INSIGHT BRIEF

Enablers and challenges to operational efficiency pilots

Global Maritime Forum Short Term Actions Taskforce

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Table of contents

How can learnings from pilot voyages provide new learnings about operational efficiency and a better understanding of the barriers to uptake and hope to overcome them?

This paper explores this question as part of a series that examines the undervalued opportunity presented by operational efficiencies to reduce shipping emissions in the short term and pave the way for long-term decarbonisation solutions. The learnings presented here have emerged from a series of meetings and workshops gathering perspectives from experts across the maritime value chain—shipowners, operators, charterers, ports, and NGOs—as part of the Short Term Actions Taskforce. Other papers in the series provide an overview of the issue, and dive deeper into the identified solutions and enablers: the role of data, legal and contractual changes.

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1. Role of pilots

While it is known that the decision-making processes for ship operations are complex,[1] there remain large gaps in understanding of the importance of agency for energy efficiency. Running pilots can help the shipping industry to learn firsthand about the various frictions and obstacles that must be removed to capture the speed optimisation[2] and operational efficiency opportunities.

Currently, the industry faces challenges to get beyond isolated examples of speed optimisation to scale up from isolated pilots to fleet-level changes. For speed optimisation, collective action requires a mix of shipowners, charterers, and terminals to send a strong signal to both industry and regulators. There is thus an opportunity to start catalysing the broader structural changes needed to introduce speed optimisation at scale. Because drag decreases exponentially as the ship slows down, sailing 10 percent below a vessel's rated speed can reduce fuel consumption by 25 percent. We know speed optimisation leads to significant gains on fuel savings, but this does not always translate to savings for all parties involved. The role of pilots is to create mechanisms with which a measure's uptake can be scaled.

What we expected to learn when we started the process and how that evolved over time led to many insights on enablers and challenges. The overall goal of pilots is to demonstrate the commercial viability of speed optimisation. There can be many learning opportunities from pilots, including both quantitative (data driven) findings as well as qualitative learning. The aim of collecting quantitative data throughout the pilots is to verify and validate changes in fuel savings based on a "before-and-after" comparison of operational measures. Examples of these measures are hull cleaning, voyage and speed optimisation, just-in-time (JIT) or virtual arrival, etc. The aim of the qualitative part is to have a better understanding of the barriers/challenges e.g. contractual implications, to learn about the frictions and obstacles that must be removed to capture speed optimisation so that these can be addressed.

2. Process

A pilot form was sent to Global Maritime Forum members in May 2022 to understand who would be interested in running pilots. A pilot was defined to comprise "a single or multiple deep-sea voyage(s) that maximises operational efficiency using a range of different measures, including but not limited to slow steaming / speed optimisation, virtual arrival, port call optimisation, etc.". Several members of the Short Term Actions Taskforce started conducting pilots to build the learnings around speed optimisation, the main challenges, and its enabling environment.

Quantitatively

- What is the scalability or repeatability of a pilot?
- To what extent would the emission / fuel savings apply to other voyages / routes / sectors?

Qualitatively

- What are the barriers and how could transaction costs be reduced in the future?
- What would need to change to move from a pilot to full scale implementation within a company?
- What can we learn about split incentives and overcoming them through benefit sharing ?

1 *Poulsen, R. T., Viktorelius, M., Varvne, H., Rasmussen, H. B., & von Knorring, H. (2022). Energy efficiency in ship operations—Exploring voyage decisions and decision-makers. Transportation Research Part D: Transport and Environment, 102, 103120.*

2 *In the work of the Short Term Actions Taskforce, speed optimisation refers to optimisation of speed for reduction of bunker costs, which is also a proxy for reduction of emissions. In conventional time charter and voyage charters this responsibility lies with the charterer.*

3. Pilot case studies

When trying to find pilots for the Short Term Actions Taskforce, we learned that it has been more difficult than expected for companies to get the pilots up and running. Although more Taskforce members have shown interest in contributing, we are now able to present three pilots that have happened or are still running. Learnings from the pilots are captured as case studies below.

Case Study 1: Cargill Ocean Transportation - Virtual NOR

Pilot voyage: Cargill is looking at a running pilot on supply optimisation, meaning to reduce their vessels' idle time in port and optimisation of Cargill's assets. They will be using vessels that are on time charter to themselves, to carry a grain cargo for discharge to one of their internal counterparts. They are running trials out of their terminal in Santarem. Although their idea was first to run just-in-time arrival pilots, they figured the best solution would be virtual notice of readiness (NOR) as it is being used for example by Port of Newcastle.

Conditions: The pilot voyages still need to happen, but conditions are that they will be on time chartered vessels with the receiver and the charterer being the same company. Further, conditions are a functional queue at the load port. Cargill is also currently designing some solutions to optimise the loading time.

Fuel & emissions savings: Savings from these new pilots will be confirmed after they have been run. However, Cargill reported that some voyages that implemented virtual NOR last year yielded quite substantial fuel savings.

Barriers and enablers: The main barrier for these pilot voyages is deficiency in internal alignment. Each entity within Cargill has its own interest and KPIs. This needs to be overcome in order to run a pilot. As commodity contracts are agreed upon well in advance and signed for a period of around two years, Cargill needs to revisit them and renegotiate in order to implement clauses about on time arrival. For bulk carriers, tendering a virtual NOR is more complicated, especially when it comes to grain which requires a certain treatment and vessel preparation (clean cargo holds and such). It is also important to discuss who controls the load / disport. Sometimes it is the receiver that dictates when the vessel should unload, but other times it is the port. Further, it is very important to consider how on time arrival could impact underlying commodity contracts. However, despite these difficulties and the need to align better internally, running a pilot within internal business is generally easier than between two different companies.

Scalability: In terms of scalability, Cargill found that once the contractual complications of the commodity contracts have been clarified and confirmed, there shouldn't be any barrier to replicate it. Replicating it elsewhere would require port authorities to buy into the idea of virtual NOR. Some benefits for the ports would include fewer accidents and less coastal air pollution, among others.

Learnings: The main learning from this pilot is that although the charterer and the receiver were the same company, there are still many contractual intricacies involved, i.e. freight contracts, commodity contracts, Free on Board (FOB) shipments, etc. Thus, internal alignment between different desks is crucial to implement operational efficiency measures.

Case Study 2: Euronav - Benefit sharing through slow steaming

Pilot voyage: The pilot was a voyage of a Suezmax tanker from Basrah in the Arabian Gulf to Singapore, with speed optimisation and benefit sharing between shipowner and charterer, in this case Euronav and an oil major. Ten days before the estimated time of arrival, the charterer instructed them to slow down the vessel and arrive later.

Conditions: The pilot voyage was not chosen in advance, i.e. it is a hindcast pilot. The conditions that led to the slower steaming was that it was a spot voyage where the charterer requested to slow down and arrive later to better align with terminal readiness. A benefit sharing clause was provided in the charterparty.[3] The reason for a

3 *Wording of the benefit sharing clause: "Charterers shall also have the option to instruct the vessel to reduce speed on laden passage. Additional voyage time caused by such instructions shall count against laytime or demurrage, if on demurrage, and the value of any bunkers saved shall be deducted from any demurrage claim owners may have under this charter with the value being calculated at original purchase price."*

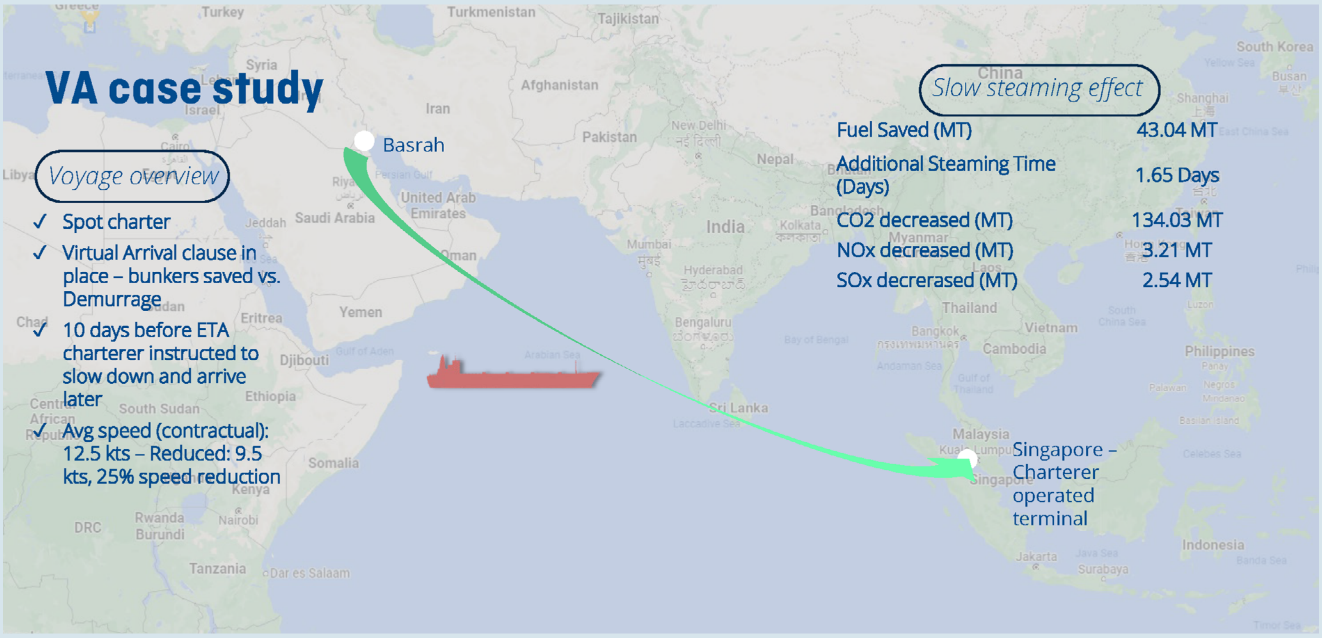
late arrival was a set contractual delivery date, which was known to the charterer well in advance. As the cargo receiver was the same as the charterer, this information could be shared very early during the voyage. This allowed for an early request to slow down the ship (ten days before arrival on a 12-day voyage).

Fuel & emissions savings: The fuel savings amount to around 43 metric tonnes (mt) with an additional steaming time of 1.65 days. CO2 emissions were decreased by around 134 mt, NOx by 3.21 mt, and SOx by 2.54 mt. While fuel savings models are used to quantify expected savings, these expectations can be more or less accurate depending on external factors, such as weather. When deciding for slow steaming, a calculation is done of expected cost savings with slow steaming vs. costs of demurrage.

Barriers and enablers: The main barrier for slow steaming or Virtual Arrival (VA) identified by Euronav is that the shipowner has no control over when the ship should arrive outside the contractual limitations of the charterparty speed (the speed specifications described in the charterparty agreement). This means that unless the charterer declares VA or decides to slow down the ship, the owner yields no decision-making power to reduce the speed, unless for safety or other emergency reasons. A main enabler is giving charterers the option to reduce the speed. Generally, the sooner the charterer knows the concrete delivery time of the cargo, the easier it is for them to decide for slow steaming. In this case, the charterparty included a benefit sharing clause. However, it was pointed out that whether or not such a clause exists beforehand is not decisive. Once the charterer is sure of delays, it is usually beneficial for the owner to agree to slow steaming, as they would otherwise just sit on demurrage. Thus, an agreement about slow steaming can be found right there and then without the need for a pre-established clause.

Scalability: From the owner perspective it is difficult to replicate this pilot, as the owner yields no decision-making power. It was pointed out that in principle it is easy, but not likely, to replicate as similar conditions need to be in place for this to happen again. As pointed out above, it is not the charterparty clauses that enable such voyages, but rather a new expected discharge time that enables a vessel to arrive later. Within all voyages by Euronav, slow steaming has occurred only in 1-2%.

Learnings: The main learning from this pilot is that the sooner there is available information about delays and waiting time, and the sooner the charterer and owner are in conversation about the possibility to slow down, the more significant is the saving potential, and the more likely it is for the vessel to slow down. Sharing the experience from pilots like these and creating an awareness about the options for VA / slow steaming is an important leverage point for a broader uptake of operational efficiency measures.



Source: Euronav

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Case Study 3: BP - Virtual arrival case

Pilot voyage: The pilot was a laden voyage of a very large crude carrier (VLCC) from Luanda (Angola) to Huizhou (China) with a distance of 8808 nautical miles. The original laden passage was planned with a speed of 12.5 knots, which was changed to a speed instruction after VA of 11 knots. About 17 days into the voyage (13 days sailing remaining), the charterer decided to slow down the vessel and enable virtual arrival 10 days before the estimated time of arrival.

Conditions: The charterparty contained a speed optimisation and benefit clause sharing between shipowner and charterer. Once aware of port congestion, a speed instruction was issued with a virtual NOR tender which allowed the ship to slow down. The charterer initiated the proposal of VA and started the process. CP - BPVOY5 (a voyage charterparty clause which is designed for use by BP as charterer and includes many requirements for owners and the vessel to comply with) with the VA clause is needed for clarity on demurrage. There are other factors to consider, such as downstream delivery commitments on arrival windows

Fuel & emissions savings: There were significant fuel savings in this case. As all time on demurrage is chargeable for arrival at charterparty speed, reduced bunker consumption is the main driver for the charterer.

The models are based on vessel speed and consumptions (S&C) and as long as it is accurate and reliable, the expected savings would match with the actual fairly closely. It does not reflect on the effectiveness of the process itself. The model is fairly simple – reduction in speed brings the savings due to reduced fuel demand for propulsion

Barriers and enablers: The greatest barrier to effectively and frequently implement and scale VA is a lack of actionable timely information. The fear of the unknown prevents uptake with third parties due to the addition of another variable into the demurrage claim, so accurate ETA info is essential. Another critical enabler is good communication with the terminal so as to gauge what is going on with the queuing system. Several additional success factors were identified, including the ability to discuss options openly with all participants and a willingness to participate in a common goal of reducing carbon emissions; understanding that charterers could also have downstream sales to consider with contractual obligations on arrival windows; and clear guidelines on what is expected from voyage operations and a culture of supporting operational efficiency in those actions. Finally, operations must be familiar with the concept of VA and have the contractual and operational information ready to make the decision as soon as possible.

Scalability: In the two years sampled (2021 and 2022), 27 voyages where a virtual arrival opportunity could be leveraged were observed. The cumulative savings from those cases were circa 1750 mt (fuel oil equivalent). The majority of cases (80%) were on owned or time-chartered vessels, and about 20% on spot chartered vessels. There are many variables in play and hence virtual arrival opportunities are hard to come by. We cannot expect one to occur in a certain voyage or expect a certain number of VA cases per year. VA is not implemented that often and there are good reasons for not doing so. Not every voyage is going to be suitable but there is scope to make a cultural shift within operations to highlight the importance of VA and to push even the slightest reduction in speed where viable. Additionally, if voyage speeds are already low or vessels are already at the most economical speed in general, then there is no benefit in declaring a virtual arrival as the vessel cannot steam any slower.

Learnings: VA appears to be a simple concept, but is in fact quite difficult to implement. Trustworthy and accurate information is key to implementation. Support and clear expectations from within are essential in order for VA to be given more space to grow. A consistent observation is that it is easier to implement this initiative if the parties involved are well connected and able to transparently share information and execute to realise the potential that exists. Such pilot studies and sharing experiences can create awareness about the potential of VA and how that can be unlocked in a win-win situation for all parties involved.

In this case, the voyage of a ship under time charter was nearly 60% completed when the vessel started slowing down, but even then there were significant fuel and emission savings (236 mt of fuel corresponding to 741 tonnes of CO_2). Weather routing data and the calculated arrival time and fuel savings are provided by third parties. This pilot demonstrates that there is no set time at which VA discussions can be triggered, and as soon as it becomes clear that there is no capacity at the terminal, the ship can start slowing down. Obviously, the earlier these conversations start, the better. BP has a clause on VA in the charterparty, which provides a mandate to choose VA if the opportunity arises and determines that the bunker savings will be shared with the owners, which results in benefits for all parties. This points to the need for internal buy-in paired with decarbonisation commitments or targets shared by leadership that help prioritise it.

Speed Description	Actual Original Speed	Actual Adjusted Speed	Virtual Arrival Simulation
Voyage Description	From COSP to VAD	From VAD to EOSP	From VAD to EOSP
Distance sailed (nm)	5129.30	3679.00	3679.00
Time en route (hrs)	410.00	334.50	289.42
Average Speed (knots)	12.51	11.00	12.71
Weather Factor (knots)	-0.29	-0.05	0.05
Current Factor (knots)	-0.44	0.32	0.26
Current Performance Speed (knots)	13.24	10.73	12.50
Ordered Speed (knots)	12.50	11.00	12.50
Ordered ME Fuel Consumption (mt/day)	53.00	39.00	63.00
Actual ME Fuel Consumption (mt/day)	47.50	28.90	53.00
Total ME Fuel Consumption (mt)	811.40	402.80	639.14
Fuel Saved (mt)	**236.34**		

BP Virtual Arrival Case Study data. Source: BP.

Case Study 4: Chevron - Just in time

Pilot voyage: The pilot was with the VLCC "London Voyager", loaded with crude oil for a laden voyage from West Africa to the US West Coast Pacific Area Lightering (PAL)—a voyage of 12,300 miles. The vessel was proactively slowed down upon identification of delays at the discharge port. In this case, the delay was driven by refinery scheduling, and as often is the case, the receiver (Chevron) controlled the arrival at the lightering areas. The original laden passage was planned for a speed of 13.5 knots with average fuel consumption of 57 mt per day (total consumption expected at 2,163 mt over the voyage duration of 37.9 days).

Conditions: As Chevron controlled the vessel performing the voyage from west Africa to the US West Coast for Chevron refinery supply, the charterer and receiver were the same. Because Chevron controls the refinery schedule, they were therefore able to identify the opportunity to slow down rather than proceed at full charterparty speed on the laden passage. This opportunity was identified with sufficient time to obtain significant fuel savings while being confident about not jeopardising refinery operations.

Fuel & emissions savings: The laden passage speed was reduced from 13.5 to 10.2 knots, increasing passage time from 37.9 to 50 days. The result of this speed adjustment reduced daily consumption from 57 to 37 mt/day, with the total voyage consumption reduced to 1,900 mt. The resulting total fuel savings was 263 mt, corresponding to a CO_2 emissions reduction of approximately 828 mt (assuming 3.15 mt CO_2 produced per mt/HFO consumed).

These fuel savings were in line with those modelled by Chevron's integrated operations centre based on historic vessel performance data. An additional benefit of the fuel savings was the improvement of the vessel's AER rating for this voyage from a theoretical "B" rating to "A".

Enablers: One of the key enablers for this case was that this shipment was an internal system cargo for Chevron's own refinery supply. This case was also enabled through interaction with a trusted partner and a broader top-down mandate to reduce emissions from operations.

Scalability: Scalability is only possible if there is consistent awareness of discharge port schedules, required arrival dates, and passage speeds (particularly on larger vessels where more impactful emission reductions can be achieved by reducing speed). Expansion to voyages involving third-party shipowners would require charterparty clauses around virtual arrival and savings/sharing clauses.

Learnings: This case study demonstrates that the opportunity for meaningful emission reductions exists within the current operational framework without negative financial consequences. In this case, the fuel savings of 263 mt of fuel would have yielded a net positive financial result from the speed adjustment. This case demonstrates that such opportunities are actionable and have the potential to be tremendously impactful when performed at scale.

Case Study 5: Klaveness Chartering - Vessel Utilisation

Pilot voyage: Klaveness Chartering is continuously assessing the emission reduction potential of several levers, including ballast distances, how to de-incentivise demurrage rates and increased vessel utilisation (i.e. cargo intake vs. vessel DWT/volume). All levers are considered obvious candidates for improving voyage execution and reducing emissions intensity. One voyage in particular provided useful insight and its learnings will be carried forward. The voyage in question was a grain cargo for an external counterpart, which was fulfilled with a vessel on time charter to Klaveness Chartering. The pilot set out to achieve emission reductions via vessel selection considerations, speed optimisation and maximised cargo intake to demonstrate that it is possible to achieve significant savings without compromising the financial result. In the following we focus in particular on what can be achieved by maximising intake.

Conditions: To maximise vessel utilisation, physical restrictions at load and discharge ports need to be known in detail. If additional volume would exceed contractual maxima, the cargo buyer and seller both need to be willing to maximise cargo intake. The operator needs to be given an orchestrator role and be in a position to make a range of stakeholders communicate efficiently.

Fuel & emissions savings: Based on the estimated emissions performance for this voyage (the baseline), a 27% reduction in CO_2 emissions per cargo tonne was achieved. This was mainly driven by maximised intake as well as shorter ballasting. An even higher reduction would have been possible with a shorter load port call and slower laden leg.

Barriers and enablers: Operators are not incentivised to review cargo volumes after fixing. Multiple entities need to agree to any changes, including the cargo buyer and seller as well as the vessel and port operators.

Furthermore, when port limitations are communicated, they are often oversimplified and overstated. Physical constraints can be more complex than a single number and depend on the specific situation in a port. To maximise cargo intake, limitations need to be communicated across various parties who do not convey the complexities of the situation. The damage caused by violating physical constraints and halting port throughput by grounding is an order of magnitude more significant than the potential gain from allowing vessel draft to be a few more centimetres.

To succeed with this kind of initiative, both the charterer and operator need to be open to sharing the financial benefits of improved vessel utilisation.

Scalability: The solution is very scalable but requires a structural change in openness between shippers, receivers, financiers, shipowners, and other stakeholders. In most cases the letter of credit and pricing structure surrounding the commodity contracts would be the obstacle as rarely would both shippers and receivers have an incentive to increase volumes. Improved transparency across commodity prices and freight instruments would be crucial to tackle the complexity of the supply chain head on.

Learnings: The main learning from this pilot is that once emission reductions were included as an independent KPI to be optimised in its own right, this created a joint incentive amongst the stakeholders to look at improved vessel utilisation. An unambiguous commitment from the charterer was also key to unlocking new ways of collaborating. The approach may improve several KPIs, both financially and on emissions. The pilot demonstrated that significant savings can be achieved without compromising the financial result of a voyage.

4. Learnings: Barriers and frictions

a. Mindsets

The hindcast data have shown that there could be a significant potential fuel savings from using efficiency and VA clauses. However, from the discussion in the taskforce and one-on-one interviews with the companies involved, it has become clear that such clauses are acted upon only in exceptional cases. Conversations have shown that there is an assumption that triggering VA clauses to enable JIT arrival is complex and requires too much effort.

One comment that was often repeated in taskforce meetings was that there is a strong belief in the industry that shipping is already optimised, however this optimisation is around financial efficiency and from the perspective of a single party. The challenge we are presented with is how to expand the frame of reference to include efficiency of the whole system, and thereby shift from profit maximisation of a single party to optimisation of the whole value chain.

b. Internal frictions, priorities, and KPIs

Most of the barriers identified to running pilots are internal frictions within a company, often driven by organisational culture, a lack of understanding of the savings opportunities, and/or lack of resources. The weighting of financial metrics and differing incentives across company departments create internal frictions to operational efficiency, limiting the availability of real-world evidence that could be provided by pilot voyages. For example, there is often a lack of engagement from chartering desks whose aim is to maximise a ship's time charter equivalent (TCE),[4] influencing priorities both onshore and at sea.

Taskforce discussions have revealed that changing any aspect of a voyage between a shipowner and charterer—which is the point of running a pilot—cannot be done by tinkering with the ship at some theoretical/operational level outside a contractual framework. Meanwhile, legal counsels have stated that "anything can be done as long as the contracts are not changed", while external legal experts have indicated that, in fact, nothing can be changed without changing the contracts.

It was noted that there is a lot of focus on voyage optimisation and perhaps not enough on supply chain optimisation, including having a view upstream to the commodity sale, which would require multilateral collaboration across the value chain. Within trading companies involved in the pilots, the role of the trading desk, which controls the head contract for the commodity trade, always supersedes the freight contract, which must be optimised within boundaries set by the trade.

c. External frictions between owners, charterers and ports / terminals

Planning a pilot in advance and ensuring that these operations can become the default will require deep engagement between charter parties. Adding benefit sharing clauses that incentivise both parties to use VA when the opportunity arises requires amendments to the relevant contracts, and therefore early conversations with charterparties in addition to legal team support. Ideally, a pilot would be enabled at the contractual negotiation stage, though it must be acknowledged that many time charters are long term and are already under contract.

Emphasis was put on the role of terminal owners/operators as they have an influence on charterparty contracts, and the terms set by the terminals cascade into the contracts further down the supply chain. Thus, ports and terminal operators should play an important role in the pilots over time.

Besides efficiency gains, a key goal of the pilots is to build more trust among the different actors and to eventually scale up the pilots. It has also been observed that VA clauses have so far only been used in the liquid bulk sector and that there are no known cases in the dry bulk sector.

d. Complex decision-making processes

The role of onboard crew in decision making should not be forgotten, especially the roles of the captain and the chief engineer in optimising speed. As noted in a **case study published by the taskforce**, new use of data targeting human behaviours that affect operational efficiencies to reduce fuel usage is showing promise. This type of

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4 TCE is a measure used to calculate the average daily revenue performance of a vessel, defined as the gross freight income minus voyage costs (fuel, port, and canal charges) divided by the round-trip voyage duration in days.

solution can target and improve a range of behaviours, including trim and draft optimisation, speed optimisation, port turnaround time, autopilot improvement, and route optimisation. At sea, crews are constantly making decisions with multiple priorities and endless factors and nuances to consider. A study revealed that there is a clear difference in efficiency practices between individual captains and chief engineers, offering savings potential of at least 12% from behavioural changes alone.[5]

5. Learnings: Enablers and opportunities

By understanding the barriers to piloting and scaling VA and other operational efficiencies, they can be broken down and specific enablers and solutions can be identified and implemented. By working together to share learnings and best practice, companies can engage in a virtuous cycle to improve their operations with the reward of fuel and emissions savings.

a. Internal strategic alignment

The changes required to implement operational efficiency at every opportunity will involve a mindset shift at all levels of a company. Leadership can commit to supporting this shift by setting an example and creating the internal incentives, KPIs, and change management systems across companies and implementing these across all business units. Breaking down silos to connect board-level ambitions to chartering desks, trading desks, and legal teams will be a starting point for the cultural change within a company.

The savings potential of operational efficiency is made clear by the case studies above. The right internal incentives can make pilots like these become more widespread, saving fuel and OPEX for the company. At the same time, the quicker companies reduce fuel consumption and emissions today, the better they position themselves for broader decarbonisation. Reduction of fuel use today also lowers the anticipated need for the more expensive alternative fuels required to comply with regulations and commitments.

As companies start to explore their immediate opportunities for decarbonisation, the capital expenditure needed to optimise the speed will be relatively low, especially when compared to the opportunities that can be gained. This is in contrast to energy efficiency technologies, which require capital investments and taking vessels out of service for installation. As pressure to reduce emissions at a company level increases, either from regulatory pressures or corporate commitments to decarbonisation or science-based targets, operational efficiencies will be highlighted as having the lowest marginal cost and sizeable abatement potential.

b. Regulatory compliance and CII rating optimisation

While current incentives for short term emission reductions have clearly been insufficient, new environmental regulations are providing additional impetus. One new opportunity is the positive impact that speed optimisation has on the Carbon Intensity Indicator (CII) rating of a ship. Despite controversy around CII, it will factor into decision making and the whole sector can use operational efficiency to make progress towards these ratings. However for CII to be effective it needs to have sufficient enforcement mechanisms and ambitious reduction targets in line with the latest science, which calls for much greater reduction than currently agreed. In parallel, EU Monitoring, Reporting and Verification (MRV) regulation is also calling for disclosure of emissions, driving additional transparency across the significant portion of the industry that operates in or out of Europe.

c. Collective action through multilateral collaboration

Conversations with industry players have revealed that engaging in solving for operational efficiencies can be daunting, as the challenge is often seen as too complex. By engaging with peers from across the industry and counterparts across the value chain, these seemingly insurmountable barriers can be broken down. By acting collectively, large players can make commitments together that can set the benchmark for industry best practice.

The pilots so far have been using hindcast data to quantify the potential efficiency gains through the uptake of speed, voyage, and utilisation clauses. There are currently too many barriers (financial, legal, operational) to start setting up new pilots and test VA clauses. Looking forward, it is expected that pilots can also be planned in advance.

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5 *Rehmatulla, N. (n.d.). Behavioural nudging of crews shows significant potential for improving energy efficiency and reducing emissions in shipping. UMAS.*

Setting-up a new pilot will require very close collaboration within the different departments of the company but also externally between the charterer and the owner. Bringing together the shipowner and charterer already proved to be challenging let alone the terminal operator.

d. Standardisation of data collection protocol and performance evaluation

In order to set-up a pilot to test new clauses leading to ships optimising their operational performance, better data will be needed. Although the use of real-time sensors and data flow meters is becoming increasingly common, there is no standard way of gathering data from vessels. Vessel noon reports are one of the best sources of information. Ongoing efforts to standardise noon reporting data should match the data needs of the industry to optimise its voyage, vessel, and bunker operations, as well as minimise its carbon emissions.

6. Conclusion and recommendations

A central conclusion of this paper is that more pilots are needed, but also that these can be done. Many researchers are using models to quantify the impact of ships slowing down, but it is very rare to find the actual numbers from shipowners through vessel performance monitoring systems and subsequent KPIs. Where the numbers can be found and made public, they are promising, and sharing them more widely will help uptake of more pilots. Moreover, more diversified pilots are needed, meaning pilots with different vessel types and different voyage types (time charter, spot vessel, etc.). This would allow for more granular quantifications that are still missing and would shed light to the differentiated opportunities and barriers per vessel type, voyage type, and sector.

A broader knowledge base from more and different pilots will lead to a deeper and more quantified understanding of the scalability and replicability of pilots. By running pilot projects and reporting publicly on the results, it is possible to quantify the fuel reduction potential of speed optimisation, share learnings from the frictions, and identify enablers that can be built into corporate strategy. In order to create this knowledge, data transparency between owners and charterers is key. This has been discussed in more depth in the **insight brief on data and standards**. Pilots often require contractual changes, and therefore buy-in from legal counsel, creating an additional hurdle. For the time being, until a new (and improved) model contract comes along, contracting parties must find ways to make sense of the amalgam of clauses available and rules applicable to them. Commitment from company leaders can help overcome these internal barriers, get more pilots on the water to demonstrate the advantages of operational efficiency, and ultimately make it the default way of operating.

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7. Annex: Glossary

Carbon Intensity Indicator (CII): An operational index based on all the carbon emissions from all ballast and laden voyages, anchorage, port stays, all divided by the deadweight and distance sailed in a year (grams of CO2 per DWT mile). Based on these results, ships are grouped into different CII ratings, ranging from A to E.

Charterparty: Contract by which the owner of a ship lets it to others for use in transporting a cargo. The shipowner continues to control the navigation and management of the vessel, but its carrying capacity is engaged by the charterer.

Charterparty speed: The speed or speed range described in a charterparty agreement, sometimes referred to as the "base speed", in contrast to the "maximum speed" or "full speed", and the economical speed or "eco-speed"

Demurrage: A charge payable to the owner of a chartered ship on failure to load or discharge the ship within the time agreed. It refers to the time that a shipowner has lost because the charterer could not complete required cargo operations within an agreed time frame.

Just-in-time (JIT) arrival: Allows for ships to optimise their speed during the voyage in order to arrive at the Pilot Boarding Place (PBP) when the availability of berth, fairway and nautical services is ensured. It smooths out the energy inefficient moving parts of a voyage.

Noon report: A report prepared by a ship's chief engineer on a daily basis comprising the vessel's position and other relevant data to assess the performance of the ship based on its speed and weather conditions

Notice of Readiness (NOR): A document issued by the captain of a ship to showcase readiness for loading or unloading goods from/into his ship. This is traditionally issued upon arrival at port.

Service speed: The average speed maintained by a ship under normal load and weather conditions, which is a factor of vessel design and engine power

Slow steaming: Deliberately operating a vessel at an average speed that is below its service speed to cut down fuel consumption and carbon emissions

Time charter equivalent (TCE): A measure used to calculate the average daily revenue performance of a vessel, defined as the gross freight income minus voyage costs (fuel, port, and canal charges) divided by the round-trip voyage duration in days. This is relevant to the subject of speed optimisation because the aim of the chartering desks is to maximise a ship's time charter equivalent without regard to emissions.

Virtual Arrival (VA): A process that involves an agreement to reduce a vessel's speed during a voyage to meet a required time of arrival when there is a known delay at the discharge port. This concept uses digitalisation to make all parties acutely aware of the optimal arrival time and share the benefits and requires the Notice of Readiness (NOR) to be accepted by the port enroute.