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On the attitudes and opportunities of fuel consumption monitoring and measurement within the shipping industry and the identification and validation of energy efficiency and performance interventions

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1 Introduction

In the past few years, energy efficiency has received increasing attention in the shipping industry. On the one hand, the introduction of environmental regulations such as the Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP) is driving an increase in energy efficiency. On the other hand, with bunker fuel often representing around 60-70% of many ships' operating costs and at sustained high bunker prices, increasing energy efficiency can result in considerable costs savings. Measurement of fuel consumption is an important component in energy efficiency management, and yet there is little work to date quantifying the measurement techniques currently used in the industry and the applications of these techniques.

1.1 Policy applications – SEEMP compliance and MRV

In July 2011, amendments to MARPOL Annex VI were adopted, introducing mandatory technical and operational measures to reduce greenhouse gas (GHG) emissions from ships (IMO, 2011). Accordingly, as of 1 January 2013, ships over 400 gross tonnage and above are required to keep on board a ship-specific Ship Energy Efficiency Management Plan (SEEMP). The SEEMP is an operational measure that aims to stimulate more energy efficient operational practices through four steps: planning, implementation, monitoring, and self-evaluation and improvement. This should be done using an established method, preferably an international standard, such as the Energy Efficiency Operational Indicator (EEOI), which is proposed as the primary monitoring tool in SEEMP (IMO, 2012). Currently, the IMO has only issued guidelines for implementation; it is then up to the ship owners to set up a plan, using the guidelines as a framework (Leander, 2012). However, the collection of performance data, particularly the measurement and analysis of fuel consumption data are expected to form an integral part of any implementation of the SEEMP guidelines.

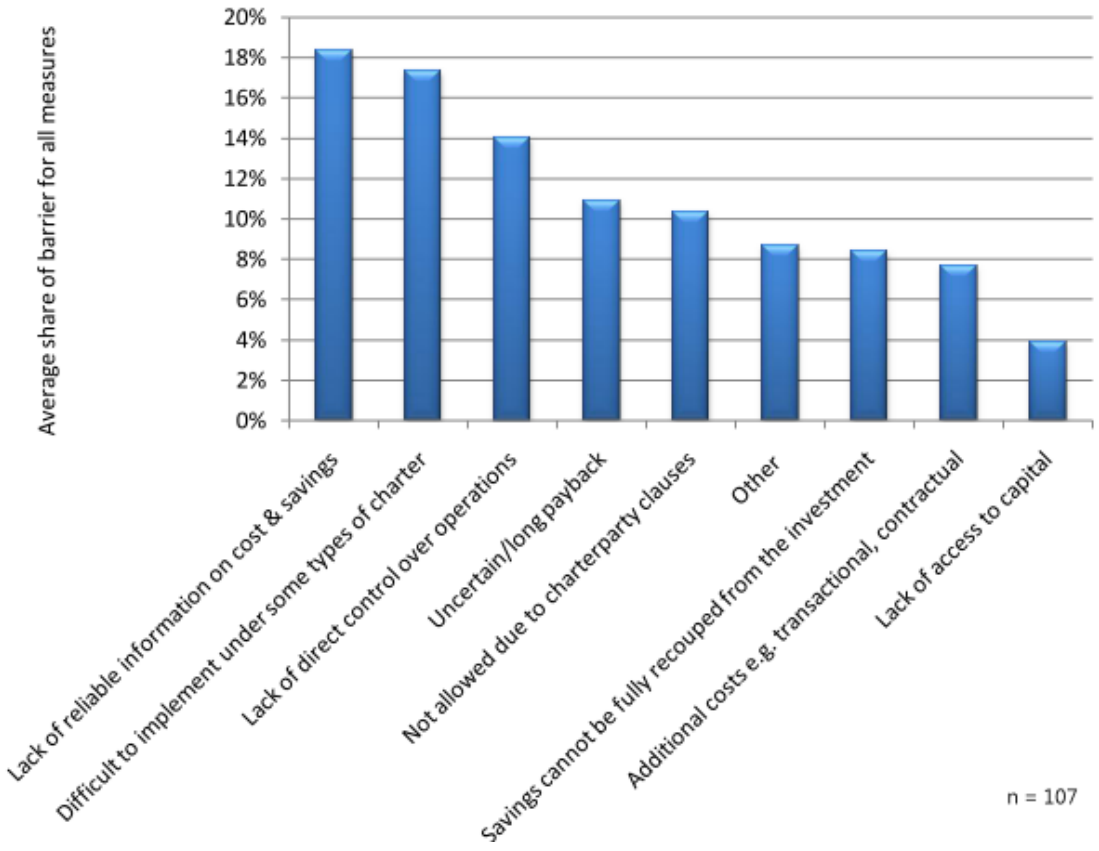
Further incentive on the collection of this data may come from rules related to fuel consumption and emission monitoring which are being discussed by the European Commission in the form of its Monitoring, Reporting and Verification (MRV) scheme. Upon approval of the European Parliament and Council, ship owners will have to monitor and report the verified amount of CO2 emitted by ships above 5,000 gross tonnage on voyages to, from and between EU ports. Ship owners may select one out of the four monitoring methods: Bunker Fuel Delivery Notes, bunker fuel tank monitoring, flow meters for applicable combustion processes or direct emission measurements. Owners are also likely to be required to provide data on distance travelled, cargo carried and time spent at sea in order to obtain a general overview of ships' average energy efficiency, although this is the subject of ongoing discussion and debate (EC, 2013a). The MRV scheme is the first step of the EU's strategy to reduce CO2 emissions from maritime transport. The two consecutive steps are likely to be to set GHG reduction targets for the maritime transport sector and introduce further measures such as market-based measures in the medium- to long-term (EC, 2013b). Related discussions of similar regulation that could be enforced for monitoring, reporting and verification of emissions at a global level are underway in the IMO.

1.2 Commercial applications – identifying fuel cost savings, and increasing transparency and economic efficiency in the shipping markets

In its simplest form, fuel consumption measurement and performance analysis are the key tools that a ship owner or operator has to manage its voyage costs and therefore the company's profitability. Procedures to undertake an analysis exercise internally (i.e. within the shipping company) have been common practice for decades. However, with increasing fuel prices comes the justification for companies to increase the effort and sophistication of these processes in order to gain further performance increases (perhaps through increasing the frequency and accuracy with which measurements are made, or through more advanced algorithms for processing and trend analysis).

In addition to perfecting their own existing operations and procedures, increasing regulatory and economic pressures also give rise to increasing numbers of companies manufacturing technologies that can be applied as a newbuild or retrofit solution or as a new operational procedure. Therefore, another area of application of fuel consumption monitoring is the evaluation of energy efficiency interventions offered by a third party. A number of reports (Alvik et al., 2010; Buhaug et al., 2009; Faber et al., 2009, Maddox Consulting, 2012) suggest that there are several ways to increase efficiency which are not fully taken up. Whilst it is possible that the models and data used for analysing the interventions are inadequately representing costs and benefits, there is also some evidence that the explanation could be associated with a shortage of reliable information on costs and savings (see Figure 1 – extracted from Rehmatulla, 2012).

Figure 1: Most important barriers for measures that were not selected as not having high savings potential



Several components exacerbate and contribute to this observed phenomenon:

- A shortage of publicly available detailed, transparent, audited information on an 'average' ship's fuel consumption and performance trends
- An array of bespoke measurement and analysis techniques used across the industry restricting accessibility, standardisation and the sharing of best practice
- A high degree of operational specificity in the global fleet – different ship types and the different styles of contract with which they are deployed create specifics, which make performance difficult to compare (and therefore savings assessment).
- A wide variability in day-to-day performance – cargo loading, weather conditions, hull and machinery condition and the crew can all contribute to significant fluctuations in day-to-day performance making analysis of performance trends even for the same ship difficult.

All of these features make it difficult for energy efficiency providers (e.g. technology companies) to characterise the costs and benefits of their technology for use in presentation to potential customers (ship owners and operators), and can lead to difficulties in estimating, communicating and proving their product or service's costs and benefits (Maddox Consulting 2012).

Often, manufacturer's claims are perceived to be overly optimistic and therefore are not trusted (Faber et al., 2009; Rehmatulla and Smith, 2012). Concerned about the recoverability of cost savings and the speed of the return on investment a technology can provide, ship owners and operators are inevitably less inclined to invest in energy efficiency improvements; particularly at a time when there is little liquidity within the shipping industry.

Reliable performance monitoring and verification of the technologies is also in the interest of all technology manufacturers, as well as wider industry stakeholder groups.

Performance monitoring has become a business in itself as an increasing number of companies and classification societies provide software tools to record vessel performance. These software packages come with a host of tools and additional add-ons for which an owner can pay (Eason, 2012b). Conveniently, such software and consultancy services also offer to facilitate the implementation of the SEEMP. However, opinions on the use of software in implementing SEEMP are mixed. Some argue that realizing immediate and tangible benefits lies in the "real-time" management that only ship management software can provide (Henttinen, 2012). They claim that annual fuel savings of about 3-5% can be realized by using their software (Chew, 2011). BIMCO, on the other hand, has urged caution over the use of these software solutions in application to the SEEMP. According to the organization, SEEMP could best be used as a tool to empower crews to take part in fuel-saving awareness. It would therefore be most sensible to keep the SEEMP simple and effective rather than investing in expensive software solutions or consultancy services (Eason, 2012a, 2012c).

1.3 Purpose of this study

Conscious of this backdrop, this study aims to develop and share knowledge and insight from a broad range of ship owners, operators and managers about the current views on energy efficiency solutions, the extent of fuel consumption monitoring, attitudes to its use, and what purposes it is being used for (both commercial and compliance).

2 Method

In order to reach the research objective, an online survey was conducted among a broad range of shipping companies in July 2013. In the survey, respondents were asked about:

- the reasons for (not) monitoring fuel consumption and the tools used to do so (Q1-Q4),
- the importance of energy efficiency within their organisation (Q5-Q6),
- their perception of the need for a common standardised methodology for measuring fuel consumption (Q7-Q9),
- the adoption of fuel saving technologies in the past and monitoring of fuel savings achieved (Q10-Q14), and
- their attitudes toward the validation of performance claims and fuel saving guarantees (Q15-Q18).

The majority of questions were close-ended, including discrete (yes/no), single and multiple choice, and ordinal scale questions, however, some open-ended questions allowed respondents to provide more details on specific topics. To make sure questions were relevant to the respondent and matched previous answers, question piping was used. The complete survey can be found in the appendix.

In the following, discrete and single choice questions are depicted in a pie chart, and multiple choice questions in a bar chart.

The survey was distributed both through mailing lists and internet fora such as LinkedIn, mainly to ship owners-operators and long-term time charterers. In total, the survey yielded 130 responses. Due to question piping or non-completion of the survey, the number of responses varies per question. The number of responses is included in each graph.

2.1 Demographic profile of respondents

Respondents were asked demographic questions on the size of the company by number of ships, the type of company and the sector and region the company mostly operates in.

Judging by the number of ships, the majority of respondents are large shipping companies with 50 ships or more, followed by medium-sized companies with 11 to 49 ships. 18% of the respondents are small companies with ten ships or less (see Figure 2).

Figure 2: Company size by no. of ships;

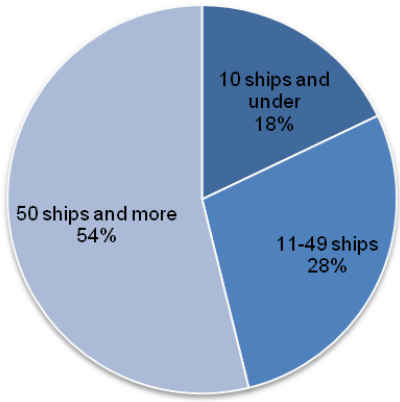
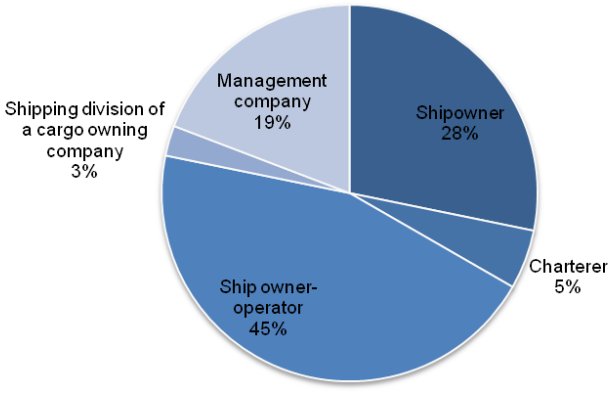


Figure 3: Shipping company types; n=78

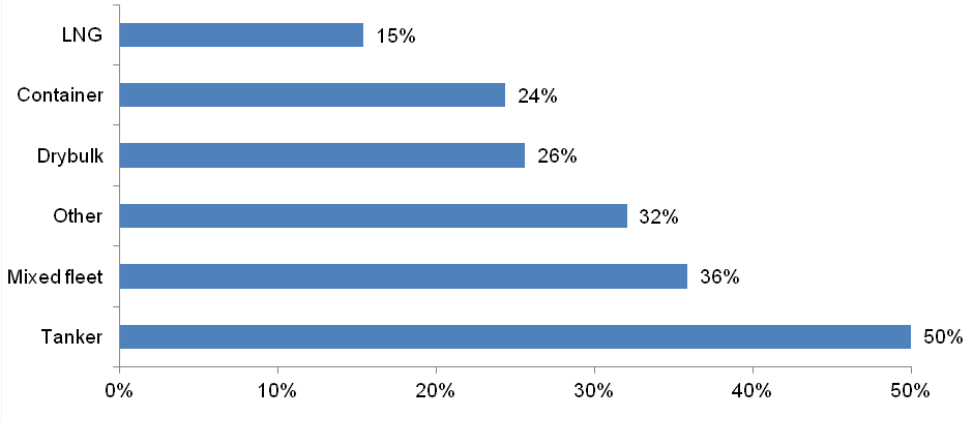


The sampling frames represented well ship owner-operators, ship owners and management companies, whereas only few charterers and shipping divisions of cargo owning companies took part in the survey (see Figure 3).

Respondents were also asked in which sector(s) their company operates its fleet.

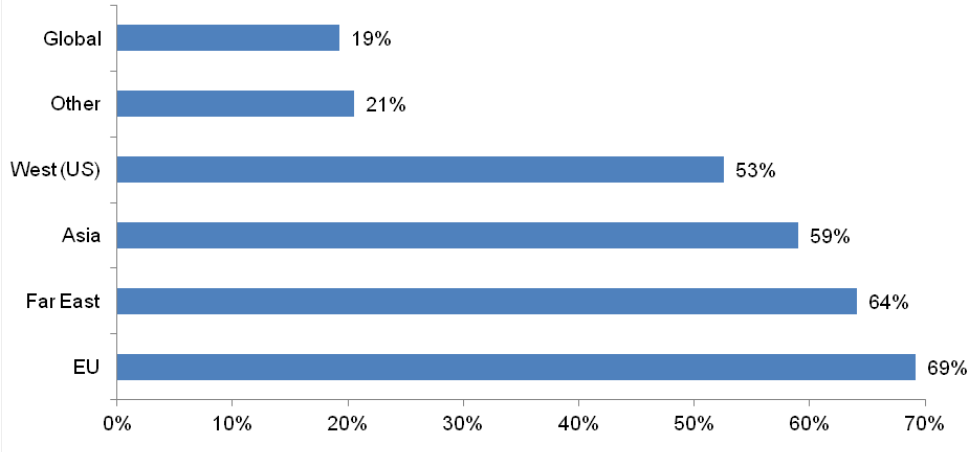
Figure 4 shows that the majority of respondents operates in the tanker sector or has a mixed fleet. The option “other” was mainly chosen by companies with passenger ships and cruise lines or offshore support vessels.

Figure 4: Sectors represented; n=78



With regard to the main regions represented, most respondents operate in the EU or Far East, followed by Asia (see Figure 5).

Figure 5: Main regions of operation; n=78



3 Key findings

Q1-Q4: reasons for (not) monitoring fuel consumption and the tools used to do so

The vast majority of respondents (92%) measure fuel consumption, almost all of them in order to identify opportunities to increase energy efficiency and reduce costs. Other reasons for measuring fuel consumption are shown in Figure 6:

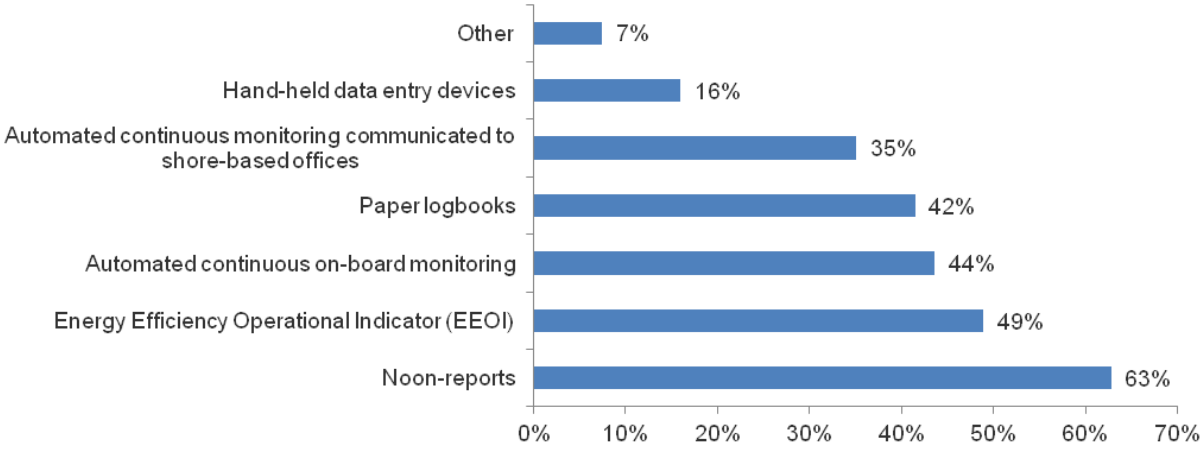
Figure 6: Reasons for monitoring fuel consumption; n=94

A high percentage of respondents indicate monitoring data is used for internal reasons, such as for benchmarking and target setting purposes and to satisfy sustainability-related reporting requirements. The impact of external pressure stemming from legislation, shareholders and other stakeholders on the monitoring decision seems to be rather low.

In terms of tools used to monitor and communicate fuel consumption, the survey found that noon-reports and the EEOI topped the list (see Figure 7). Considering the level of resistance against the introduction of energy efficiency regulations by the IMO (Macqueen, 2013), the uptake of the EEOI is quite high.

Even though noon-reports are the most widespread monitoring tool, they are mainly used in combination with other methods, primarily with automated continuous monitoring. The same applies to the EEOI which is a reporting rather than a monitoring tool and requires prior data collection. The 46 respondents using the EEOI employ the following monitoring tools (sorted by order of importance): noon-reports (35), automated continuous on-board monitoring (23), automated continuous monitoring communicated to shore-based offices (19), paper logbooks (15) and hand-held data entry devices (8).

Figure 7: Tools used to monitor and communicate fuel consumption and emissions data (several answers possible); n=94

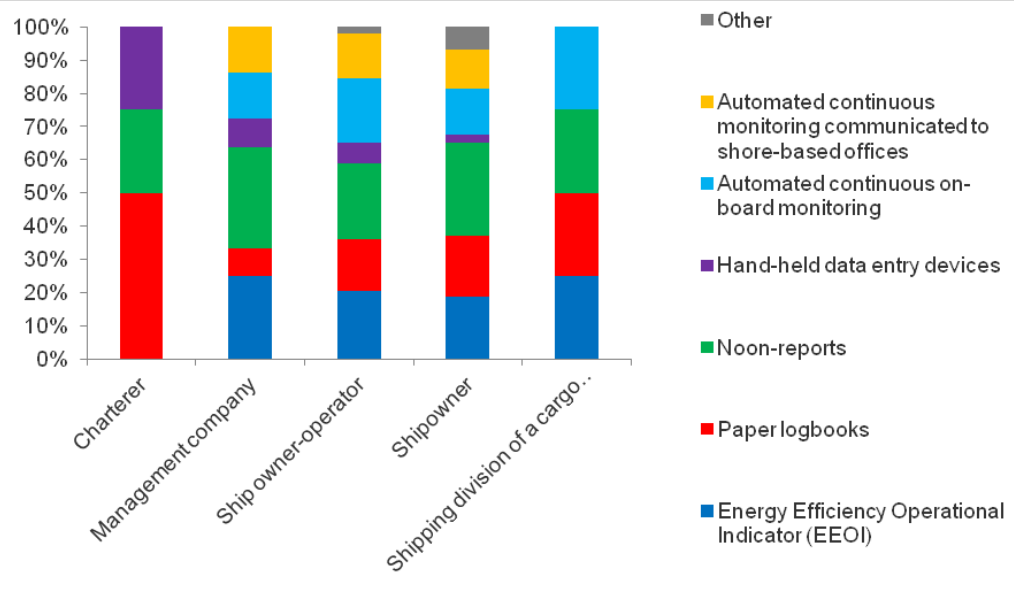


According to the survey results, the uptake of automated monitoring is high: both methods add up to almost 80%. This number is somewhat misleading as many respondents have selected both options. If corrected for this duplication, the uptake of automated continuous

monitoring among respondents still amounts to 56%, with 21% using automated continuous on-board monitoring, 12% automated continuous monitoring communicated to shore-based offices and the remaining 22% selected both.

Whilst the sample is low, it appears to suggest that when distinguishing between the shipping company types, the uptake of higher fidelity monitoring systems is predominantly with shipowners and ship owner-operators, whereas charterers are still using poorer quality data (see Figure 8). This reinforces the impression that end-users do not have a good handle on the fuel consumption component of the costs they are paying. The exception to this is the sector of the shipping division of cargo owners that use monitoring equipment (probably the biggest companies or niche companies) – which shows there are a few companies who have invested and are probably making better deals than their competitors.

Figure 8: Tools used to monitor and communicate fuel consumption and emissions data distinguished by company type; n=78[1]



Only few respondents indicated that their company was not monitoring fuel consumption. This was mostly explained by the fact that the company does not own or operate any vessels, is still evaluating different measurement methodologies or lacks adequate measuring instruments.

Q5-Q6: the importance of energy efficiency within their organisation

The high percentage of companies monitoring fuel consumption could already suggest that energy efficiency is of high importance to their organisation. When being questioned about it, 78% of respondents indicated they had an individual (or a group of individuals) dedicated to improving fleet efficiency within their organisation and 71% stated that improving energy efficiency was a boardroom agenda point.

Q7-Q9: the need for a common standardised methodology for measuring fuel consumption

The majority of respondents consider a common standardised methodology for measuring fuel consumption either very important (52%) or important (35%). More than half of the

[1] The number of responses displayed in this figure is lower than in figure 7 because not all respondents provided demographic information.

respondents (57%) would like to see the establishment of a voluntary measurement methodology, with the option to select from a number of standardised methods. e.g. as defined in an ISO. With another 15% in favour of an entirely voluntary measurement methodology, the majority of respondents (i.e. 72%) clearly preferred a voluntary over a mandatory measurement methodology. 25% of respondents preferred a mandatory measurement standard which could still be considered as quite high, given that they are asking for a new regulation. The remaining 3% chose "other". On the whole, this suggests that the industry would like to have more guidance with regard to measurement methodologies, but in the end still wants to have the last say on whether or not they want to use it.

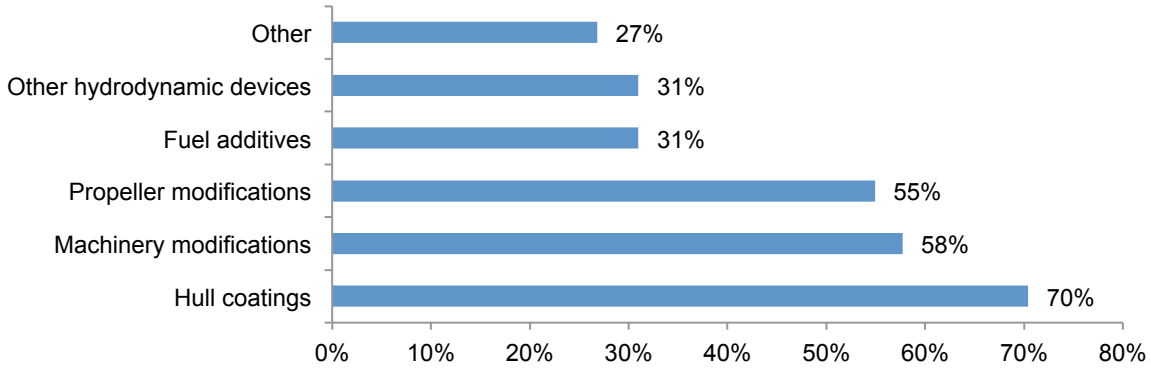
78% agreed that in the future, continuous monitoring of fuel consumption could become an important tool for improving energy efficiency of the global fleet. In this context it is interesting to note that 56% of respondents are already using automated continuous monitoring. Two tentative conclusions can be drawn from this. On the one hand, it could imply that current users of automated continuous monitoring are satisfied with the technology and expect to realize further fuel savings by the continued use of the technology. On the other hand, it could mean that respondents see room for improvement, which would help realize as yet untapped fuel saving potentials.

Q10-Q14: the adoption of fuel saving technologies in the past and monitoring of fuel savings achieved

Nearly 80% of the surveyed companies have adopted fuel saving technologies in the past five years, almost half of which include more than one technology at a time. When contrasting the three most represented shipping company types with each other, i.e. shipowners, ship owner-operators and management companies, we find that the ship owner-operators are the most progressive in terms of technology uptake: 86% have adopted energy efficient technologies in the past five years. Ship owners and management companies are less likely to have purchased fuel-saving technologies during that time frame which might be explained by the split incentive problem according to which shipowners cannot appropriate the benefits of their investments and by the fact that management companies have generally less control over the vessels. Nonetheless, the levels of technology uptake are still relatively high (82% for shipowners and 73% for management companies). Whilst we had some responses from charterers and shipping divisions of cargo owning companies, they were not statistically significant enough to comment on them.

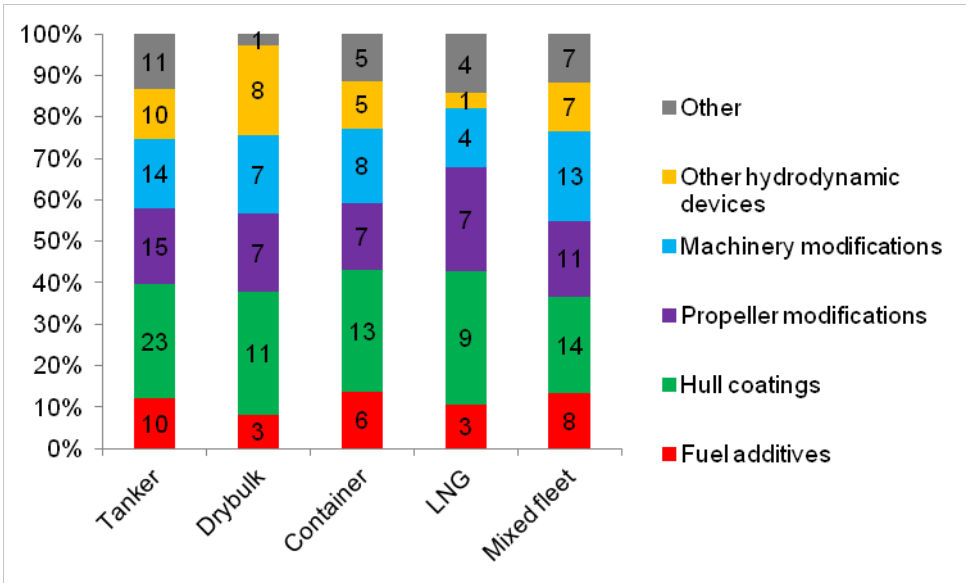
Figure 9 shows which technologies have been purchased in the past five years.

Figure 9: Adoption of fuel saving technologies; n=71



With 70% uptake, hull coatings top the list, yet it should be noted that the question was not explicit about the type of hull coating (foul-release, smooth polymer, biocidal etc.), so we can only conclude that the original coating was either upgraded or replaced. The second- and third-most purchased technologies are machinery and propeller modifications (58% and 55%, respectively). The responses have been further disaggregated by sector and company type. Figure 10 shows that the uptake of fuel saving technologies differs between fleets as different solutions might be appropriate for different sectors. One specific example is that higher speed ships, i.e. container vessels and LNG tankers, have a low uptake of hydrodynamic devices, both overall and compared to the tankers and drybulk fleets which implies that the fleets were already well optimised for hydrodynamic efficiency.

Figure 10: Adoption of fuel saving technologies distinguished by sector, n=62[2]

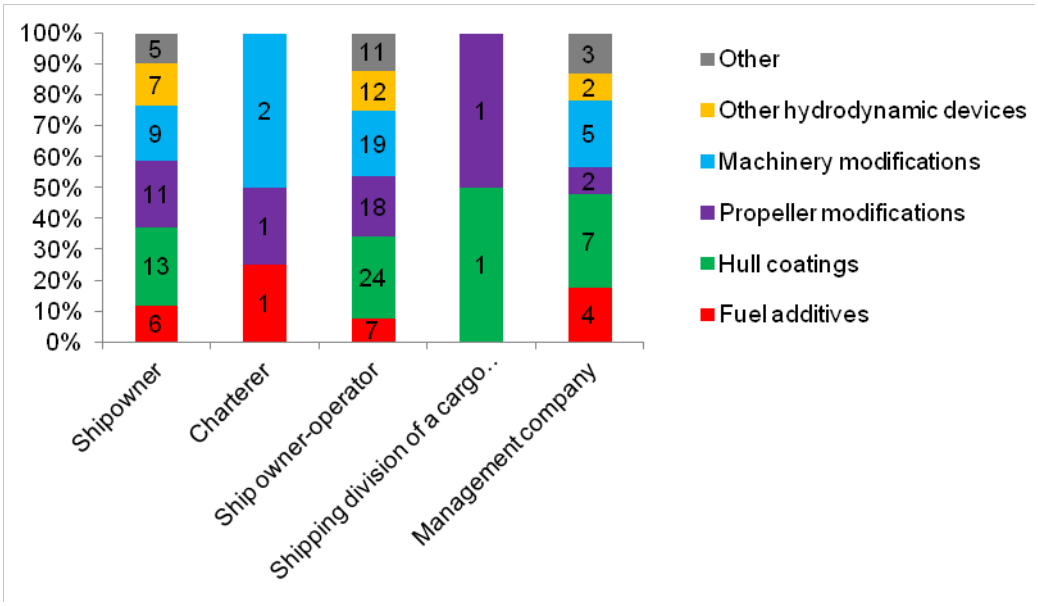


In Figure 11, the uptake of fuel saving technologies is displayed by shipping company type. Ship owners, management companies and ship owner-operators appear to be making similar retrofits which is an encouraging sign given that incentives are expected to be most aligned in the ship owner-operator sector.

Furthermore, Figure 11 shows a significant contrast between owner categories and the customer categories, i.e. charterer and shipping division of a cargo owning company, which is to be expected as these would typically have less control over the asset. The low response for these shipping firms could also reflect the fact that very few firms of this type are retrofitting at all. But without a larger sample size, this cannot be definitively concluded.

[2] The number of responses displayed in this figure is lower than in figure 9 because not all respondents provided demographic information.

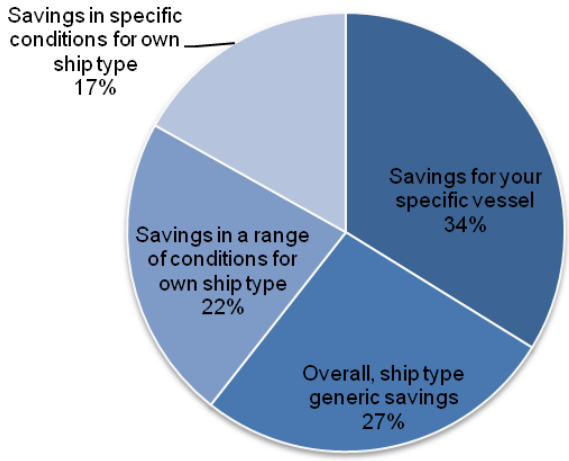
Figure 11: Adoption of fuel saving technologies distinguished by shipping company type; n=62[3]



After fitting the technology, fuel savings were monitored in almost all cases (97%).

Respondents were also asked how fuel savings had been communicated to them prior to purchasing the technology(ies), the answers to which are shown in Figure 12.

Figure 12: Communication of fuel savings for purchased technology; n=71



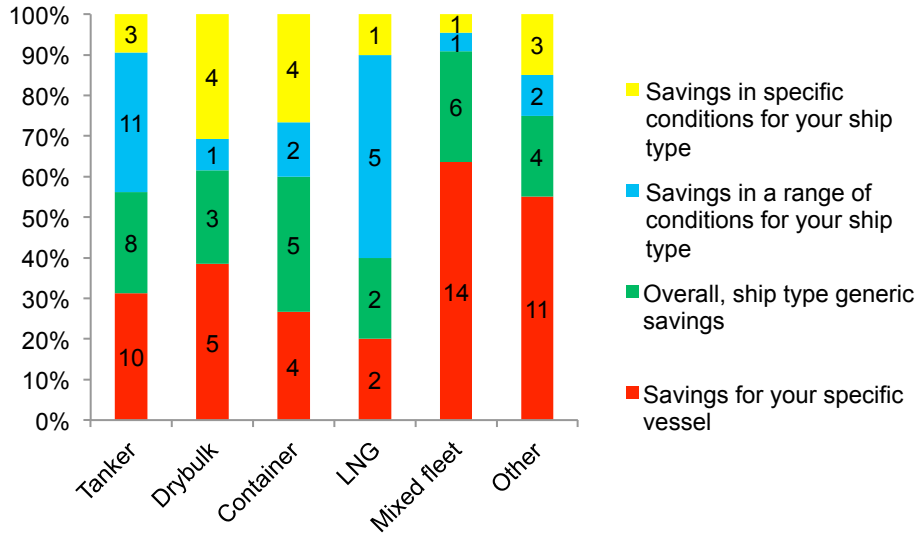
The majority received information on savings for their specific vessel; however, only slightly fewer respondents replied savings were communicated on a generic level. This could either mean that there was a lack of specific data and respondents had to accept the information available or that specific information is not always needed.

When distinguishing between different ship types, the dataset suggests that for some ship types, more bespoke data might be required (see Figure 13). Tanker, drybulk and container ships seem fairly similar in terms of percentage distribution. The only notable difference is that in relative terms, tanker operators are interested in specific conditions, whereas

[3] The number of responses displayed in this figure is lower than in figure 9 because not all respondents provided demographic information.

drybulkers more in generic conditions. For LNG carriers, the sample size was too small to draw any conclusions.

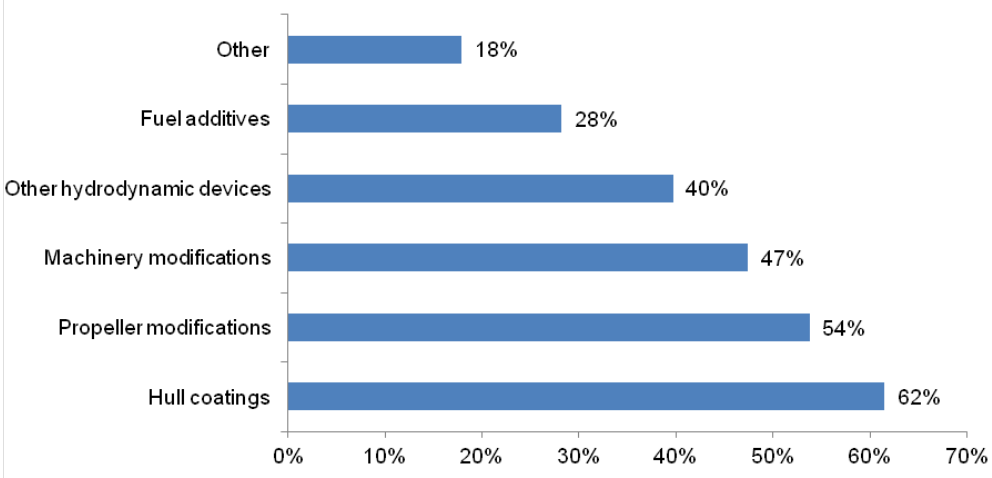
Figure 13: Communication of fuel savings for purchased technology distinguished by ship type; n=71



Q15-Q18: attitudes toward the validation of performance claims and fuel saving guarantees

In order to better understand the customer requirements on fuel saving data, respondents were asked for what types of fuel saving technologies performance claims could be generalized. More than half of the respondents stated that generalized performance claims would be acceptable for both hull coatings and propeller modifications (see Figure 14). Most of the respondents that chose 'other' were altogether against the generalization of performance claims.

Figure 14: Generalization of performance claims; n=78



In advance to integrating a technology, respondents mention several types of evidence needed to validate the fuel saving claims of technology providers. These include approval by IMO or classification societies, numerical analysis, model tests and computational fluid dynamic (CFD) assessments, evidence from sea trials and references from other clients. Only few respondents said that results from numerical analyses, model tests and CFD

assessments would be sufficient evidence to validate fuel saving claims. The majority required evidence from sea trials and/or references from other clients. Some of the answers from the two latter categories included:

- “Evidence of savings in real life examples.”
- “Hands-on experience”
- “Proven Technology & track record”
- “References from other clients.”
- “References/ data over a longer period, let’s say between two dockings.”
- “Experience from previous customers; Pilot project”
- “Case studies of relevant ship types at different speeds.”
- “Evidence and references from other ship owners using the technology”
- “Reports / Proof from other shipowners, then piloting on 1-2 own ships”

In addition to the data requirements prior to purchasing the technology, 83% expect the technology manufacturer to provide fuel saving guarantees. At the same time, only 44% are willing to pay for additional information above the existing data collection to verify the claim. This puts technology providers in a difficult situation as the provision of performance guarantees requires further data collection, yet the clients’ willingness to pay for this is low.

4 Key messages

- As expected, for a parameter crucial to the profitability of shipping operations, virtually all respondents cited the identification of potential cost-savings as the reason for monitoring fuel consumption. This was further corroborated by the fact that over 70% of respondents had “improving fleet efficiency” as a boardroom agenda item. Further uses in areas which are often less directly connected to profitability included use in sustainability reporting (48%), and use in environmental indices (51%).
- Encouragingly for the IMO, 49% of respondents were assessing performance using the EEOI, with a small majority (56%) acquiring the data to analyse performance using some form of automated continuous-monitoring system (either onboard data collection or linked to shore base). The noon-report remains in widespread use, although often now as a supplement to other methods (63%)
- There appears to be both a mix of methods used for measurement across each shipping company type, and some differences in that mix between the type of company. The owner/operating type firms (ship owners, owner operators and management companies) all had a similar mix of methods, with significant uptake of continuous monitoring. This differed to the shipping customers, charterers and shipping divisions of cargo owners, – the former were using data from continuous monitoring sources or the EEOI, and were most dependent on paper-logbooks.
- A large majority (87%) of respondents thought a “common standardised methodology for measuring fuel consumption” was either important or very important, and 78% saw continuous monitoring as a likely enabler of this.
- Hull coatings proved the most common fuel saving technology that has been applied recently, but this was followed closely by machinery and propeller modifications and a number of other energy efficiency interventions. This implies that it is likely to be important that any methodology can be applied to assess performance taking into account any technology type. From four options given for the nature of the methodology (voluntary bespoke, voluntary standardised, mandatory or none), the

majority of respondents (57%) selected a voluntary standardised method e.g. as defined in an ISO. Comparing this response to the findings from the literature in Section 1.2 implies that this is likely to be a response to the lack of transparency in the data currently used to evidence a technology's fuel saving and a need to standardise the wide range of bespoke methods currently deployed. This in turn points to the importance that any ISO standard developed to standardise performance measurement and improve on the current situation must be developed through a neutral and independent process, incorporating the views of all the relevant stakeholders (ship owners, charterers, as well as technology providers and monitoring solution providers).

- On the questions around the communication of the performance benefits of different technologies, there were a number of different experiences to the level of specificity that was being provided, and a number of different types of evidence used. This variability in response could be a reflection of the differences between ship types and technologies, so remains hard to interpret. However, common to a large majority (83%) of respondents is the requirement for the vendor of a technology to provide some type of fuel-saving guarantee. The standardisation of a fuel consumption and performance measurement technique would be an enabler for transparency in the provision of that guarantee, and lower the transaction cost for the firms involved. However, perhaps unsurprisingly given the phrasing of the question, a minority (44%) are willing to pay for additional information (beyond what they already measure). Given the continued dominance of noon-report data as the primary measurement method, and the expectation that this remains a crude tool for measuring to the accuracy required to resolve the performance benefits of many interventions, this raises some crucial future questions for the sector:
    - Whilst a common standardised measured method should assist, how can it be developed so that it can be used robustly and rigorously across a wide range of measurement sources (noon-reports, paper logbooks and continuous monitoring)?
    - When greater quality of data is required to prove the benefits of a technology, how will this be financed?

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Appendix: Questionnaire

Q1: Do you currently measure your vessels' fuel consumption?

- Yes
- No

Q2: What are the reasons for measuring fuel consumption? (Please select all relevant from the list.)

- To satisfy legal requirements
- To identify potential cost-saving opportunities/ to identify opportunities to increase energy efficiency
- For benchmarking and target setting purposes
- To respond to pressure from charterers or customers
- To respond to pressure from investors or shareholders
- To respond to pressure from other stakeholders
- To satisfy requirements for Sustainability reporting
- To satisfy reporting requirements for Environmental Indexes (e.g. Clean Cargo Working Group, Clean Shipping Initiative, Environmental Ship Index)
- Other (please specify)

Q3: Which tools do you currently use to monitor and communicate fuel consumption and emissions data? (Please select all relevant from the list.)

- Energy Efficiency Operational Indicator (EEOI)
- Paper logbooks
- Noon-reports
- Hand-held data entry devices
- Automated continuous on-board monitoring
- Automated continuous monitoring communicated to shore-based offices
- Other (please specify)

Q4: What are the reasons for not measuring fuel consumption?

Q5: Do you have an individual (or a group of individuals) dedicated to improving fleet efficiency within your organisation?

- Yes
- No

Q6: Is it a boardroom agenda point?

- Yes
- No

Q7: How important do you consider a common standardised methodology for measuring fuel consumption?

- Very important
- Important
- Somewhat important
- Somewhat unimportant
- Very unimportant

Q8: Any methodology for measuring and verifying the effect of clean technologies on vessel performance should be:

- Entirely voluntary, e.g. drawn up between technology provider and vessel owner/operator as part of a performance contract
- Voluntary, but with the option to select from a number of standardized methods e.g. as defined in an ISO
- Mandatory, e.g. through a body such as the International Maritime Organisation
- Other (please specify)

Q9: Do you agree or disagree with the following statement: “High accuracy sensor data sampled at high frequency to measure fuel consumption and performance trends could become an important tool for improving efficiency in the global fleet.”

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

Q10: Have you purchased fuel saving technologies in the past 5 years?

- Yes
- No

Q11: What technology(ies) did you adopt? (Please select all relevant from the list.)

- Fuel additives
- Hull coatings
- Propeller modifications
- Machinery modifications
- Other hydrodynamic devices
- Other (please specify)

Q12: How were fuel savings communicated for that specific technology?

- Overall, ship type generic savings
- Savings in specific conditions for your ship type
- Savings in a range of conditions for your ship type
- Savings for your specific vessel

Q13: Have you fitted more than one technology at a time to any specific vessel to improve efficiency?

- No
- Yes. Number of technologies:

Q14: Did you monitor fuel savings of the technology afterwards?

- Yes
- No

Q15: In advance to integrating a technology, what evidence would you need to validate the fuel saving claims of technology providers?

Q16: Once the technology is implemented, would you pay for additional information above your existing data collection to verify the claim?

- Yes
- No

Q17: Would you expect the technology manufacturer to provide fuel savings guarantees?

- Yes
- No

Q18: For what types of fuel saving technologies is it okay to generalize about performance claims? (Please select all relevant from the list.)

- Fuel additives
- Hull coatings
- Propeller modifications
- Machinery modifications
- Other hydrodynamic devices
- Other (please specify)

Q19: What is the size of your company's fleet?

- 10 ships and under
- 11-49 ships
- 50 ships and more

Q20: In which sector does your company operate its fleet? (Please select all relevant from the list.)

- Tanker
- Drybulk
- Container
- LNG
- Mixed fleet
- Other (please specify)

Q21: Which of the following best describes your company?

- Shipowner
- Charterer
- Ship owner-operator
- Management company
- Shipping division of a cargo owning company

Q22: In which region(s) do you mainly operate? (Please select all relevant from the list.)

- EU
- West (US)
- Asia
- Far East
- Other (please specify)

Thank you very much for completing this survey!