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Seafarers' current awareness, knowledge, motivation and ideas towards Low Carbon – Energy Efficient operations

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Abstract

Worldwide there is increasing concern regarding green house gases, in particular carbon emissions and their detrimental effects to our earth's atmosphere; resulting in climate change. International and National pressure requires the shipping industry to play its' role in reducing the 3.3% of total global carbon emission that it currently emits into the atmosphere. On the 1st January 2013 the IMO are expected to enforce mandatory measures to reduce shipping carbon emissions and these measures will directly and indirectly affect the daily operations of seafarers, onshore performance staff, and managerial personnel with influence over operational procedures. It is therefore imperative that these personnel have the awareness, knowledge, skills, and motivation necessary to successfully implement the operational changes that are needed. A questionnaire has been distributed to investigate seafarers' and onshore personnels current levels of awareness, knowledge and motivation towards carbon emissions in general and towards shipping carbon emissions. The questionnaire also asked participants to contribute which level of personnel have the most influence over carbon changes and what are the most important operational improvements that can be made. 317 questionnaire responses were collected in total and the analysis of the results is discussed within this paper. The primary benefit of this study has been to support the development of a specific Low Carbon – Energy Efficiency maritime education and training program, by identifying target group needs and attitudes, and key areas for focus.

Keywords: Low Carbon, Energy Efficiency, Maritime Education and Training, Awareness, Knowledge, Motivation, Seafarers

1. Introduction

Within the atmosphere carbon emissions (specifically carbon dioxide, CO₂) are considered to be of most concern out of the green house gasses (GHG's); due to their damaging GHG properties, large proportion in the atmosphere, and the influence that human activity can have over their proportion in the atmosphere. As a result several International and National carbon targets have been introduced over the recent years and the IMO have taken responsibility to ensure that the shipping industry plays its' role in reducing the 3.3% of global carbon emission that it currently emits; 2.7% from international shipping alone (Buhaug 2009). Amendments have been made to the MARPOL Convention, Annex VI, Regulations for the prevention of air pollution from ships (IMO 2011) that include the introduction of the Energy Efficiency Design Index, EEDI, ensuring carbon emission constraints within the design of new builds (above 400 gross tonnes), and the presence of a Ship Energy Efficiency Management Plan, SEEMP, onboard all new and existing vessels. These measures are expected to come into force in January 2013 (IMO 2011).

The EEDI will affect the daily operations of seafarers in the long term as it is expected to catalyse the development and installation of new technologies and innovations. Although it will take some time for the next generation of the world fleet to exhibit these new technologies and innovations (and the existing fleet to take up retrofits) it is necessary that seafarers have the awareness, knowledge and skills to operate these technologies and adjust existing operations for safe and efficient use. The aim of the SEEMP is to provide a document and tool to be used by the ship's master, operators and owners, to monitor the ships' and fleets' performance efficiency over time; with aim to optimize operational efficiency (IMO 2012). The SEEMP covers operational improvements such as: voyage optimisation, optimum ship handling, hull maintenance, propulsion systems and maintenance, waste heat recovery, improved fleet management, improved cargo handling, energy management, fuel types, etc (IMO 2012). Many of these factors require

management and onshore involvement (i.e. decision to install weather routing, changes in average voyage speed, etc). However, regardless of the decision level, the majority of the SEEMP will directly impact on the daily operations of seafarers. Therefore it is imperative that seafarers have the awareness, knowledge, skills, and motivation required to make best decisions and implement operational changes detailed within the SEEMP and beyond, safely and efficiently.

The need for Low Carbon – Energy Efficiency Maritime Education and Training (LC-EE MET) is thus evident and the first step towards development is to carry out a needs analysis. Therefore this paper presents novel questionnaire findings carrying out such an analysis: investigating seafarers' and onshore personnel's current levels of global and shipping carbon emission awareness, knowledge and motivation. Participants' responses also contributed to which levels of personnel have the most influence over carbon changes and what are the most important operational improvements that need to be made. Section 2 of this paper gives details about the questionnaire design followed by Section 3 that discusses the profile of participants. Section 4 then presents the questionnaire results whilst discussing the key findings followed by conclusions and future work considerations in sections 5 and 6 retrospectively.

2. The questionnaire

2.1 Questionnaire design

The questionnaire was designed to consist of 6 parts each addressing the following question areas that included collecting information about the participants' background, opinions and experiences. Part 4 had two sub parts to it where part A asked the engineering team to complete questions specific to onboard systems and maintenance, and part B asked the deck team to complete questions specific to voyage planning. The questionnaire took around 15 minutes to complete and it was distributed in an online (via a link to Google questionnaire documents) a PDF (that could be printed, completed by hand, scanned and emailed or posted) and a protected word document (where participants were only able to check boxes and type in the permitted boxes).

2.2 Types of questions

The questionnaire was made up of different types of questions to insure the collection of informative results. Single and multiple-choice questions were used within the questionnaire. Results have been analysed using a frequency analysis which then presented as percentage of the N number of responses for that question (The N number of responses is quoted within each graph caption). Where there was an 'other' category was provided for the single and multiple-choice questions the count has been included in the frequency analysis and the additional written information has been treated as linguistic.

The questionnaire also used rating questions asking participants to rate their opinion on a scale. A five-category Likert scale was used for the rating questions (see Agresti 2010 and Section 6 for alternative options, assumptions and analysis techniques). Ordinal data (generated from Likert scales) is descriptive data and has no mathematical value, and for this reason the median has been used to analyse the average response of participants. However, although not statistically correct, the likert scale is historically associated with values (1 assigned to the least desirable value and 5 to the most, increasing at intervals of 1 for each category) and thus mean values have also been determined (Agresti 2010). The calculation of the mean responses has been particularly useful for the analysis of the dependent rating questions (asking the participant to rank more than one variable on one Likert scale) allowing for a ranking order to be determined. Where one variable was not completed within the dependent rating questions, the whole question response has been excluded from the analysis. An important remark to make is that the mean values presented within this paper should not be analysed in terms of their value, rather just as a tool to determine a ranking order and/or for comparison of responses. In addition it is important to note that the data analysed contains elements of subjectivity due to the expression of personal opinions and judgments.

The final type of questions used within the questionnaire are linguistic questions; asking participants to share their knowledge, experience, and opinions in a written format. For the analysis of linguistic response, each response has been grouped into a group of similar responses.

Throughout this paper some of the linguistic responses have been quoted within textboxes; each representing reoccurring comments within the analysis and demonstrating the points being discussed within section 4. Questionnaire results and discussion.

2.3 Questionnaire distribution

The achievement of effective low carbon operational changes requires co-operation and input from many levels of shipping personnel, as discussed within (Banks et al 2011). However, this paper focuses on the role of the seafarer whilst also considering onshore vessel performance personnel. To reach this target group the questionnaire was distributed to shipping companies and MET institutes. It was also distributed to trainee seafarers (cadets) who are currently undergoing maritime education, and to students who are training to go to sea but who have not yet completed any sea training: to reach these target groups the distribution was carried out within MET institutes and at Maritime Collages. The questionnaire was distributed towards the end of 2011 and 317 responses were received in total (84% were hardcopies and 16% were online).

3. Profile of Questionnaire participants

Part 1 of the questionnaire asked participants to provide background details so that the results could be analysed taking into account the past experiences of the participants shaping their current views. The questionnaire asked participants to provide details of where they had completed their maritime education and training. Figure 1 demonstrates that the participants have been educated and trained in a large range of countries; thus encompassing the global maritime community and including a range of educational and cultural differences.

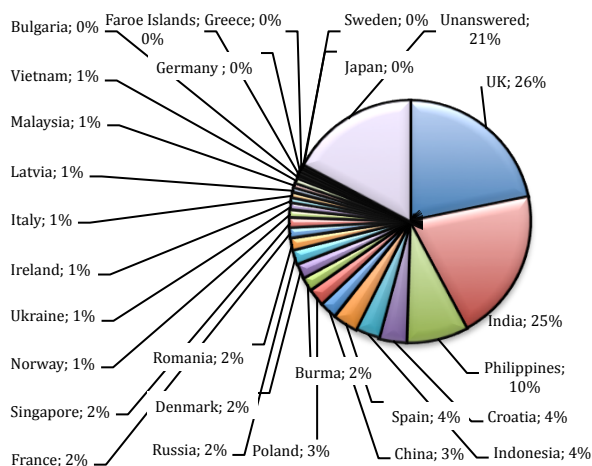


Figure 1: Country of MET (N=317)

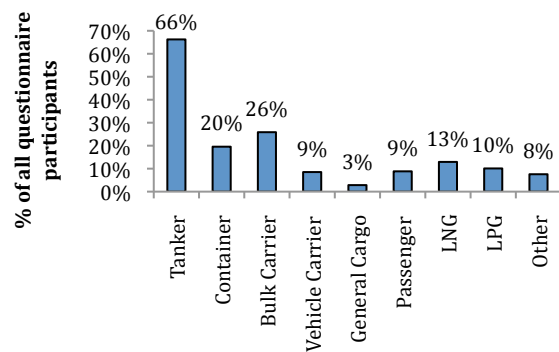


Figure 2: Types of vessels participants currently or have previously worked on (N=317)

Participants were asked what type of vessels they have previously or presently work on: again participants were able to select more than one type of vessel. Figure 2 demonstrates that 66% of the 317 participants have worked on tankers whilst only 26%, 20% and 13% have worked on bulk carriers, containers and LNG vessels, retrospectively. Thus the comments proved within the questionnaire responses are most likely to be based on tanker operation expertise but may also include operational experience onboard other vessel types. Figure 3 demonstrates the job roles that

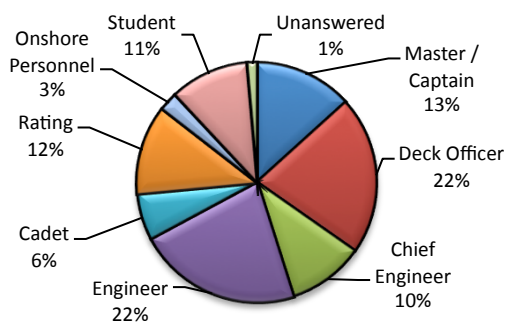


Figure 3: Job role of participants (N=317)

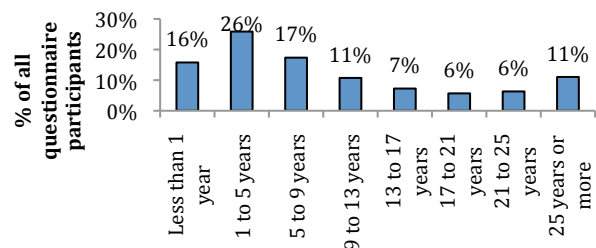


Figure 4: Years experience at sea of participants (N=317)

the participants currently work in. 35% of participants are from the bridge team (Master/Captain and Deck Officer) and 33% are from the engineering team (Chief Engineer and Engineer). This is a good response, both in terms of sample size and proportion, which is particularly beneficial for the analysis of questionnaire parts 4A and 4B that are addressed specifically to the bridge or engineering teams. Finally, Figure 4 demonstrates that 84% of participants have had more than 1 years sailing experience and therefore the results can be assumed to represent the opinion of seafarers at sea. (The 16% of participants who have had less than 1 years experience includes the 11% of students (Figure 3)).

4. Questionnaire results and discussion

4.2 General awareness and knowledge of carbon emissions

When regulation is introduced (SEEMP and EEDI in January 2013) and mandatory operational procedures evolve, if seafarers do not have the background knowledge and understanding of why these changes are being enforced upon them it will result in blind following of mandated procedures. It is already known that workload on seafarers is high and increased procedures set by management are not always well received. Therefore a lack of awareness, knowledge and understanding of why changes are occurring is likely to generate negative attitudes towards the subject and lead to possible negligence and/or a build up resentment between operational groups (see sections 4.4, 4.5, 4.7, 4.9). This will not allow for the behavioural change that is needed for effective carbon emission reductions. For this reason, even if the seafarers themselves remain sceptic about climate change, it is necessary for them to understand the scientific background to carbon emission, how it is prompting international change (UNFCCC, Kyoto Protocol, etc) and hence why reactive changes are happening within and out-with the shipping industry. Participants were therefore asked about their general awareness and knowledge about the effects of carbon emissions.

'...each country has to be responsible not target the seafarers ... Why we are targeted because we are the easy catch ...'

Figure 5 demonstrates that whilst the largest proportion of participants believe they are aware of the effects that carbon emission have on our world, there are still 23% who believe they are only fairly or a little aware. Only 20% of participants have the confidence to say they are very aware. Awareness levels are the foundation on which to build knowledge and motivation and therefore this result clearly demonstrates that there is a need to increase general awareness about carbon emissions.

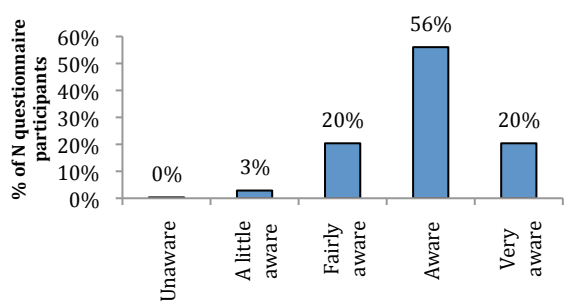


Figure 5: Participants' awareness of the effects carbon emissions have on our world (N=314)

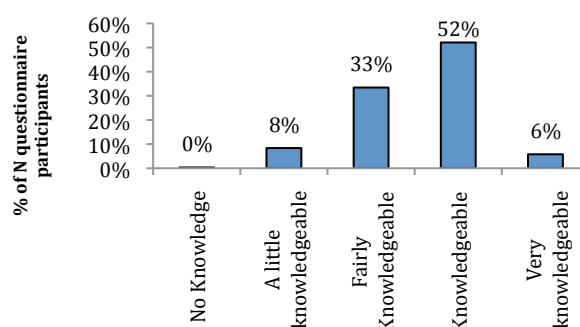


Figure 6: Participants' knowledge of the effects carbon emissions have on our world (N=311)

Figure 6 demonstrates that participants believe they have less knowledge than awareness about the effects that carbon emissions have on our world (assuming the scales are comparable). Only 6% believe they are very knowledgeable. In a similar way to awareness, without this knowledge how can it be expected that seafarers will have the understanding and motivation to develop more technical knowledge. To further emphasis this point and to demonstrate the real benefit of this knowledge, Figure 7 shows clearly that those participants who increasingly believe they have more knowledge about the effects that carbon emissions have on our world have currently increasingly tried more to make energy efficiency improvements onboard. Thus the motivational benefit of general carbon knowledge is evident. (The result for 'no knowledge' can be ignored as it is based on only 1 response and thus is reflective of personal opinion and not of seafarers in general).

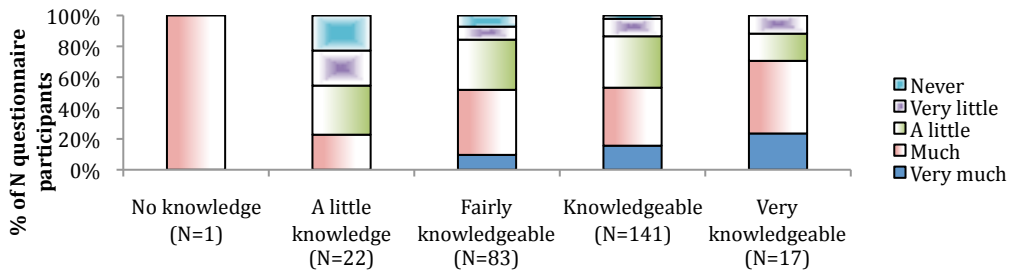


Figure 7: How much participants have currently tried to make energy efficiency improvements onboard depended on their level of knowledge about the effect that carbon emissions have on our world

4.3 Knowledge sources for LC-EE Knowledge

Figure 8 demonstrates that the most common method for knowledge acquisition about the effects of carbon emissions is via newspapers followed by TV documentaries, TV news and magazines. It is known that the knowledge content within these sources is not comprehensive and/or specific to carbon emissions, particularly to shipping, and thus these sources do not provide the knowledge levels required for effective shipping carbon emission reductions. Figure 8 also demonstrates that less than half of the participants have discussed the topic with other people indicating that energy efficiency for carbon emission reductions is not a topic of focus and hence discussions: ‘share and discuss’ has been quoted and identified in many response as an effective method for learning. A significant result also shown in Figure 8 is that only 20% of the 311 participants have gained knowledge about the effects of carbon emissions via an education or training course. The participants who have undertaken such courses were also asked to provide further details of which, in which no comments appeared specific to the subject of energy efficiency or carbon emissions; although awareness of other GHGs (SO_x and NO_x) appears to be increasing.

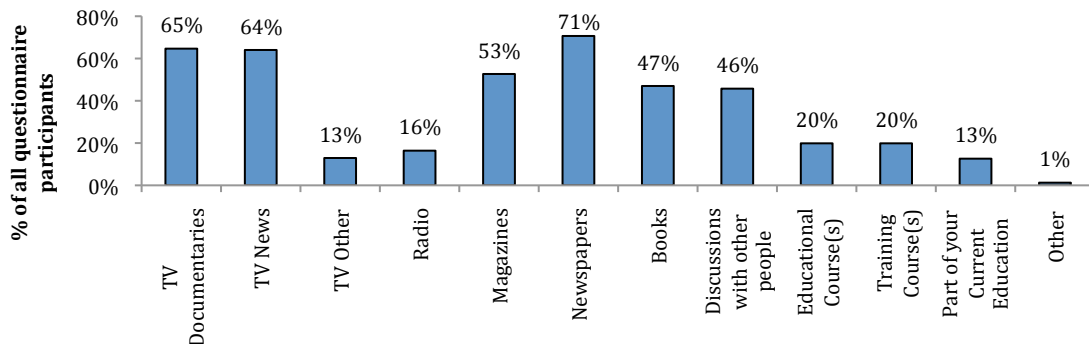


Figure 8: Methods for knowledge acquisition regarding the effects that carbon emissions have on our world (N= 311)

4.4 Technical awareness and knowledge of how to achieve carbon emissions

Within the questionnaire participants were asked to provide written answers about how the operation and maintenance of systems and voyage planning can be improved to achieve energy efficiency savings. Only a relatively small proportion of participants provided an answer to these questions (taking into account that there was a part for the engineering and bridge teams). The style written of question may have had an influence on the response rate due to the time, effort and English language skills required to provide a written answer. Nevertheless, the small percentage of answers could also be indicative of a lack of ideas and knowledge of how energy efficiency improvements can be carried out. Furthermore, the responses provided contained many reoccurring general comments, that lacked in technical content and often included management and design decisions, switching off lights, using less fresh water, etc (see the following quotes and quotes throughout the paper). Furthermore, some comments (not shown in quote boxes) varied greatly and in a few instances appeared contradictory. All these points demonstrate an uncertainty or a lack of awareness and knowledge, or motivation to acknowledge, how seafarers can also contribute towards carbon reductions. It should be the case that seafarers instantly recognize the key best

'Keep the main engine parts in tiptop condition to guarantee the performance recommended by maker.'	'Route and speed instructions should be given to the vessels, where the eco speed must be better defined to ensure all utilise the lowest possible steady main engine load point during a given voyage.'	'Good quality fuel should be used.'	'Good support should be provided from the company by providing vessel spare parts to maintain vessels machinery'
'During cargo operation, there is great potential to optimizing the use of cargo pumps.'		'By reducing unnecessary operation of machinery.'	
'The deck team should stop cargo service machines in time after cargo operation and inert gas generators.'	Hull Scrubs. 'Prop Polish and high performance antifouling.'	'Steady running of the vessel at sea.'	
		'The safest and shortest route should be selected.'	'Train bridge personnel to think further ahead to be able to minimize alterations of course.'
		'Reduce use of incinerator.'	

practices that they could carry out to improve energy efficiency. This is not saying that all seafarers do not already have this level of technical knowledge needed, but it is clear that currently it is not at the forefront of their focus. Thus this topic needs to be given emphasis, particularly for operational improvements at a seafarer level and not just for management and design improvements.

4.5 Motivation towards carbon reductions (importance and possibility)

The questionnaire participants were asked how important they think it is to reduce global and shipping carbon emissions, how possible they think it is to do so, and how possible it is for crew to help do so. These questions were asked to provide an indication of the participants' motivation towards the subject. The following set of graphs (Figure 9 to Figure 12) demonstrate an average (median) positive view of seafarers. However, there is still a spread of results across the scale for all questions.

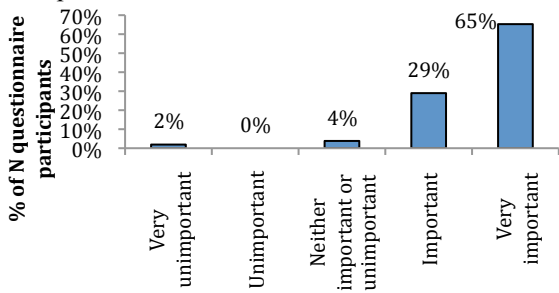


Figure 9: How important participants believe it is to reduce global carbon emissions (N=314)

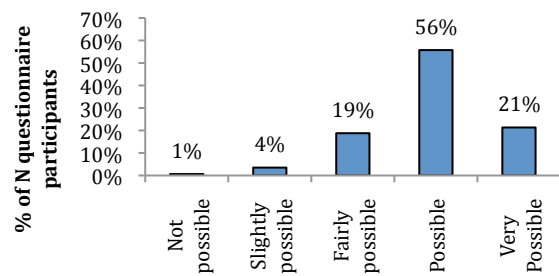


Figure 11: How possible participants believe it is to reduce shipping carbon emissions (N=314)

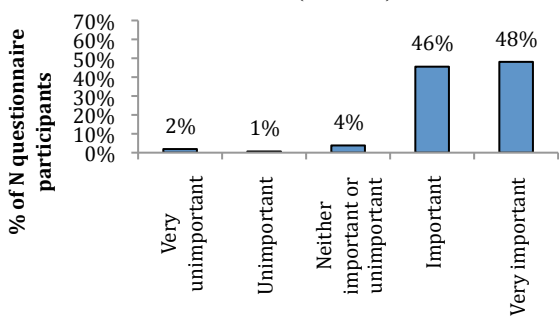


Figure 10: How important participants believe it is to reduce shipping carbon emissions (N=314)

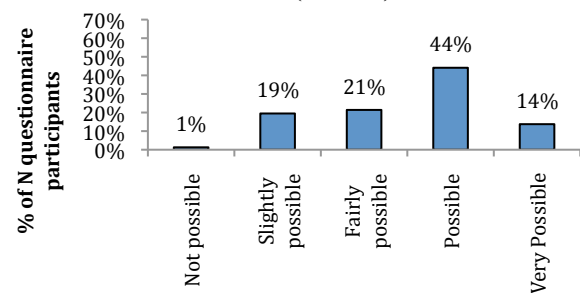


Figure 12: How possible participants believe it is for crew to help reduce shipping carbon emissions (N=314)

Figure 9 and Figure 10 show that 2% of participants believe it is very unimportant to reduce carbon emission and a further 4% believe it is neither important nor unimportant. It can also be determined by comparing mean values, that the average view of participants is that it is more important to reduce global carbon emissions than shipping carbon emissions (the mean response decreases by 4% (from 4.56 to 4.37)). Figure 11 and Figure 12 demonstrate how possible participants believe it is to reduce shipping carbon emissions and how possible it is for crew to help do so. It cannot be expected that crew will make a conscious effort to reduce carbon emissions if they do not think it is

possible. Figure 12 in particular show a large spread of responses, with 40% of participants believing it is only fairly or slightly possible. There is also a large decrease (11%) between how possible participants believe it is to reduce shipping carbon emissions (mean of 3.94) and how possible it is for crew to help do so (mean of 3.50). This therefore demonstrates that there is a need to teach and demonstrate to participants (increasing awareness and knowledge) just how possible it is for crew to help reduce shipping carbon emission.

'Proper knowledge, training and motivation are not there.'

Figure 13 shows that 74% of participants would like to know more or a lot more about how crew can help reduce shipping carbon emissions, but 27% would still only like to know some or a little. This demonstrates a lack of motivation and could be due to anyone of the following; low motivation to learn in general, lack of interest in the subject, a reluctance to learn additional tasks to carry out. These are very important considerations that need to be taken into account when developing an educational course or inspiring motivation and the following sections of this paper discuss effective methods to achieve them.

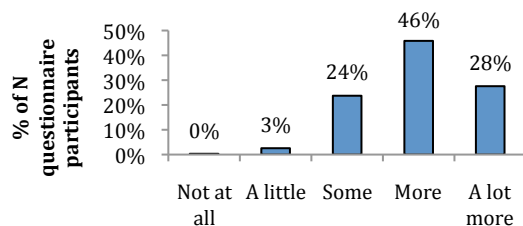


Figure 13: How much more participants would like to know about how crew can help reduce shipping carbon emissions (N=312)

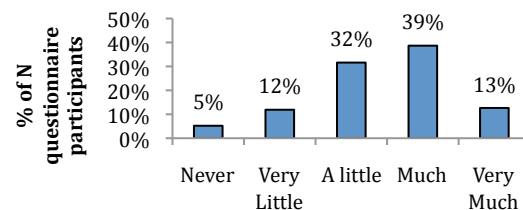


Figure 14: How much participants have already tried to make energy efficiency improvements onboard (N=269)

Figure 14 demonstrates a large spread of responses across the scale for how much participants have currently tried to make energy efficiency improvements onboard, with 49% trying a little, very little or never. Participants were asked to provide written details of how they have currently tried to make energy efficiency improvements, or why they have not. The current efforts made were similar to those stated within the technical knowledge, Section 4.4. However, the reoccurring comments that appeared for why efforts have not been made included:

'Very busy on board, extremely busy. It is better to stop using your car and continue with bicycle.'

'Limited by operation requirements and resources. Lack of time and man power.'

'This priority is not so high in my mind'

'No time to think about that'

'Not much mainly because I am part of the deck department, but I do my best to contribute for the carbon emission cause.'

The above quotes demonstrate that there is clearly a current viewpoint that will not allow for effective carbon emission reductions. It thus needs to be made clear to crew that this is becoming a more important topic, it is everyone's responsibility, there are ways that everyone can contribute, and efficiency can enhance workload in some cases. It has already been demonstrated that knowledge increases motivation to make efforts (Figure 7) and therefore knowledge needs to be taught via the most effective methods for educating and training seafarers. Section 4.9 discusses how integrated operations can help achieve these points and increase motivation.

4.6 Effective learning methods

Participants were asked to rank which methods for teaching/learning are most effective.

'Anticipation is always a key word in this issue.'

Learning from personal experience is one of the most effective methods for teaching/ learning and therefore it is no surprise that practical workshops, simulator training and onboard training are considered by participants to be the most effective methods: noting that practical workshops are ranked as more effective than simulator training (Figure 15). Exercises (practical where possible: including practical workshops, simulators and onboard) are an essential part to the education as they demonstrate (quantify) the potential savings that can be achieved by improved operations, and how each saving varies with external or changing

'Proactive attitudes to implement and explain the benefit for long and short term gain'

conditions. This knowledge and insight is what will help increase understanding of the benefits and hence motivation towards carrying out energy efficiency improvements. Simulator training offers the advantages for seafarers to practice and observe low carbon energy efficient operations in a safe environment where performance can be monitored and fed back. In particular it allows for situational awareness to be further developed (enhancing both safety and efficiency) and this has been highlighted as a best practice within the technical comments. Thus where possible simulator facilities should be utilized for LC-EE MET. A disadvantage of onboard learning for the topic of LC-EE is that onboard learning is very dependent on the knowledge, skills and motivation of the supervisor and if they do not have LC-EE awareness, knowledge and motivation (as currently demonstrated within this questionnaire analysis) then this method may not be of greatest benefit. However, as LC-EE knowledge is distributed and motivation increases within existing crew this will become much more effective method for this topic and should be included within the onboard learning objectives. Individual learning has the benefits of flexibility and allowing for knowledge development at an individual's most effective rate. However the disadvantage for this subject is that it largely depends on a trainee's motivation to learn, and if that is not there (demonstrated in Figure 13), it cannot be expected to translate into motivation for LC-EE operations.

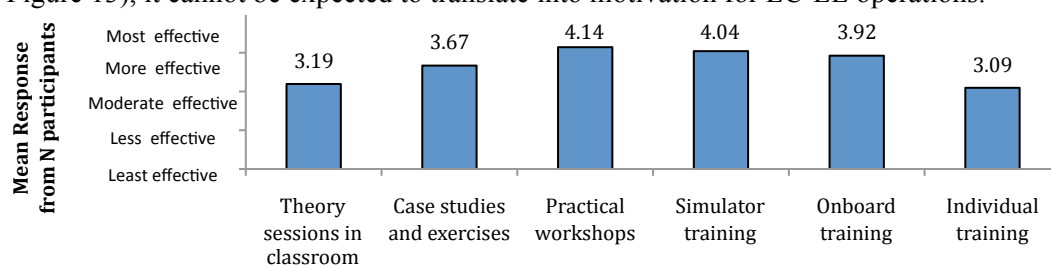


Figure 15: Effectiveness of methods for maritime education and training (N=274)

'Well it depends on the topic, but in general, with respect to carbon reductions, the problem is not the knowledge, but the motivation to use the knowledge and information'

The delivery content and style of a maritime education and training course should be correct for the specific trainee group. The primary objective should be to enhance existing knowledge and skills and this should be made clear from the beginning of any course. In some cases fundamental background may need to be revisited depending on the group of trainees; to ensure sufficient knowledge and understanding on which to start the development on more advanced techniques. However, if existing knowledge (learnt during basic training and previous courses) is laboured upon then this will lose the interest of the trainees and hence defeat the objective of the course. It should also be made clear to the trainees that they are recognised experts in their field (seeing as they carry out their jobs in a practical environment each day) and thus the education and training should also provide a

platform for discussion where the ideas and comments of the trainees are heard. If possible the comments from the education and training should be fed back to the company or training institute, as it is likely that the feedback will contain very useful and beneficial comments regarding practical implementation and progress. It is also likely to increase trainees' motivation (through individual empowerment) and benefit shore-sea relationships (through communication and knowledge exchange).

'Feedback that it actually works and makes a difference'

4.7 Incentive to achieve energy efficiency and hence carbon emission reductions

In addition effective education and training to providing the knowledge base and motivation for LC-EE, various incentive methods should also be considered. Firstly, Figure 16 demonstrates that the majority of participants (94%) believe it is important or very important to introduce shipping carbon emissions regulations. This is further emphasised within the written comments; particularly in the comments regarding why current improvement efforts have not already been made. In addition to shipping regulations, company policy was also strongly commented on; the general view is that without mandatory pressure to carry out energy efficiency improvements, it will not happen due to existing high workloads and other priorities (see section 4.5 for quotes). Figure 18 discussed in the following section of this paper, further demonstrates that participants believe low carbon regulations are the third most important improvement that needs to be made (after the availability of new low carbon technologies and management decisions) to achieve effective carbon emission reductions).

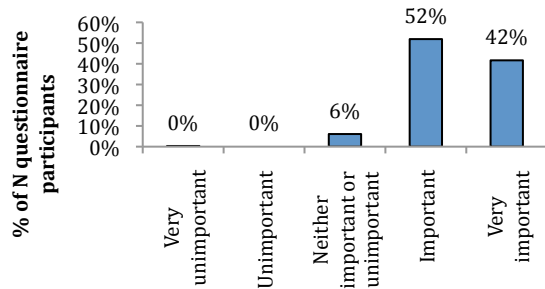


Figure 16: How important participants believe it is to introduce shipping carbon emission regulation (N=312)

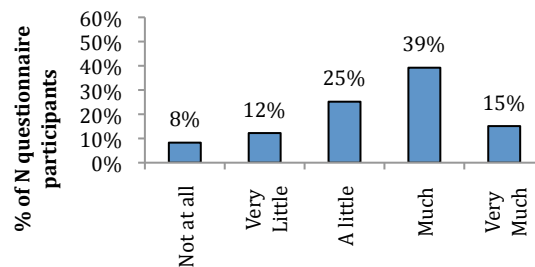


Figure 17: How much participants think a reward would affect the amount they try to make energy efficiency improvements (N=278)

Participants were also asked if a company reward would affect how much they try to make energy efficiency improvements onboard. Figure 17 indicates that although, a reward is likely to make a positive difference, opinions over this question varied considerably and therefore it is not recommended as strong or certain method for increasing motivation.

4.8 Improvement focus areas

Participants were asked to rank the areas shown within Figure 18 in order of improvement importance to achieve carbon emission reductions. The ranking order could be considered when identifying a LC-EE strategies and prioritising operational improvements. It should be noted that all average responses (median) fall within needing more or most improvement and thus no areas listed need no improvement.

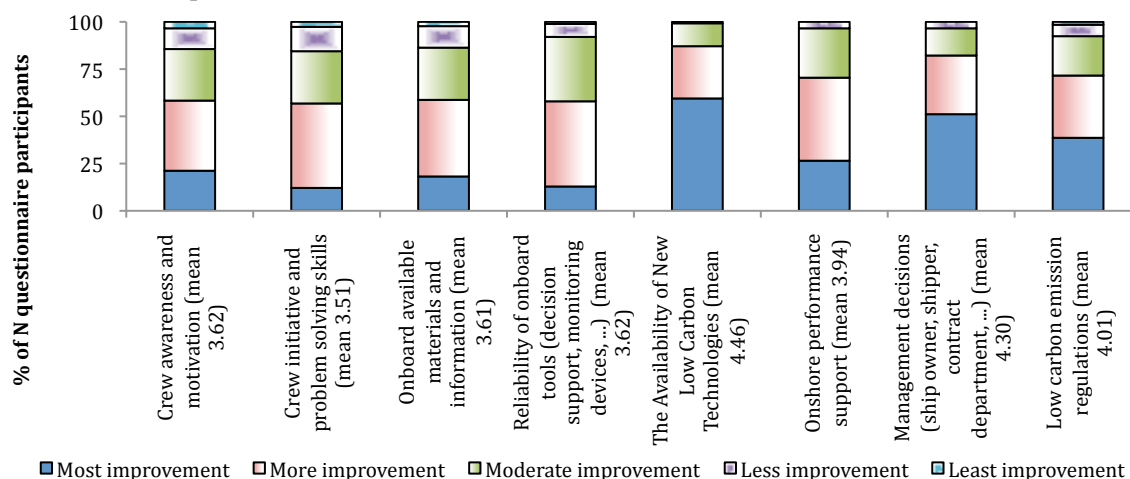


Figure 18: Areas that participants' believe need the most improvement to achieve shipping carbon emission reductions (N=264)

The availability of new low carbon technologies was ranked as the most important followed by management decision. Low carbon regulations followed by the other improvement areas were all ranked as needing more improvement. Improvement of onshore performance support was ranked 4th and this is discussed at greater length in the following section 4.9. Reliability of onboard tools (decision support, monitoring devices) was ranked as the joint 5th most important improvement to make along with crew awareness and motivation. However, crew initiative and problem-solving skills was ranked last (8th). This indicates that the participants believe that seafarers in general have better initiative and problem solving skills, but they lack more the awareness and motivation to apply them to LC-EE savings. Onboard available material and information was ranked 7th indicating it is not an area of primary concern for improvement, but is still an area for consideration. The written responses also highlighted the following as key areas for improvement: fuel quality,

"The ships management should educate and train all ship present personnel to be efficient and be given support from owners and charterers to run the vessel smoothly and efficiently."

availability of spare parts for maintenance, voyage scheduling, voyage handling, cargo handling, good plant management, training etc (also see quotes in section 4.4).

4.9 Integrated operations

'All deck officers should be at least familiar with all engines on board. Thus they can plan work and this will lead for the improvement of the environment.'

Figure 19 has highlighted management decision and onshore performance as two key areas for most improvement. Participants were then further asked which levels of personnel out of the following (Figure 19) have the most influence over the most carbon emission reductions. As expected, the shipping company and shipper were ranked as having influence over the most reductions. This was followed by the engineering team and then onshore shore support and the voyage contract department. The bridge team and deck team were ranked as having the least influence. The difference between the proportion of participants who responded most and more reductions for the engineering team and bridge team is large. However, optimised voyage planning as well as other operational improvement (see the SEEMP) can be carried out by the bridge team to achieve LC-EE operational improvements. There are also many voyage planning objectives that can be improved with good communication and co-operation between the bridge and engineering teams. Thus the large proportion difference between the results could be a due to low awareness and knowledge of how the bridge team can contribute towards reduction, or, it could be due to an association of energy efficiency and emissions with engineering operations. What ever the reason, awareness and knowledge of operational improvements should be increased. (Further analysis into the ranking order dependent on participants' job role is an area should be considered for further evaluation).

'Coordination between bridge and engine room.'

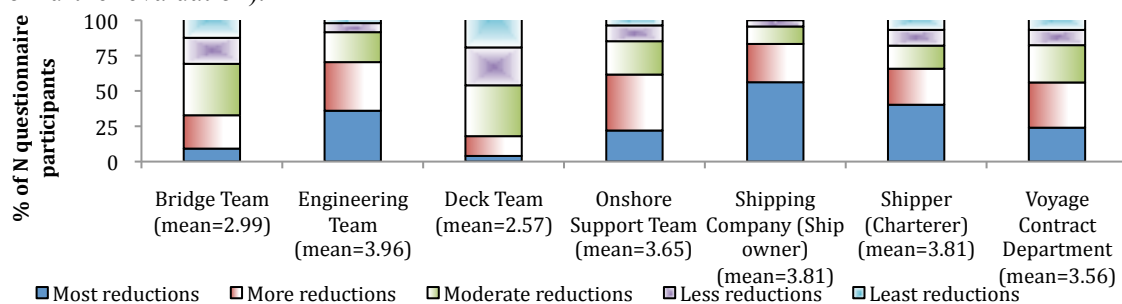


Figure 19: Who participants believe have the most influence over shipping carbon emission reductions (N=250)

Many written responses within the questionnaire also discussed how carbon emission reduction potential lies with management personnel, and that seafarers at sea have little or no influence. In addition, comments were also made that questioned why seafarers should be targeted to reduce carbon emission reductions when control and/or the most savings can be achieved ashore (also see quotes throughout paper). This identifies the necessity to have clear communication between and to all levels of personnel, including seafarers. This could be achieved with a transparent company policy and making sure that company efforts, initiatives and changes are communicated (in brief) to all personnel so that no one group of personnel gains only part of the picture or feels unfairly targeted for contributions. This way seafarers will know that changes and efforts are being made ashore (where the most reduction potential can be achieved) and thus a better, more positive and more 'team effort' understanding and attitude can be achieved.

Continuing with communication between ship and shore, the onshore team were ranked 4th out of 7, as being able to help contribute towards moderate or more carbon emission reductions (Figure 19). Onshore performance support was also ranked 4th out of 8 as an area that needs more improvement to achieve potential carbon emission reductions (Figure 18). Furthermore it was determined that 60% of participants would request information often or very often from onshore support; there is still 40% of participants who would request it sometimes, not very often or never. This raises two issues. The first is that the onshore support should be in a position to be able to

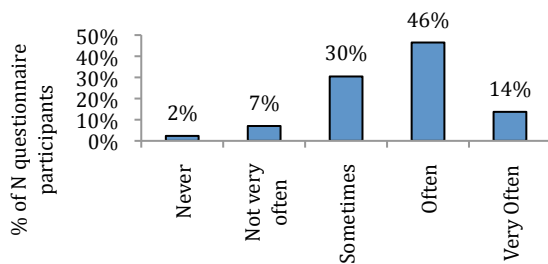


Figure 20: How often participants would request information on 'How to' from onshore support and follow it (N=299)

There should be opportunity to discuss this exchange amongst all involved personnel and how it can be valuable towards reducing shipping carbon emissions and assessing energy efficiency performance. It should be made clear that each level of personnel working at sea or ashore has their own expertise areas and therefore good teamwork and communication management combining these expertises increase motivation and teamwork to achieve low carbon efficient operations.

5. Conclusions

Currently general carbon awareness and knowledge is gathered via sources such as newspapers. Even the small percentage (20%) of participants who have undergone education or training and learnt about the effects of carbon emissions did not describe any courses that provided the focus needed for this subject. In conclusion, it is clear that the correct awareness, knowledge and knowhow needs to be provided to all seafarers to ensure that they know what the best practices are and know how implement them safely and efficiency. This is particularly important with the introduction of the SEEMP and therefore the correct low carbon – energy efficiency maritime education and training (utilising correct teaching methods to inspire behavioural change and motivation) should be provided. In addition, clear communication and integrated operations, onboard and between ship and shore, should be enhanced to achieve effective carbon reductions.

6. Future Work

In continuation of the questionnaire analysis presented within this paper there is still a large amount of information that can be drawn from the questionnaire data to support a detailed needs analysis. Investigation into the results should include looking at the differences between the teams onboard and ashore (bridge, engineering, etc), counties of learning, and experience (years at sea). Furthermore some groups of participants (i.e. a group from one company or MET institute) provided considerably more responses to the questionnaire than others. Therefore results should be analysed to investigate the varying responses from participants who have worked for different sized companies; investigating the assumptions that perhaps a larger company may be more able to trial and invest in new technologies, innovations and trainings, than smaller companies and thus knowledge and motivation may be higher. A full analysis method and associated assumptions should be presented along with the described results.

It is intended that this questionnaire analysis supports the development of a specific, formalised Low Carbon – Energy Efficiency Maritime Education and Training course, suitable for delivery to existing seafarers, as well as new cadets. In addition to this it may also provide useful for management or performance review as well as support for the development of a Low Carbon Strategy or Policy. These are still areas to be developed.

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