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"Digital solutions for ship operations and logistics processes as an enabler of ECO-Efficiency"

European Green Deal Seminar
13th November 2020

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Agenda

1. The ECOPRODIGI Methodology for digitalisation and evaluation of Eco-efficiency (5 min)

2. The ECOPRODIGI Shipping Cases

   - ✓ Digital performance Monitoring
     - ✓ Island Ferries (4 min)
     - ✓ Lauritzen (4 min)
     - ✓ Ardea Shipping (2 min)

   - ✓ Digital and Optimized Cargo Stowage
     - ✓ DFDS (15 min)

3. Results and learnings so far (5 min)

4. Next steps (2 min)

5. Q&A (3 min)

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The ECOPRODIGI Methodology for Digitalisation & Sustainability

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The Business Improvement Cycle

Common approach across 2 industry / technology cases:

1. Digital Performance Monitoring and Fuel Efficiency of Ships

2. Digital and Energy Efficient Cargo Stowage of RoRo Ships

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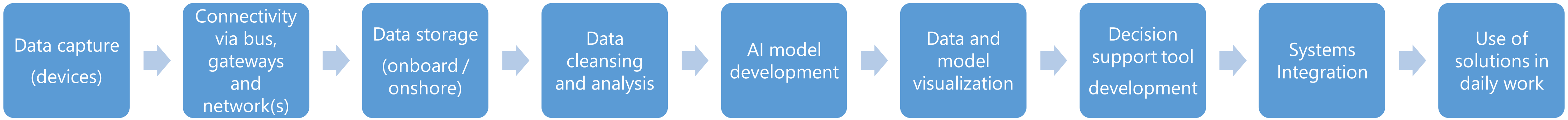
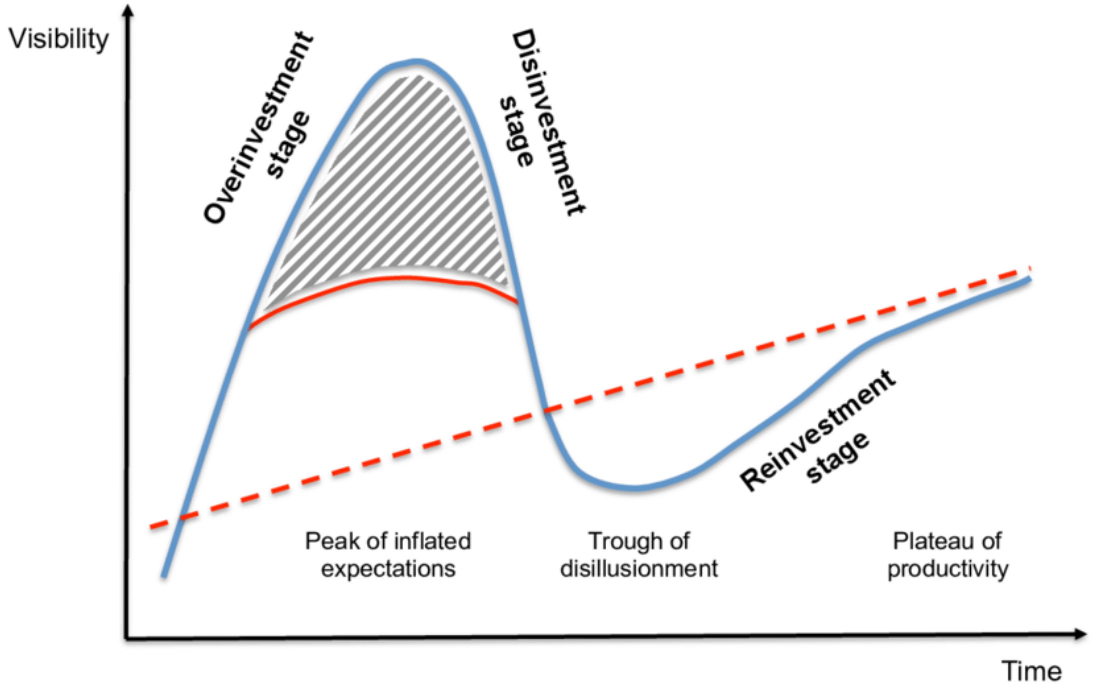
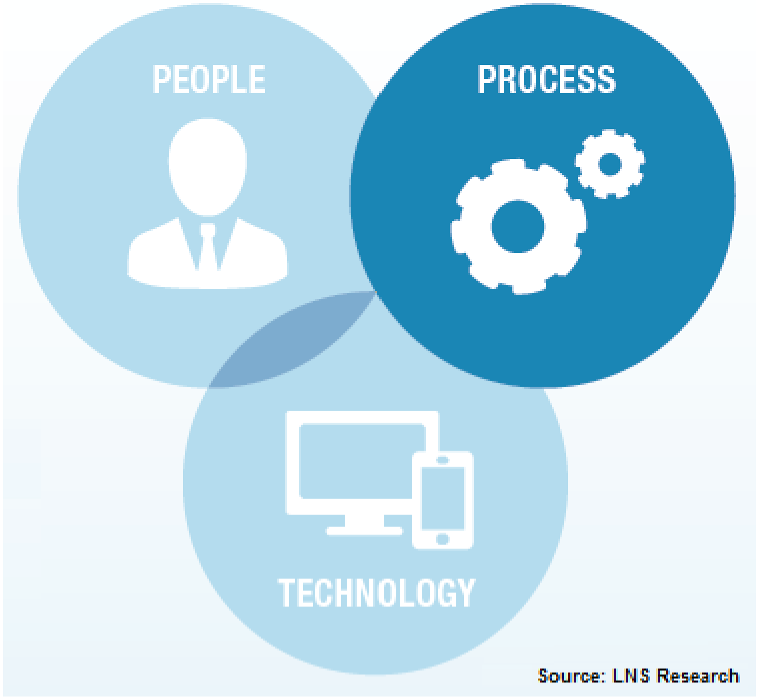
The (long) Digitalization journey towards results



When and how to invest in digitalization ?





Evaluating Sustainability outcomes

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Targeted Eco-efficiency benefits

ECO-Efficiency benefits	Port	Ship	Customer
Fuel consumption	++	+++	+
Asset utilization and uptime	++	+	+
Ressource and time waste	++	++	+
GHG Emissions	++	+++	+
Ballast water consumption	-	+	-
Safety	+	+	-

Targets have been set per case based on:

- Business model (public vs private)
- Strategic priorities and competition
- Current or upcoming Regulation
- Baseline performance
- Investment budget and time horizon
- Revenue impact is out of scope

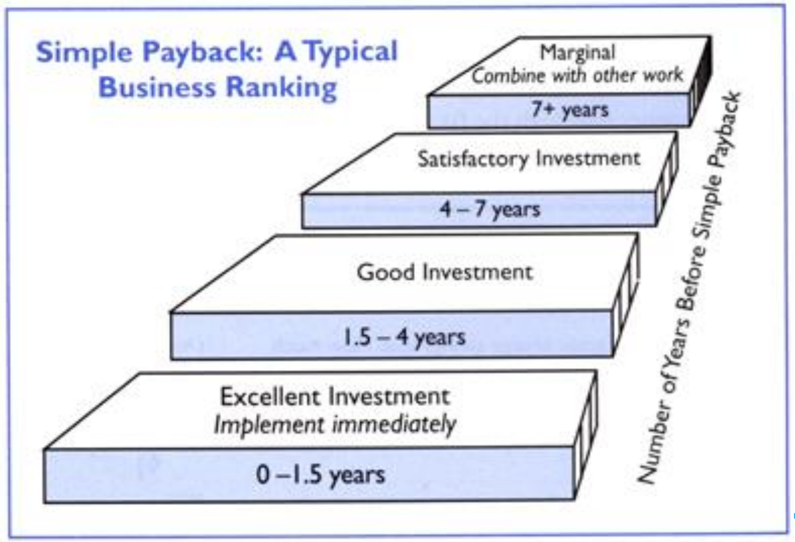
Method for benefit tracking

- Scope typically limited to selected ships / routes / ports / voyages
- Studies done for As-Is & To-Be processes
- KPIs set and performance reporting required to track benefits
- Methods used for validation are simulation and pilot testing

Estimating Digitalization Costs and ROI

Digitalization cost drivers
Sensors, Cameras, Drones etc.
Connectivity
Storage onboard
Storage onshore (cloud solutions)
Software (licenses / subscriptions)
Equipment Installation
Software Development
Data Cleansing, Analysis and Modeling
Systems Integration
Use cases, User interface, Visualizations
Cyber Security setup and validation
Handover and training
Project management / Scrum and documentation
Travels, accomodation etc.

$$\text{Payback Period Formula} = \frac{\text{Initial Investment OR Original Cost of the Asset}}{\text{Cash Inflows}}$$



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The 4 Shipping Cases

Involved Partners

Færge Sekretariatet

J. LAURITZEN

ARDEA SHIPPING

DFDS

AALBORG UNIVERSITY DENMARK

UNIVERSITY OF SOUTHERN DENMARK

CHALMERS UNIVERSITY OF TECHNOLOGY

USN University of South-Eastern Norway

RISE Research Institutes of Sweden

Vessel Performance Solutions™

KOCKUMATION GROUP

Kockum Sonics POLARMARINE Texon MARINE ALIGNMENT

Danish Maritime

LOGIMATIC integrating knowledge and technology

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Digital Performance Monitoring

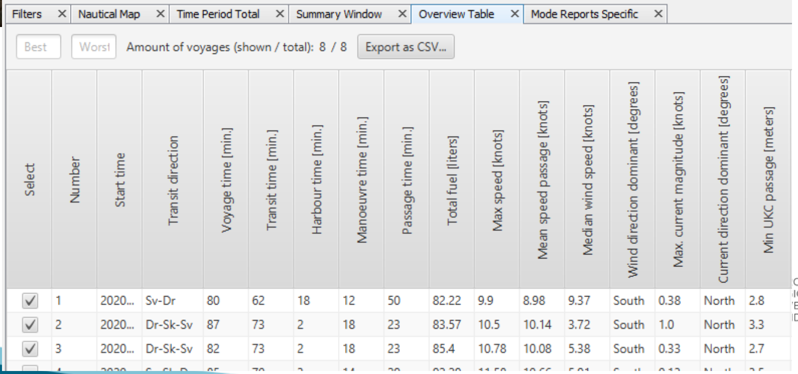
Case 1a: Digital Performance Monitoring (Island Ferries)

Aim and Scope

- Reduce fuel consumption and emissions 5-20% via data driven and optimized vessel operations
- Digital solutions tested on 3 routes / ships
- Sea trials (2018) and pilot testing (2020) have validated benefits

Implemented 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
- Use of AIS, current and weather (hindcast) data
- Connectivity via 4G and storage in Azure Cloud
- Open Source BI / Vessel performance solution
- AI models enabling real time monitoring and decision support
- Training and skill building of crew and technical staff



Select	Number	Start time	Transit direction	Voyage time [min.]	Transit time [min.]	Harbour time [min.]	Manoeuvre time [min.]	Passage time [min.]	Total fuel [liters]	Max speed [knots]	Mean speed passage [knots]	Median wind speed [knots]	Wind direction dominant [degrees]	Max. current magnitude [knots]	Current direction dominant [degrees]	Min UKC passage [meters]
✓	1	2020...	Sv-Dr	80	62	18	12	50	82.22	9.9	8.98	9.37	South	0.38	North	2.8
✓	2	2020...	Dr-Sk-Sv	87	73	2	18	23	83.57	10.5	10.14	3.72	South	1.0	North	3.3
✓	3	2020...	Dr-Sk-Sv	82	73	2	18	23	85.4	10.78	10.08	5.38	South	0.33	North	2.7

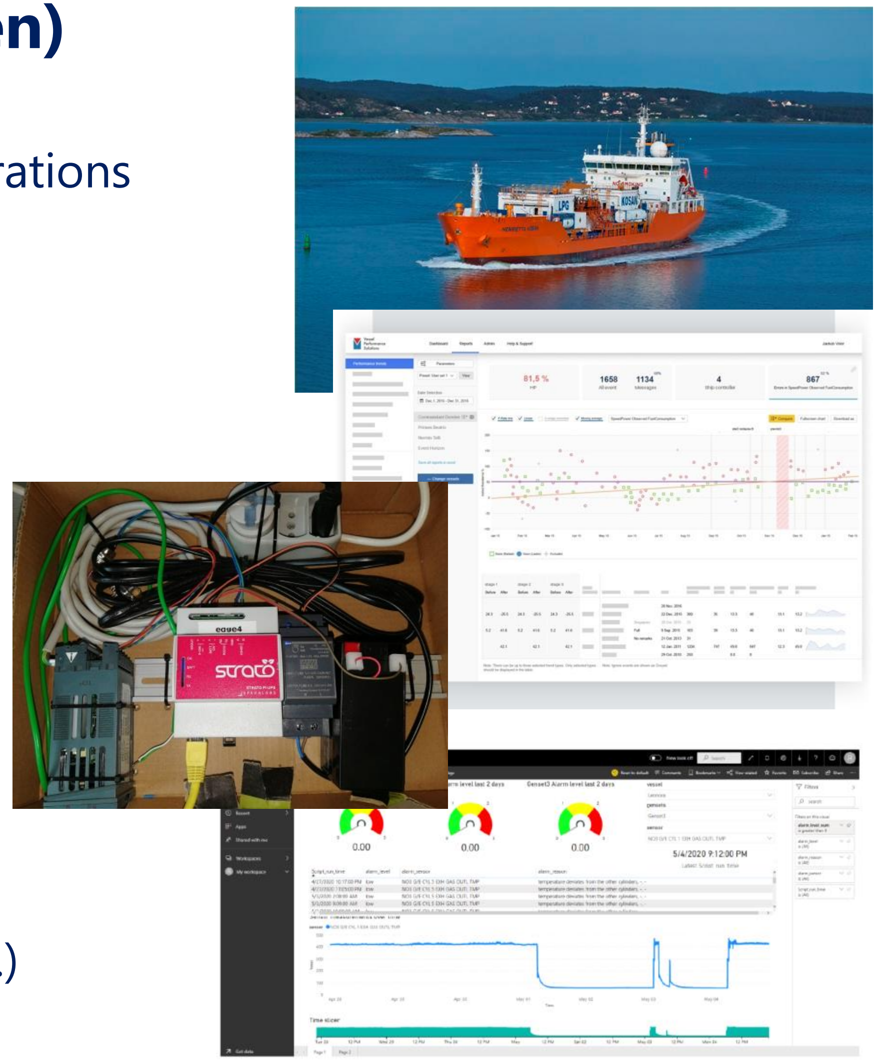
Case 1b: Digital Performance Monitoring (Lauritzen)

Aim and Scope

- Reduce fuel consumption and emissions 2-7% via data driven operations and optimized maintenance of hull, propeller and engines
- Prevent costly and mission critical engine break downs and repairs
- Digital solutions tested on 3+ gas carriers
- Pilot testing (2019+) has validated benefits

Implemented Solutions

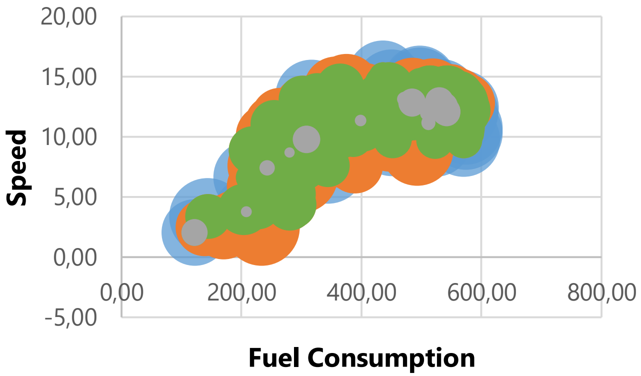
- Digital data capture from engine and bridge systems via sensors, flowmeters, Canbus / Modbus etc.
- High frequency data logging via low cost IOT device
- Use of AIS and weather (hindcast) data
- Connectivity via 4G / Satellite and storage in Azure cloud
- AI models enabling real time monitoring and decision support
- Performance visualizations / reports to users onboard / onshore
- Systems integration with existing applications (Vesper, PowerBI etc.)
- Training and skill building of crew and technical staff



Case 1c: Digital Performance Monitoring (Ardea Shipping)

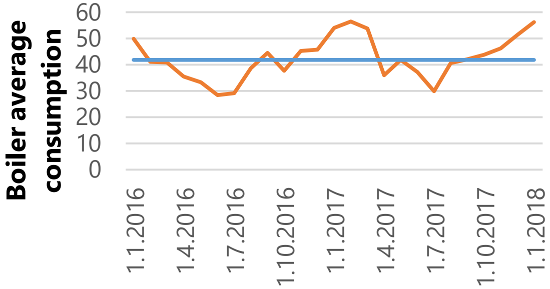
Aim and Scope

- Fuel consumption and emissions to be reduced 5-10% due to data driven and optimized ship operations and maintenance
- Test scope: 1 Bitumen tanker vessels
- Simulations and sea trials (2020) have validated benefits



Developed and Implemented Solutions

- Extraction of data captured via Blue Flow performance monitoring system
- AI models for optimizing trim and intake of ballast water
- System improvement recommendations
- Training and skill building of crew and technical staff



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Digital and Optimized Cargo Stowage

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Case 2: Digital & Optimized Cargo Stowage (DFDS)

Aim and Scope

- Reduce fuel consumption and emissions 2-10% per ship / route + 2-10% efficiency and emission gain at terminals via digital and optimized cargo cargo stowage processes
- Less waiting time and service benefits for RoRo clients
- Baseline analysis: 3 routes, 4+ ships
- Test scope: 1 route / ship
- Simulation runs (2019) have validated benefits
- Further pilot testing and validation planned from 2021+

DFDS NETWORK

8.000 employees
8.000 trailers
60 vessels
8 terminals (36)

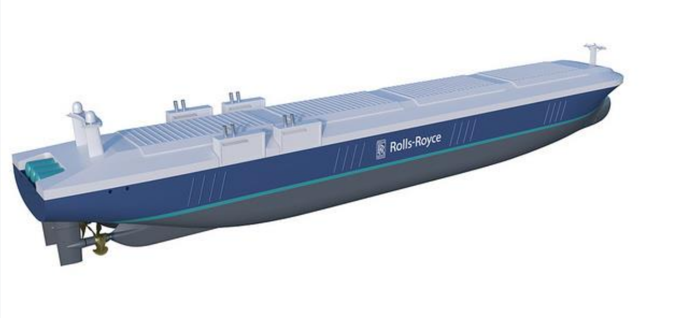
2020

DFDS

Strategy, focus areas

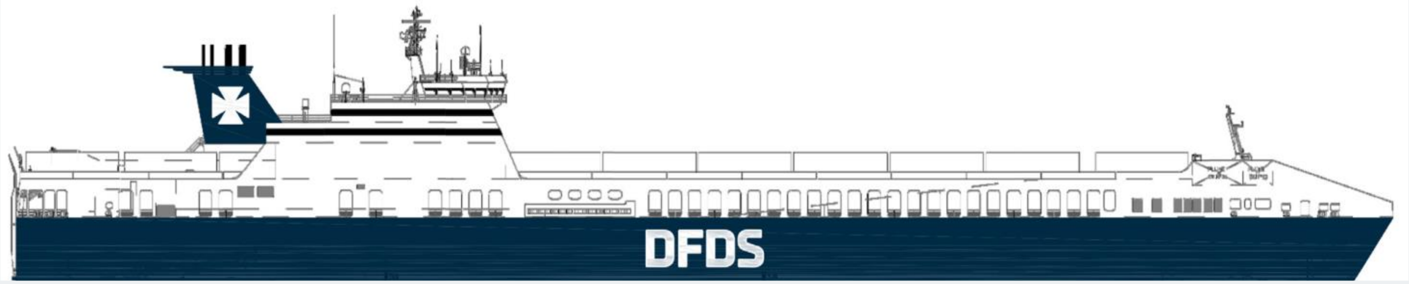
To stay relevant we need to develop and grow with our customers.

- Energy 2.0
- Automation / autonomous



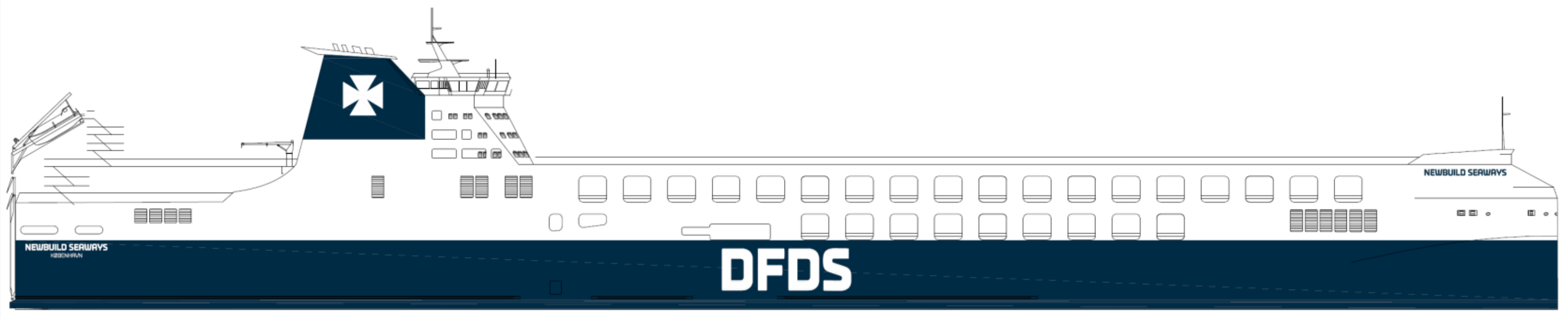
Newbuildings

- GARDENIA & TULIPA SEAWAYS (4,100 lm Ro-Ro) from Flensburg delivered in 2017



- 210 x 26 m
- 4 cargo decks
- 262 trailers
- 21.3 kn.
- 19,200 kW

- 6 x 6,700 lm Ro-Ro from Jinling (China) entering into service in 2019-2020



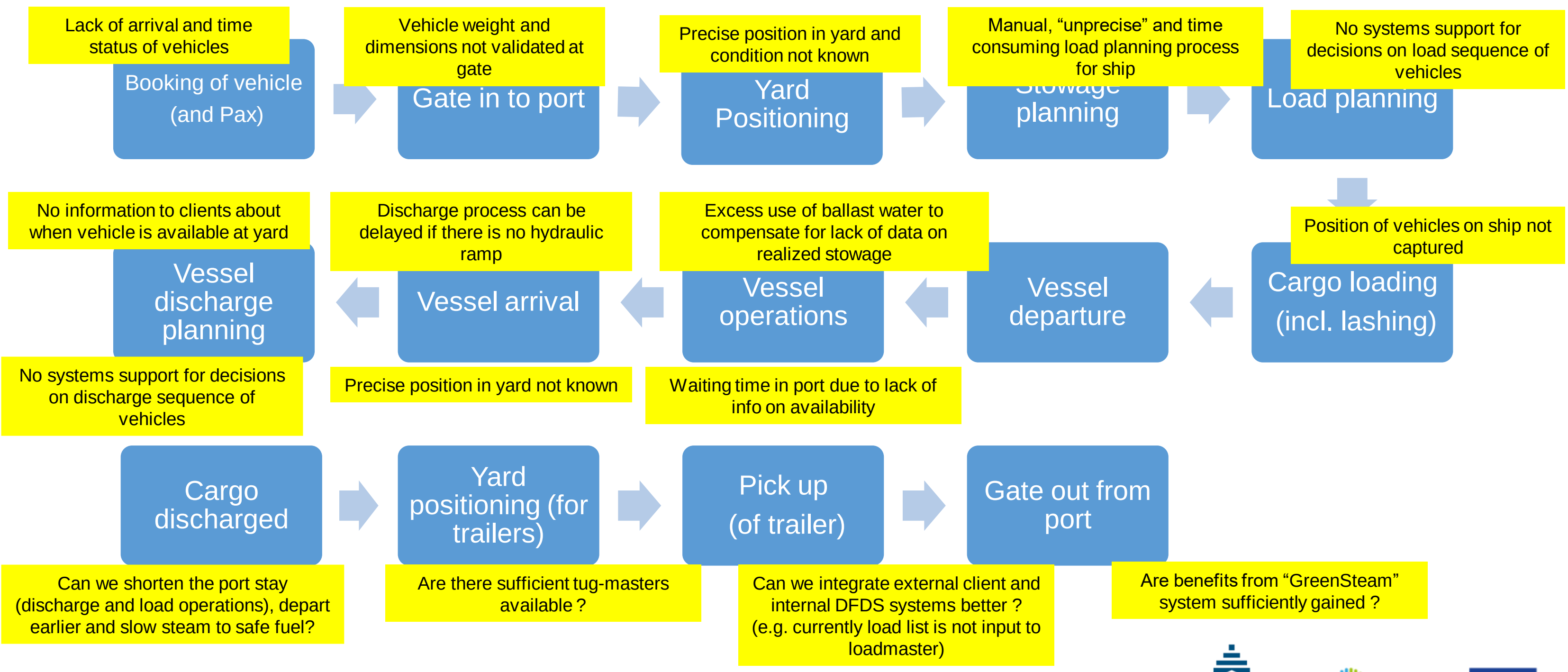
- 235 x 33 m
- 5 cargo decks
- 450 trailers
- 21.0 kn.
- 23,600 kW

Case 2: Digital & Optimized Cargo Stowage (DFDS)

Current state of End2end Cargo stowage

Case 2: Optimising Cargo Stowage

The Process - quality concerns / inefficiencies



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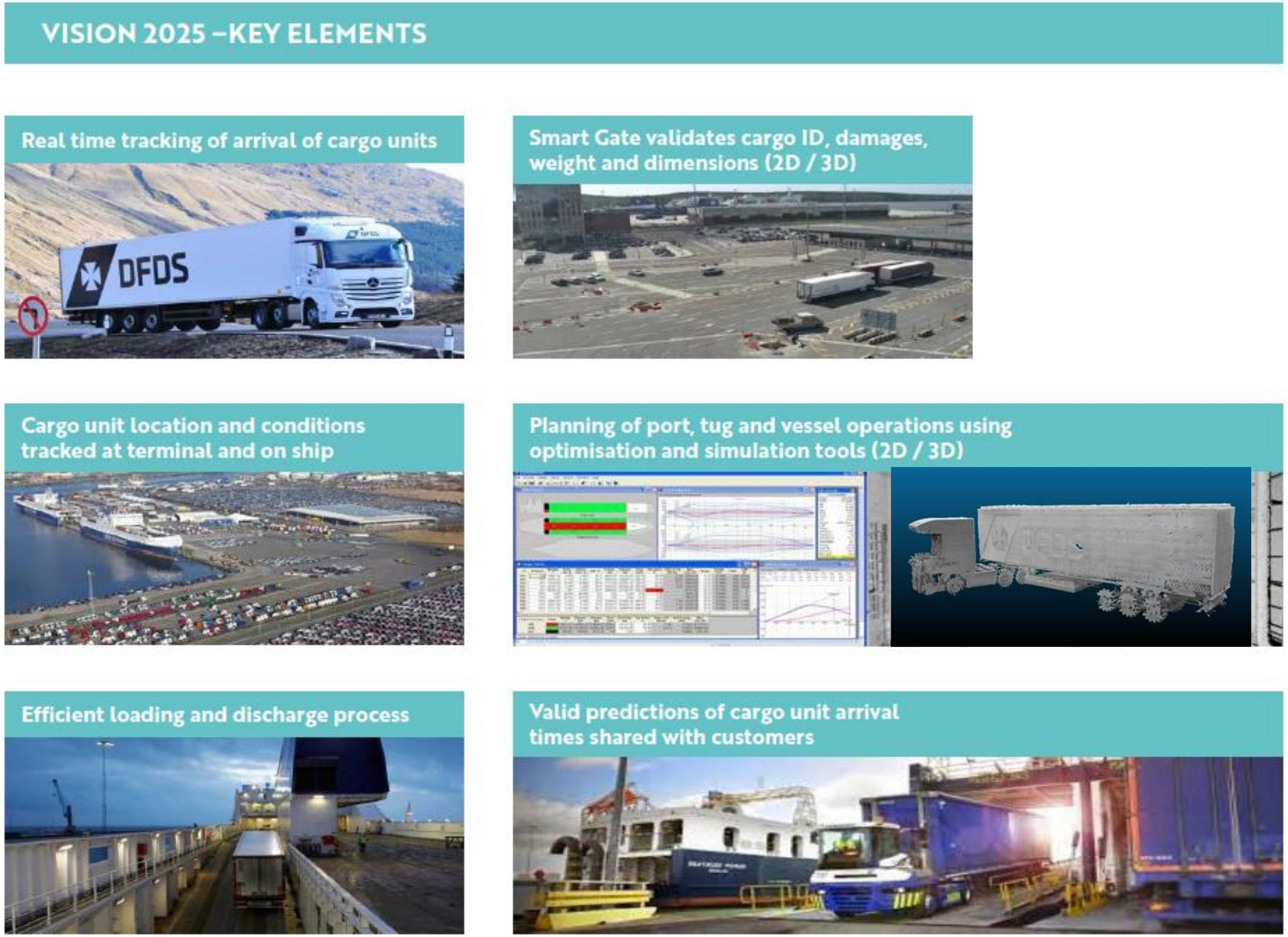
Case 2: Digital & Optimized Cargo Stowage (DFDS)



Draft of vision 2025

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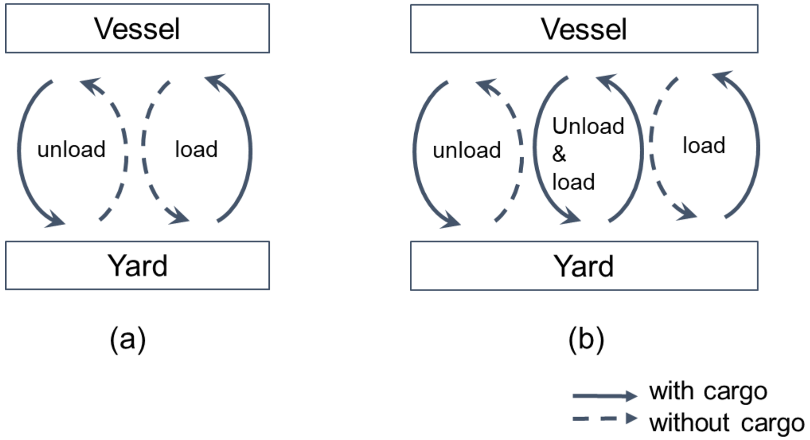
Dual Cycling Optimization



A simple example of single cycling vs dual cycling

		7	13	19	25	31	37	43	49
	3	8	14	20	26	32	38	44	50
1	4	9	15	21	27	33	39	45	51
2	5	10	16	22	28	34	40	46	52
	6	11	17	23	29	35	41	47	53
		12	18	24	30	36	42	48	54

An example of a deck with 54 trailer slots, fully loaded.
All jobs are unit length and operated by 2 tugs

Single cycling : 54+54 = 108

Dual cycling : 64

Time saved 108-64 = 44

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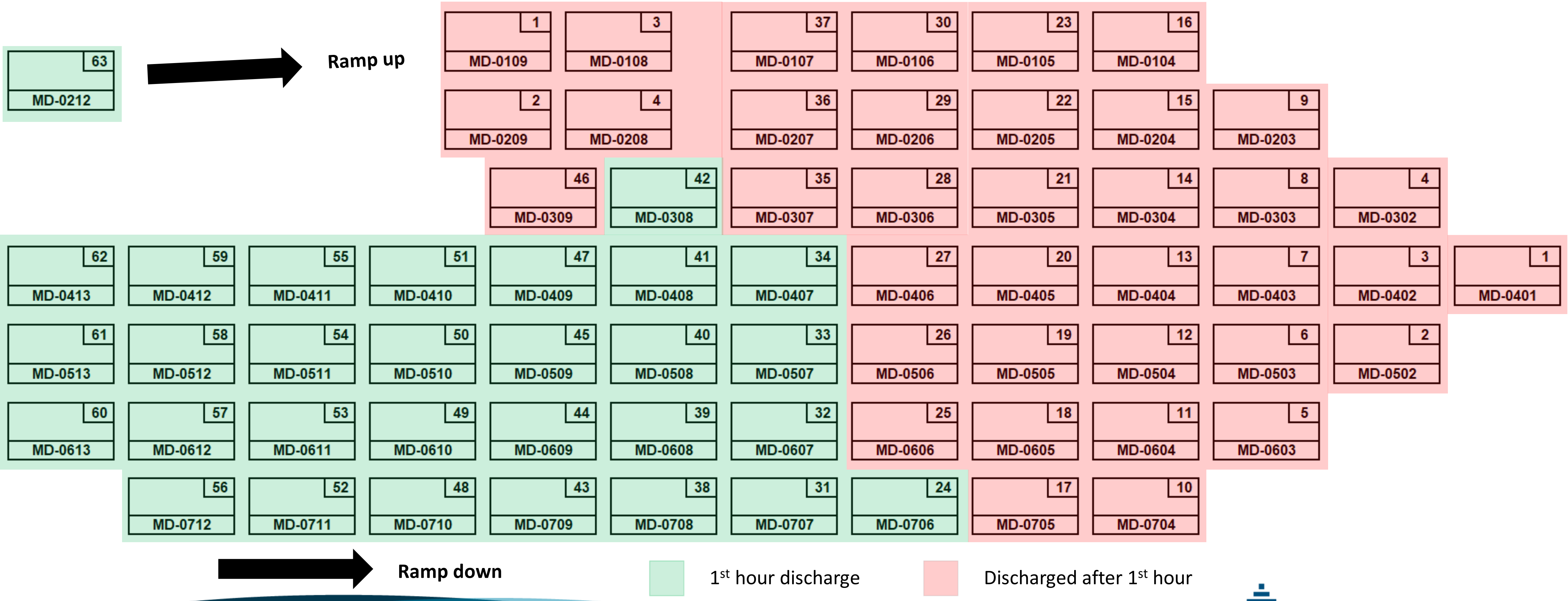
Case 2: Digital & Optimized Cargo Stowage (DFDS)

Forecasting discharge times



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Case 2: Digital & Optimized Cargo Stowage (DFDS)

Developed and Implemented Solutions

- Digital data capture for cargo units (dimensions, weight, positions, damage) at terminals / onboard ship via cameras, drones, track units etc.
- Connectivity via LORA / 4G etc. and storage in DFDS Cloud
- 2D / 3D scans and data models for cargo units and vessel (digital twin)
- Prediction models for cargo uptake per voyage
- Systems and data integration across different DFDS applications (Sertica, Phenix, Loadmaster, GTMS etc.)
- Algorithms for stowage optimization with the purpose of reducing ballast water onboard
- Algorithms for dual cycling able to optimize discharge and loading operations
- 2D / 3D simulation models able to validate alternative yard / ship layouts and discharge / loading tactics on emissions
- Training and skill building of HQ, terminal staff and onboard crew via simulation / game based training methods

Cross case results and learnings so far

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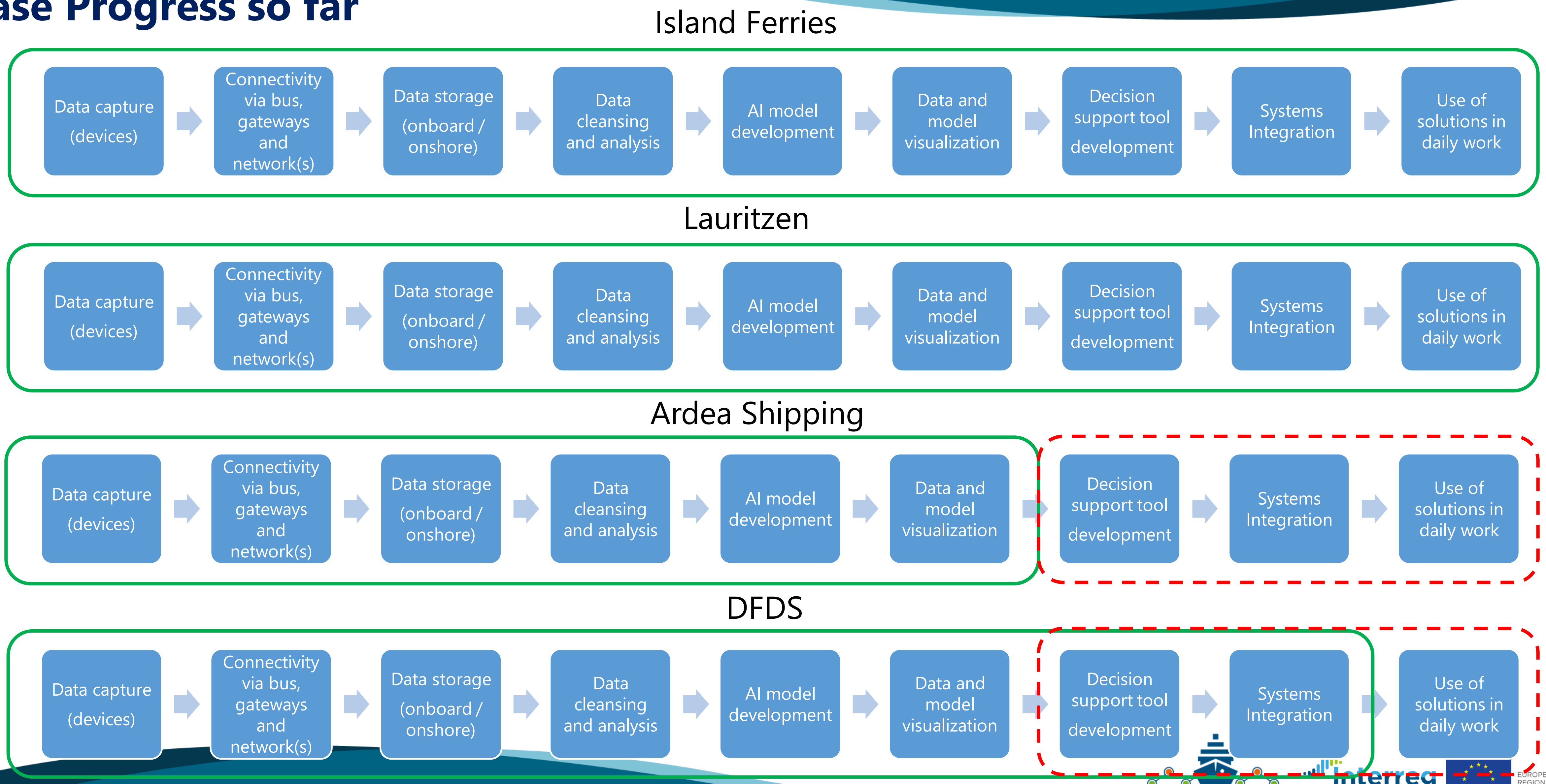
Case Progress so far



Expected ECO-efficiency outcomes

Island Ferry ECO-Efficiency outcomes	Port	Ship	Customer
Fuel consumption	-	+++	-
Asset utilization and uptime	-	+	-
Resouce and Time waste	+	+	+
GHG Emissions	-	+++	-
Ballast water consumption	-	+	-
Safety	-	+	-

DFDS ECO-Efficiency outcomes	Port	Ship	Customer
Fuel consumption	+++	+++	+
Asset utilization and uptime	+++	+	+
Ressource and Time waste	++	++	++
GHG Emissions	+++	+++	+
Ballast water consumption	-	+++	-
Safety	+	+	-

Lauritzen ECO-Efficiency outcomes	Port	Ship	Customer
Fuel consumption	-	+++	++
Asset utilization and uptime	-	++	++
Ressource and Time waste	-	++	-
GHG Emissions	-	++	++
Ballast water consumption	[illegible]	[illegible]	[illegible]
Safety	[illegible]	+	[illegible]

Ardea ECO-Efficiency outcomes	Port	Ship	Customer
Fuel consumption	-	++	++
Asset utilization and uptime	-	+	-
Ressource and Time waste	-	++	-
GHG Emissions	-	++	++
Ballast water consumption	-	+++	-
Safety	-	-	-

Estimate of impact is in progress for CO^2, NO^x, So^x (Tons) etc. reductions to be achieved

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Expected ROI

- ECOPRODIGI is 95% towards completion
- Simulation / Sea Trial / Pilot results indicate visible potential of digital technologies for eco-efficiency gains
- Benefits of 5-20% regarding fuel consumption, material consumption, asset utilization, operational expenses and emissions can be gained per ship / route / port / voyage in the longer term
- ROI / Break even time is 1-5 years for developed and implemented digital solutions
- ROI will depend on energy / fuel price (we assume average 2018-2020 prices for HFO, LFO, MGO etc.)
- ROI improve significantly when solutions are rolled out / commercialized to more ships / ports and companies
- The DFDS case appears to have longest break even time due to scale, complexity and interdependence of digital solution elements - the DFDS case is however expected to have a strong financial upside and positive ROI post 2022

Lessons learned from the digitalization and sustainability journey

- ECOPRODIGI will deliver environmental benefits to Baltic Sea citizens and also provide a stronger competitive positioning of EU Sea ship operators and technology vendors / yards in the global market place

- Digitalization requires a significant investment and longer journey than typically expected - however efforts still pay back to environment and owners / investors in a short time (1-5 years), and there are still more gains to be achieved - why not speed up the effort ?

- A long term strategy tailored to business needs combined with a step-by-step implementation approach, commitment and effort from key stakeholders as well as strong partnerships with technology vendors and (funded) researchers is critical for obtaining desired EU results

- Training and skill building is essential for implementation success - the industry can benefit from low cost scalable methods based on experiental learning methods

- (Global) digital standards for ship operations and maritime logistics will improve ROI for efforts significantly in the future

- Data, Metrics and Sustainability incentives (positive, negative) are critical to sustain improvements in the long term

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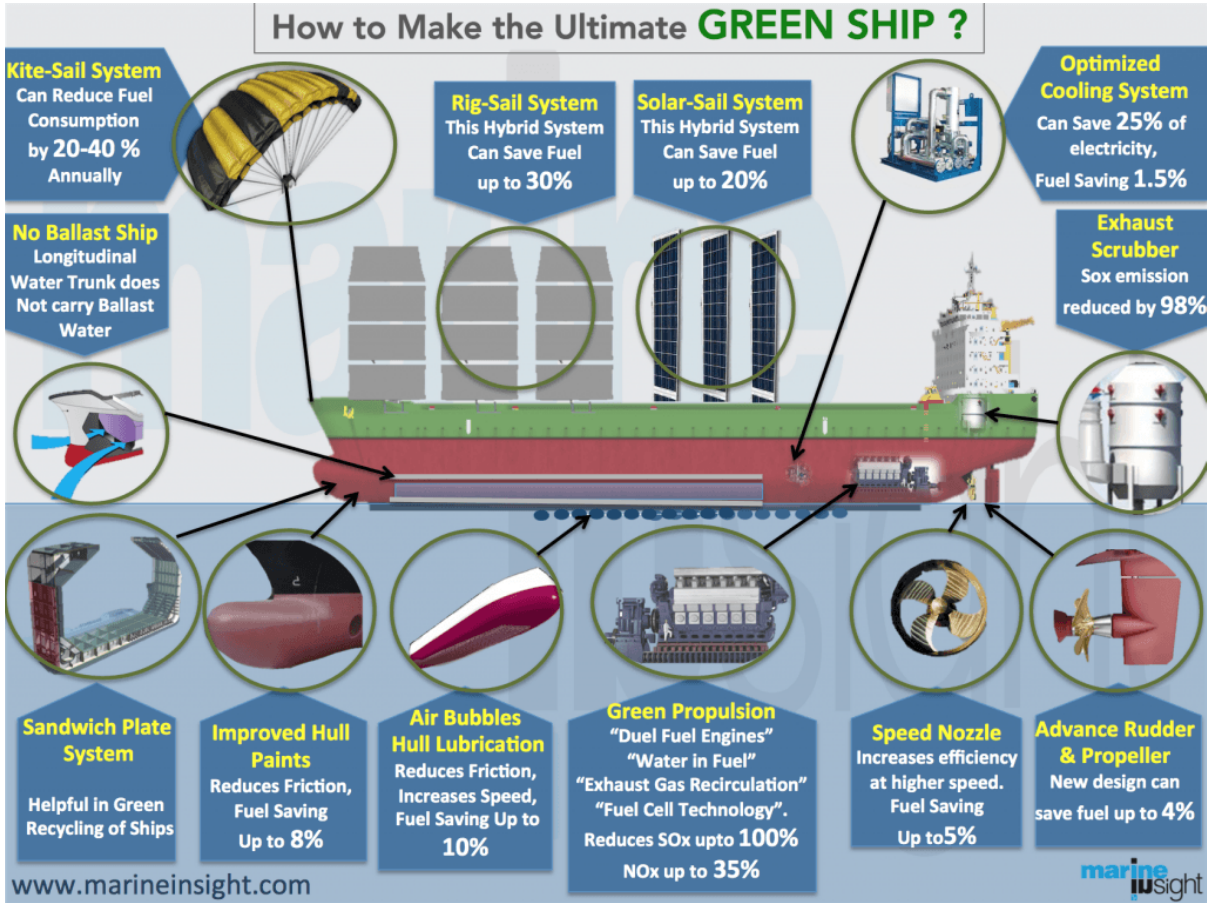
How to reduce ship GHG emissions in the future ?

Digitalization can not stand alone – but is one of many required innovations to meet future EU / IMO GHG targets for 2030 and 2050

Digitalization is particularly interesting for the next decade as industry can gain efficiencies and deliver cost and emission reductions while new radical vessel designs, propulsion technologies and fuel innovations are in the making…



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Next steps

Next steps

- Finalize and disseminate ECOPRODIGI results online and in reports / publications to a wider EU community
- Execute potential additional EXOPRODIGI activities in 2021
- Hand over of solutions to companies and vendors
- Progress efforts in ongoing or upcoming future projects via national and EU funding

Q&A

References

https://ecoprodigi.eu/

https://cshipp.eu/

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Thank You!

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Appendix