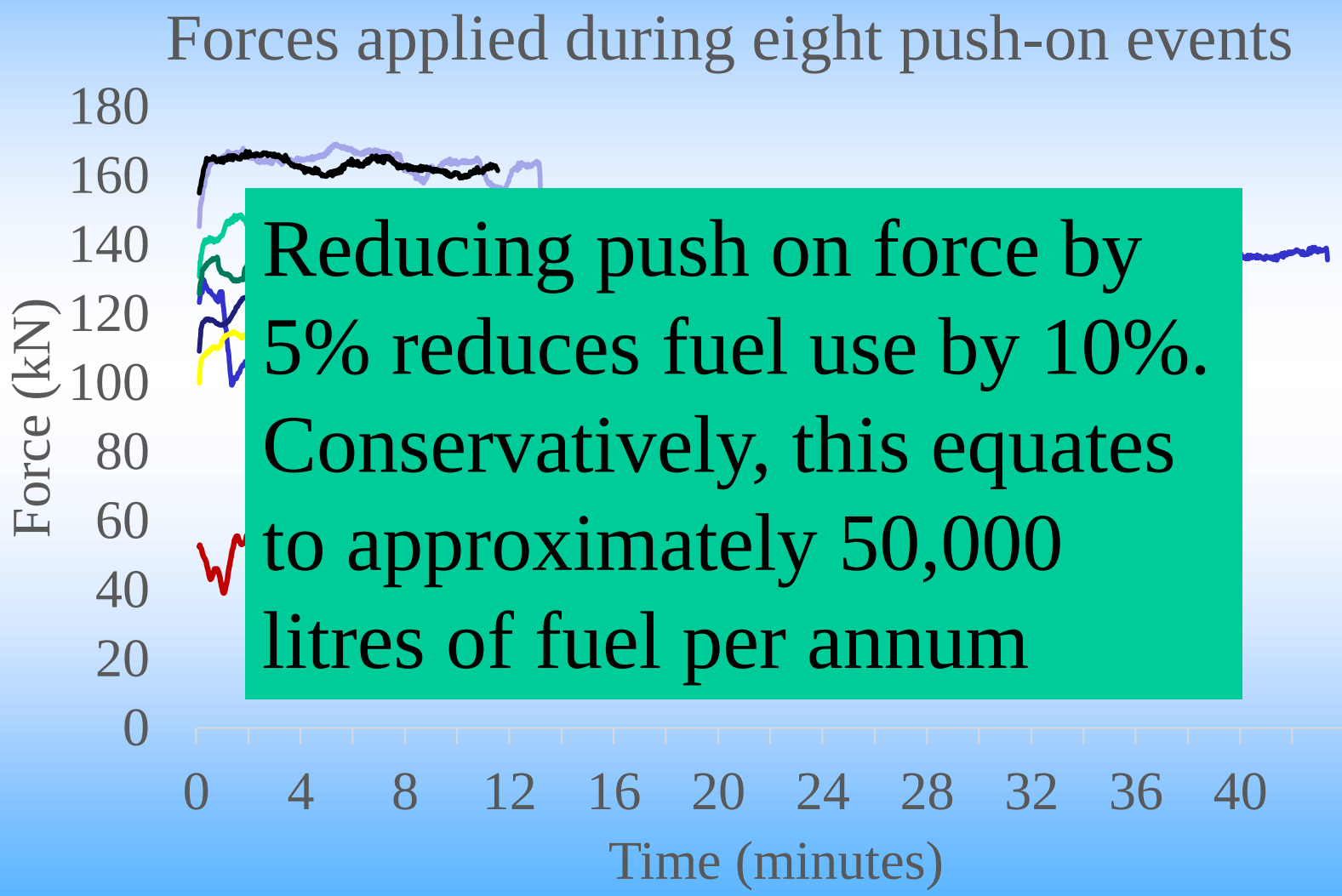
If this scenario happened in just 5% of journeys it could save 15,000 litres of fuel annually for 150 turbine wind farm.

The ability to better understand vessel performance

The vessel uses ***less*** fuel at 24 knots than at 20 knots



Safety and Fuel Usage with Push-on Events



"we want everything in one system, when we say everything in one it should also include a tablet solution to enable the technician to download their daily report"

" the industry is fairly young, people sort of gave you one system here and another system there, and another system there"

The Need for Integrated Data Storage and Visualisation

DEMO 2:

Journey planner with integrated weather data

"We need the tools to be able to make the decision as to whether the vessel sails or not"

" If a system could be monitoring all the time what's going on and flash up an alert that could be saying in our opinion you have two hours to get these guys out otherwise the wave height will be too high and they will be stranded on the turbine"

The Need for Integrated Data Storage and Decision Support

Weather and Decision Support

"We don't really use weather in a proactive manner"

" One of the biggest challenges is fighting the weather."

" It's weather days that impact most.”

"Weather is a challenge"

“[we would like] accurate weather forecasting, but that's not going to happen. Even today with the two models that we have, there is a 0.3 meters difference in the 2 models [of wave height].

" Weather days are an influence. But the biggest one is predicted weather being different to actual weather"

Better Decision Support

A 150 turbine windfarm loses as much as £10-£15 million annually due to unscheduled down time

"Our biggest … we have marg… is an opportur… to reduce cost…

…lost …the …ff for …s by

Should we sail or ca…

"We need the tools to be able to make the decision as to whether the vessel sails or not because the …are …ue, if you …re to fix …und and …adding

Increasing availability by 1 day per turbine per year would increase revenue of 150 turbine windfarm by about £500,000 per annum

To sail or not to sail?

Currently, the decision is not explicitly quantified in terms of cost.

Estimated cost of lost generation

Estimated cost of sailing

The huge amount of weather data is not quantitatively incorporated into the decision.

Use probabilistic forecasts

Implement cost based decision support tools that utilise all the data

Planning, Scheduling and Profiling

Big data will help with

- Understanding push-on forces
- Vessel profiling and reporting
- Vessel fouling
- Integrated planning and job scheduling
- Integrated weather forecasting

Recommendations

1. Collect more data from vessels to save fuel, reduce carbon and improve safety

2. Integrate data sources through a single software solution to help better visualise operations and make day to day operational decisions

3. Analyse data to help optimise medium and long term scheduling and planning