Case 1 – Digital Performance Monitoring For Island Ferries

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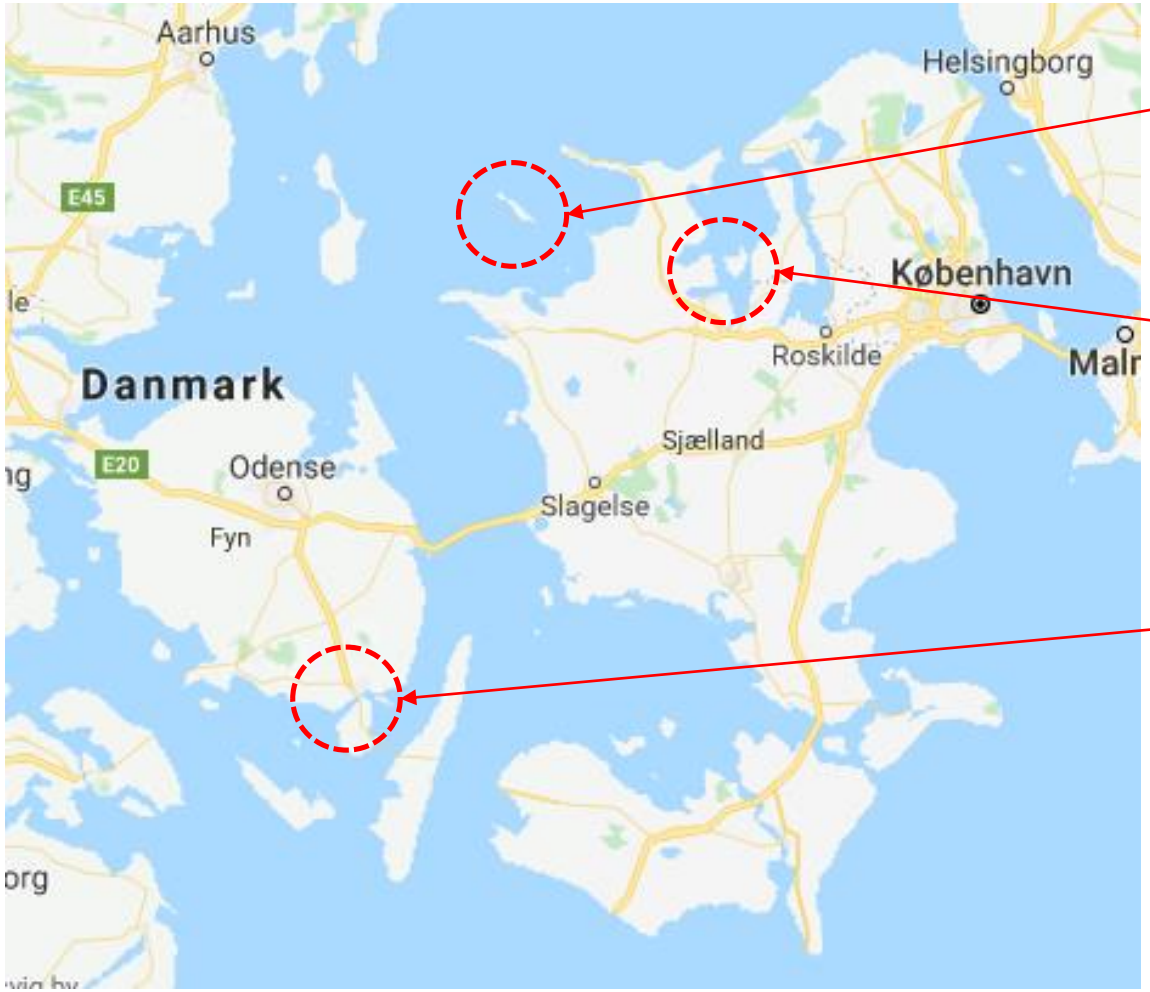
Three routes

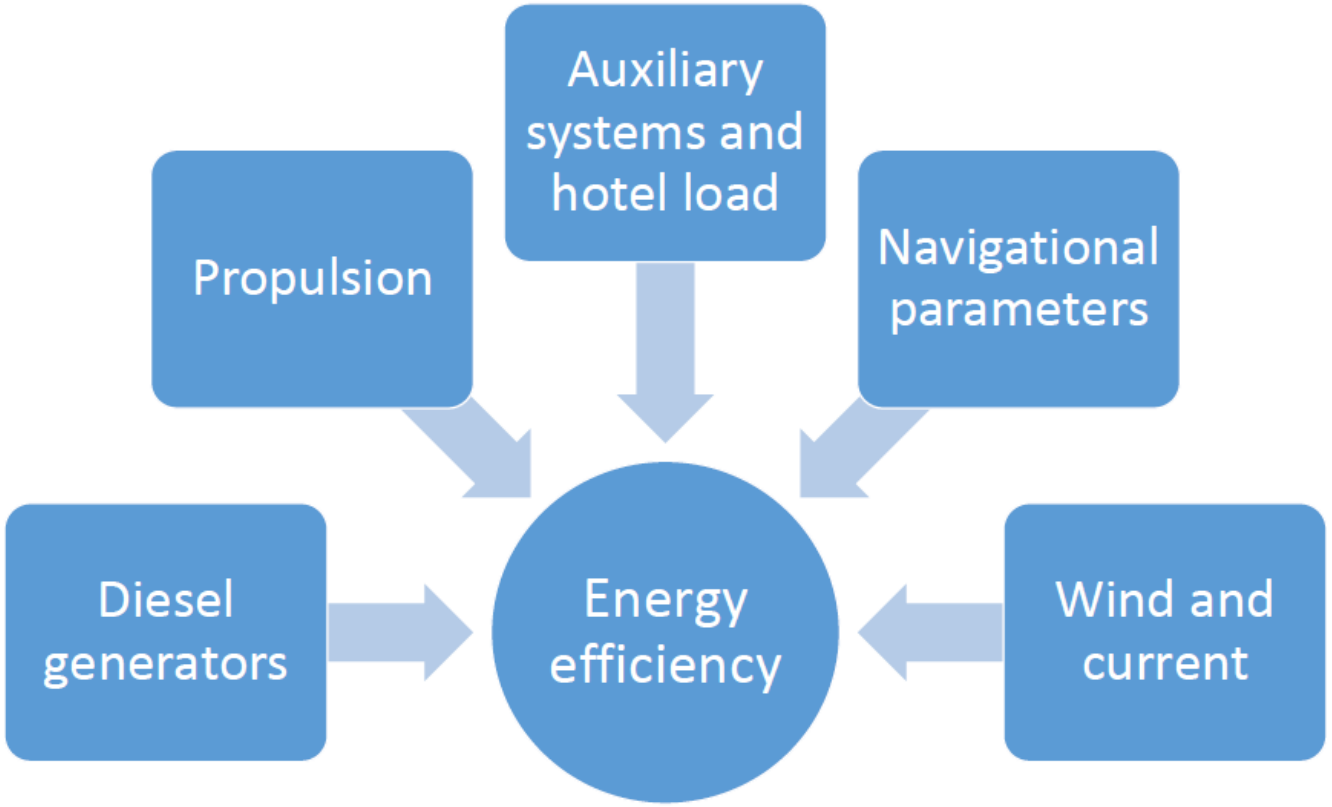


Sejerø
- Length 48.5 m
- Passengers 245 / Cars 36
- Voyage time 65 min.

Orø
- Length 41.9 m
- Passengers 98 / Cars 19
- Voyage time 25 minutes

Skarø - Drejø
- Length 35 m
- Passengers 98 / Cars 10
- Voyage time 30/45/35 min.

Data for estimating the energy efficiency on board vessels

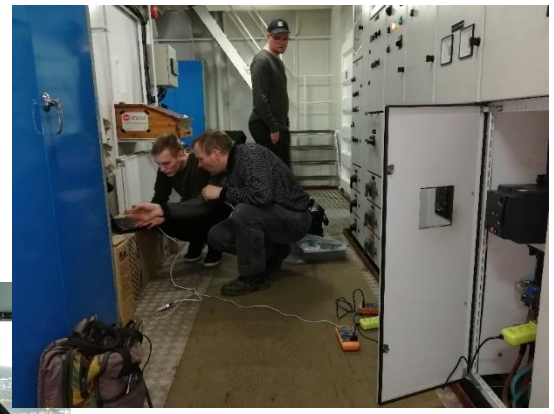


Data – Measured, Collected and Stored

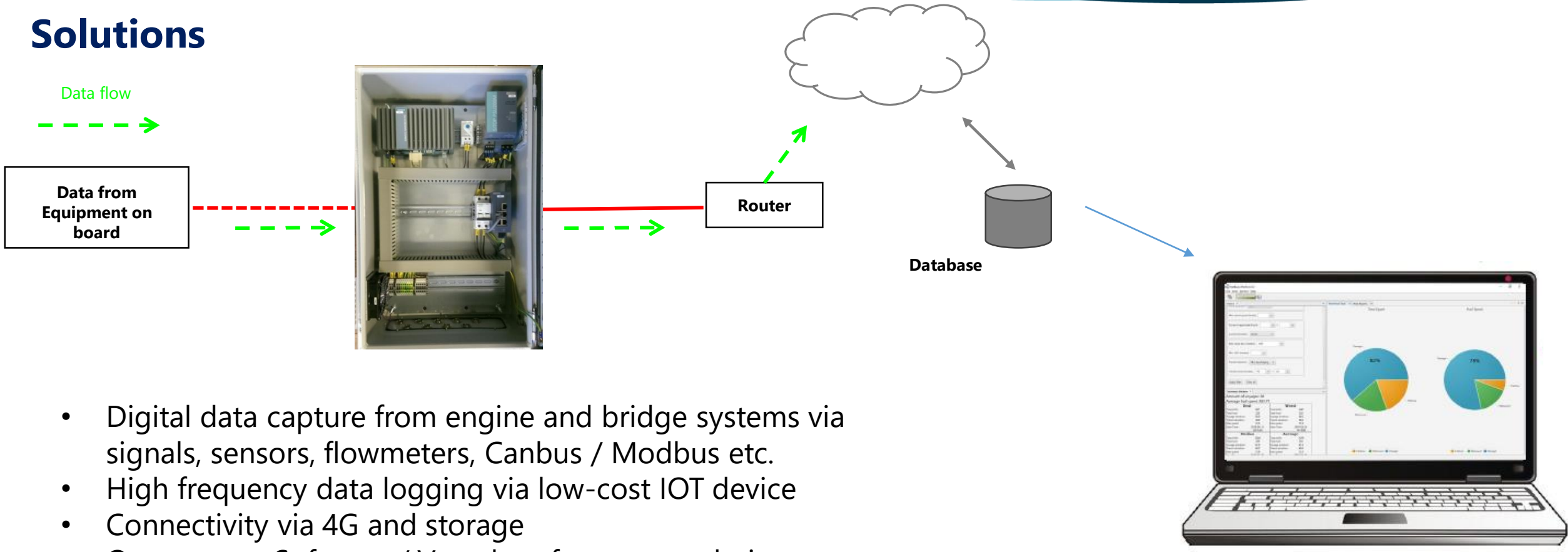
Data was not collected or stored on board the vessels

Data sniffer installation (Can bus sniffer)
Access to “black boxes”
Analog to digital data – Converter

Data is now measured collected, stored and send ashore



Solutions



- Digital data capture from engine and bridge systems via signals, sensors, flowmeters, Canbus / Modbus etc.
- High frequency data logging via low-cost IOT device
- Connectivity via 4G and storage
- Opensource Software / Vessel performance solution
- AI models enabling tactical / strategic decision support

Example

Drejø – Skarø (Højestene)

	Loggers installed
Power	Engine
RPM	Engine/ Display at bridge
Speed	GPS
Fuel consumption	Flow meter (installed)
Running hours	Engine
Depth	Depth sounder / Display at bridge
Position	GPS
Wind	Display at bridge

Current from fcoo.dk Forsvarets Center for Operativ Oceanografi

Data Series	Unit
Voyage color	
Current Direction	Degrees
Current Magnitude	Knots
DMI wind speed absolute interp…	m/s
DMI wind direction absolute inte…	Degrees
Port engine fuel	l/h
Starboard engine fuel	l/h
Port engine RPM	RPM
Starboard engine RPM	RPM
Heading (true)	Degrees
Course over ground	Knots
Speed over ground	knots
Wind speed absolute	m/s
Wind direction absolute	Degrees
GPS Longitude	DD
GPS Latitude	DD
Dept below transducer	Meter

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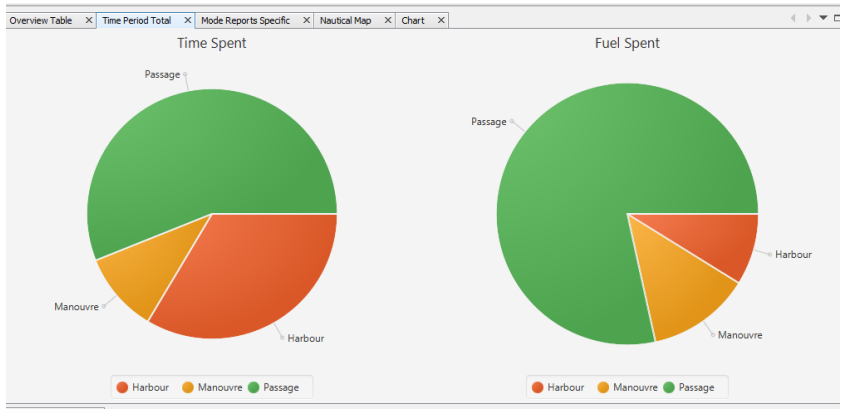
Example

Drejø – Skarø (Højestene)

Data available from Nov 2019 – Today (more than a year) - 5309 voyages

September 1-30, 2020 (246 voyages)
- Both direction / with and without Skarø



Amount of voyages: 246
Average fuel spent: 88,55

best		worst	
Total fuel:	44	Total fuel:	136
Voyage duration:	57.0	Voyage duration:	84.5
Voyage Direction:	Dr-Sv	Voyage Direction:	Sv-Sk-Dr
Max speed:	9,7	Max speed:	12,2
Start time (UTC):	2020-09-21 11:24:00	Start time (UTC):	2020-09-30 05:54:30

Example

Drejø – Skarø (Højestene)

Svendborg – Skarø – Drejø (112 voyages)

Amount of voyages: 112
Average fuel spent: 92,77

best		worst	
Total fuel:	62	Total fuel:	111
Voyage duration:	72.5	Voyage duration:	70.0
Voyage Direction:	Sv-Sk-Dr	Voyage Direction:	Sv-Sk-Dr
Max speed:	10,3	Max speed:	10,8
Start time (UTC):	2020-09-25 18:23:30	Start time (UTC):	2020-09-24 09:08:30

> 40% difference

Svendborg – Skarø – Drejø (11 voyages)
Wind: West – below 5 m/s – Current weak

Amount of voyages: 11
Average fuel spent: 87,54

best		worst	
Total fuel:	77	Total fuel:	106
Voyage duration:	69.0	Voyage duration:	66.5
Voyage Direction:	Sv-Sk-Dr	Voyage Direction:	Sv-Sk-Dr
Max speed:	10,8	Max speed:	11
Start time (UTC):	2020-09-20 12:53:30	Start time (UTC):	2020-09-16 05:39:30

Duration different

> 25% difference

Svendborg – Skarø – Drejø (11 voyages)
Wind: West – below 5 m/s – Current weak – same duration

best		worst	
Total fuel:	77	Total fuel:	94
Voyage duration:	69.0	Voyage duration:	69.5
Voyage Direction:	Sv-Sk-Dr	Voyage Direction:	Sv-Sk-Dr
Max speed:	10,8	Max speed:	10,8
Start time (UTC):	2020-09-20 12:53:30	Start time (UTC):	2020-09-03 05:40:00

> 18% difference

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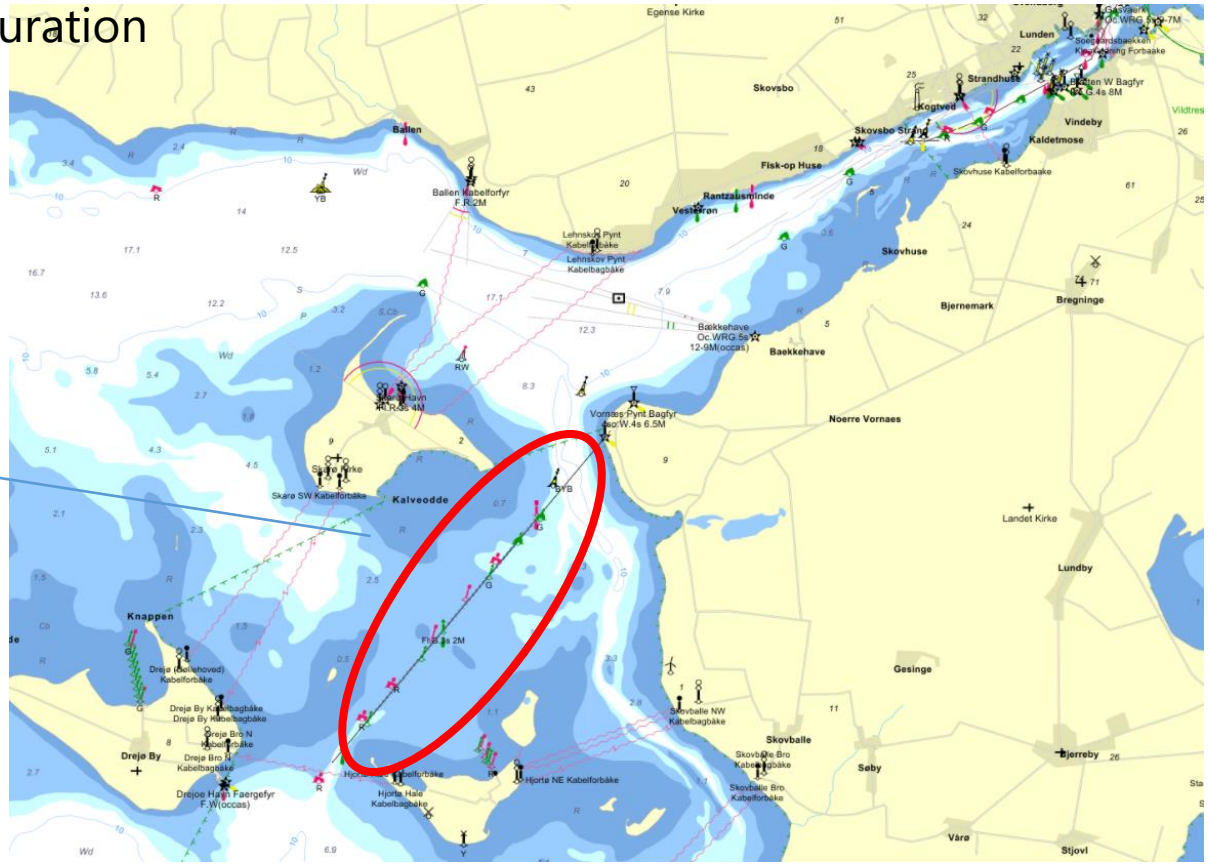
Shallow water

Svendborg – Skarø – Drejø (11 voyages)
Wind: West – below 5 m/s – Current weak – same duration

best		worst	
Total fuel:	77	Total fuel:	94
Voyage duration:	69.0	Voyage duration:	69.5
Voyage Direction:	Sv-Sk-Dr	Voyage Direction:	Sv-Sk-Dr
Max speed:	10,8	Max speed:	10,8
Start time (UTC):	2020-09-20 12:53:30	Start time (UTC):	2020-09-03 05:40:00



Example

Drejø – Skarø (Højestene)

Svendborg – Skarø – Drejø (11 voyages)
Wind: West – below 5 m/s – Current weak

Amount of voyages: 11
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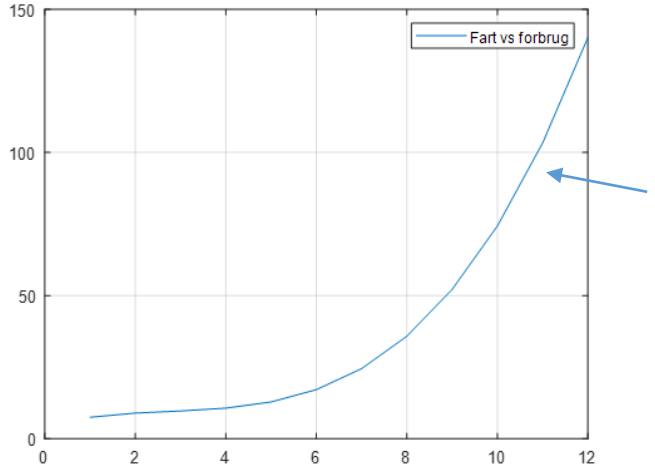
Voyage duration:	69.0	Voyage duration:	66.5
Voyage Direction:	Sv-Sk-Dr	Voyage Direction:	Sv-Sk-Dr
Max speed:	10,8	Max speed:	11
Start time (UTC):	2020-09-20 12:53:30	Start time (UTC):	2020-09-16 05:39:30

> 25% difference

A good idea to rethink the schedule – and give the vessel more time for the passages. Just a few minutes will reduce the energy consumption significantly.

Fuel consumption (speed)



Steep curve in operation area

Speed [knob]	Cons [ltr/time]	Speed [knob]	Cons [ltr/time]
2	8.9	7.5	29.6
2.5	9.3	8	35.8
3	9.7	8.5	43.3
3.5	10.1	9	52.1
4	10.7	9.5	62.4
4.5	11.5	10	74.3
5	12.8	10.5	87.9
5.5	14.7	11	103.4
6	17.1	11.5	120.8
6.5	20.4	12	140.2
7	24.5	12.5	161.8

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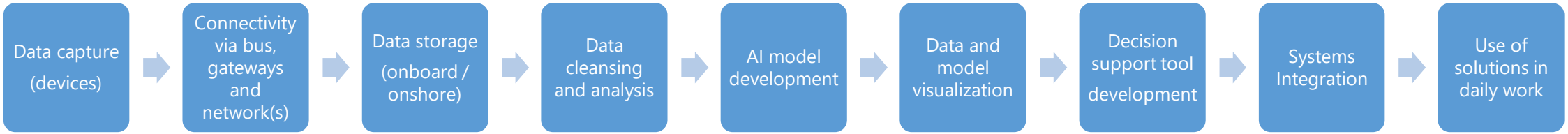
Conclusion and next steps

- Digitalization requires a significant effort across the end to end data value chain for ship operations



- Efforts are to continue and finalize as part of EXOPRODIGI:
  - Deliver cloud version of software for all 3 ferries
  - Training and skills building of ferry crew and route leaders
  - AI models and data analysis to enable sailing recommendations (for shallow water as example)
- Digital performance monitoring can enable Island Ferry routes to gain at least 10-20% reductions of fuel consumption and emissions per ship in the coming years

Thank You!

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