

“An Examination of the degree of effective application of Ship Energy Efficiency Management Plan by the Greek Shipping Companies through a Benchmarking Analysis.”

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*The author declares that the work is the result of his own
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ABSTRACT

The present study focuses on the examination of the extent of effective application of the Ship Energy Efficiency Management Plan by the Greek shipping companies vis-à-vis their international competitors and through a benchmarking analysis.

The aim of this study is to evaluate and analyse the Greek shipping companies' management with the respect to effectiveness of their approach in SEEMP implementation.

This aim is broken down into the following objectives which include:

- Examine the framework of new regulations regarding Energy Efficiency for the shipping industry.*
- Analyse the main stages of and requirements for a ship Energy Efficiency Management Plan (SEEMP).*
- Evaluate the benefits to implement the Ship Energy Efficiency Management Plan (SEEMP) especially with respect to the Greek shipping companies.*
- Carry out a benchmarking analysis of the SEEMP implemented by Greek shipping companies.*
- Identify and analyse gaps and make prospective recommendations for improvement.*

The main tools, examined in the literature review, used for the analysis purposes of this study and which have been applied to carry out the investigation and interpret primary research results include: relationship of the SEEMP with energy efficient management, SEEMP within the context of new regulations, the stages of SEEMP completion cycle, best practices for energy efficient shipping operations, Benchmarking principles and challenges for contemporary Greek shipping companies.

Primary research data was drawn from a combination of quantitative and qualitative research methodologies. Primary research results were next statistically processed through the application of SPSS software (Version 20). Results drawn from investigation and primary research results (from survey and interviews) provided evidence that through their analysis and interpretation satisfied the study's objectives.

The main conclusion drawn is that Greek shipping companies are distinguished into 'two-speed' companies with the leading ones being proactive, going beyond mere compliance and outperforming their international competitors while the 'followers' target mere compliance with the regulations.

With respect to the areas that need further improvement, these include:

- *Better implementation of Just – in time arrival/ reducing congestion.*
- *Installation of energy saving devices for propulsion and resistance improvement applicable to existing vessels.*
- *Good new building vessels with new hull no need any installation of energy savings.*
- *Companywide training/ awareness on SEEMP implementation and its beneficial prospects.*
- *Performance monitoring and development of qualified staff form SEEMP implementation/ staff motivation.*
- *Goal setting beyond compliance at the corporate level.*
- *External benchmarking.*
- *Reduction of fuel consumption of the order 200% is not impossible through LNG.*
- *Closing the ‘loop’ of SEEMP PDCA cycle through proper assessment and evaluation of SEEMP implementation and feeding back respective results to the planning stage of the next cycle, applying thus a dynamic approach.*
- *Synergies with universities and other scientific to achieve further improvements.*

Finally, main suggestions for further research include:

- a) Expansion research basis by increasing the size of the sample of the Greek shipping.*
- b) Repeating the research in a year or two so that more data will be available and safer conclusions can be drawn.*

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

The present study focuses on the concept and practice of Ship Energy Efficiency Management Plan (SEEMP). However, a within reason question could be: what is a SEEMP? This is a plan aiming to incorporate the best practices applied in the shipping industry with respect to the efficient operation of fuel by ships intended to assist the shipping industry in dealing with the environmental performance of ships and comprise a practical guide for improving operational efficiencies. In that respect the SEEMP incorporates the main best practices. The history of SEEMP goes back to the Marine Environment Protection Committee, at its fifty-ninth session (13 to 17 July 2009), recognising “*the need to develop management tools to assist a shipping company in managing the environmental performance of its ships, agreed to circulate the Guidance for the development of a ship energy efficiency management plan*” (IMO, 2009). According to its framework and its underlying principles if SEEMP is properly applied it should significantly reduce fuel consumption. Ship Energy Efficiency Management Plan (SEEMP) is mandatory for ships over 400 GT and from the 1st of January 2013 it will have to be issued an International Energy Efficiency Certificate (IEEC) on the first renewal or intermediate survey after January 01, 2013 (Tecnoveritas, 2013). In order for this certificate to be issued the presence of a SEEMP on board that is promptly and easily accessible is required.

The shipping industry has come to the centre of interest and became the subject of increasing scrutiny in recent years since the regulating authorities as well as the general community worldwide have become more concerned with carbon emissions globally. Consequently, a great deal of effort and research was carried out and on the basis of its results it was then commonly and widely acknowledged and recognised that carbon emissions could be significantly decreased if operational efficiency was improved on a wide range of ships. Within this context the SEEMP has come to provide with efficient and successful solutions (European Commission, 2013).

According to Dimakopoulos and Hatzigrigoris (2012) the phenomenon of global warming is a well-known and- at the same time- a rather complex problem to understand since it involves and affects the entire world. What makes this problem even more difficult and complex to deal with includes parameters such as coverage of society’s energy needs, necessary for its development. Specifically, the purpose of a ‘Ship Energy Efficiency Management Plan’ (SEEMP) is to be a useful and practical tool for helping ship-owners and ship operators manage their environmental performance

and improve their operational efficiency (ABS Nautical Systems (2012)). A series of maritime consultants seem to believe that the way a SEEMP is implemented determines whether it is successful or not. According to IMO (2009) the SEEMP should be developed as a ship-specific plan and not as generally applicable framework to the whole fleet of a shipping company. Moreover, it is necessary to note that the SEEMP should be viewed as a framework seeking to improve a ship's energy efficiency through four consecutive stages: planning, implementation, monitoring, and self-evaluation and improvement, which play a crucial role in the continuity of the cycle and in order to improve ship energy management (Pasin Marine Consultants INC., 2013).

The SEEMP, Ship Energy Efficiency Management Plan has become a present 'must' since in line with IMO rules and regulations (MEPC.1/Circ.683), all existing vessels must have a SEEMP available on board by 2013 therefore each shipping company has to make the most of its relevant know how and related assets in order to achieve an effective implementation of a SEEMP and its integration to the already existing and running operations.

1.2 JUSTIFICATION

A reasonable question that may arise is why SEEMP carries such an important weight for the shipping industry and the individual companies operating within this particular industry that in turn justifies academic research. The answer to this question comprises a number of parameters/ reasons which set the basis of research justification at a global, European and country (Greece) level.

First of all it has to be noted that Ship Energy Efficiency Management Plan (SEEMP) has become mandatory for all ships over 400 GT from the 1st of January 2013 therefore a sound research on its effective implementation is required.

Another reason that apparently justifies the academic research and occupation with this issue stems from the growing impact of shipping industry on the environment. Specifically, there are around 70,000 vessels engaged in the industry which carries 90% of global trade and although sea transport has a justifiable image of carrying out its operations in a way that has considerably little impact on the global environment, it seems that there is a growing trend to this impact and GHG emissions from shipping are expected to increase significantly in the future. For example and in line with the growth projections of world trade, EU-related emissions from shipping (as Greek shipping is) account today to 4%, they are expected to increase significantly further in the future by 51% by 2050 compared to 2010-levels (+86% by 2050 compared to 1990-levels) despite the adoption of minimum ship efficiency standards for new ships by the International Maritime Organisation (IMO) in 2011.

Moreover, at the EU level (where the Greek shipping industry belongs), international maritime transport remains the only transport mode not included in the EU's GHG emissions reduction commitment.

With respect to the effective adoption and implementation of SEEMP by the Greek shipping the reason that justifies this research stems from one of the biggest drawbacks which is the relevant environmental legislation system being too complicated and fragmented to be enforced, involving a lot of authorities and organisations. This results in mismanagement and insufficient communication and coordination among the responsible parties to implement the legislation. According to International Maritime Organisation IMO (IMO GHG 2009a) there will be a significant increase in CO₂ emissions predicted (200 to 300%) by 2050 in the absence of strict regulations (Hughes 2012). Nevertheless, since 1 January 2013 SEEMP became mandatory therefore it is interesting to explore the extent to which proper implementation has been followed by Greek shipping companies, especially after taking into consideration the valuable contribution that Greek shipping industry makes to the Greek economy as one of its two main 'engines' (with tourism being the second one) that may drive Greece out of its current economic depression.

1.3 AIMS AND OBJECTIVES OF THE STUDY

1.3.1 Aim:

The aim of dissertation is to evaluate and analyse the Greek shipping companies' management with the respect to effectiveness of their approach in SEEMP implementation.

1.3.2 Objectives:

- Examine the framework of new regulations regarding Energy Efficiency for the shipping industry.
- Analyse the main stages of and requirements for a ship Energy Efficiency Management Plan (SEEMP).
- Evaluate the benefits to implement the Ship Energy Efficiency Management Plan (SEEMP) especially with respect to the Greek shipping companies.
- Carry out a benchmarking analysis of the SEEMP implemented by Greek shipping companies.
- Identify and analyse gaps and make prospective recommendations for improvement.

1.4 SCOPE AND LIMITATIONS OF THE RESEARCH

The scope of this research extend to the boundaries that define the area of the present study and which have to do with the effectiveness of Greek shipping companies' management with the respect to the effective implementation of SEEMP. As far as the potential limitations are concerned these can be mainly related to the possibility of the shipping companies contacted, not providing the author with genuine and valid data for the SEEMP implementation approach they follow as of January 2013 that they have been accountable to Marpol with respect to the extent that the SEEMP framework that they have implemented comply with the respective EU regulations required.

1.5 INFORMATION SOURCES

The sources where the information and data required for the completion of the present study will be drawn from comprise two main categories of sources that match the respective research needs: a) primary and b) secondary.

Specifically, as far as the primary research needs are concerned these will be satisfied by contacting sources such as: Greek shipping companies, Greek coast guard services and non-governmental organisations (i.e. Greenpeace etc.) through a combination of a survey and interviews.

As far as the secondary research needs are concerned these will be satisfied through the use of information sources such as articles accessible at well-known databases (i.e. EBSCO, Emerald, etc.). Moreover, in order to gain an insight into the reality of Greek shipping companies with respect to the SEEMP implementation the 'Naftemporiki Journal' which is the main official information source as far as the Greek shipping industry existing conditions, events, progress as well as its wider context are concerned.

1.6 OUTLINE OF SUBSEQUENT CHAPTERS

Chapter 2: Literature Review. A synthesis of the relevant literature drawn from various textbooks, documents, academic journals, web references and relevant reports will be carried out and presented in this chapter. The theoretical framework for the study will also be presented and discussed, hence establishing in this way the context of currently relevant knowledge. Moreover, the relevant theoretical tools and concepts which will be applied for the analysis of the primary research findings will be examined and specified.

On the basis of: a) the study's aim and objectives b) literature review and c) respective empirical research findings, the results of the primary research will be interpreted. The author of the present study believes that its significance lies in the integrative approach that will be followed and which

will attempt to integrate the SEEMP introduction approach along with the effective management of the shipping companies to address the issue of Greek shipping companies' competitiveness sustainability.

Chapter 3: Research Methodology. In this chapter and on the basis of the study's objectives a combination of qualitative (interviews) and quantitative (survey) research methods will be applied and the approach to their application will be explained as well as the underlying reasoning that led the author to the choice of such a combination, supported also by relevant theoretical background. The research sample will be specified and the way that the interviews and the survey have been administered will be explained.

Chapter 4: Data Presentation and Analysis. Main findings and results of the primary research will be presented, discussed, analysed and critically evaluated in this chapter with respect to the aim and the objectives of the study.

Chapter 5: Summary and Conclusions. Main conclusions drawn from the study will be summarised and presented in this chapter with respect to the factors that have contributed to the degree of effective implementation of SEEMP by the Greek shipping companies, areas for improvement will be specified and suggestions for further research will be made.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The chapter of literature review for any project serves the purpose of specifying the appropriate framework of the relevant concepts, ideas and tools that were used to elaborate the research questions on one hand and on the other to provide the writer of the project with a sound basis on which he will be based in order to interpret and analyse the results of the primary research. Based on this rationale the writer of this work carried out a relevant literature review which evolved around two main axes: Energy Efficiency Management EEM and Ship Energy Efficiency Management Plan SEEMP as well as respective best practice approaches and actions that have to be applied for optimum results.

The reasoning behind this focus of secondary research is that these axes and the relevant concepts will in turn be applied by the writer in order to carry out the benchmarking analysis for the Greek shipping companies and decide the extent to which they are managing their energy efficiency scheme successfully, identifying at the same time areas for improvement.

2.2 ENERGY EFFICIENCY MANAGEMENT EEM AND SHIPPING ENERGY EFFICIENCY MANAGEMENT PLAN SEEMP

According to the International Maritime Organisation IMO (2009) there are approximately 70,000 vessels engaged in the international trade with the shipping industry carrying out almost 90% of the global trade. While the shipping industry is justifiably perceived as causing considerably little impact on the environment there is always room for further improvement especially when this improvement can result in reducing both environmental impact and fuel consumption. Lee and Hare (2011) on the other hand dealing with the issue of international emissions, argue that although shipping (as well as aviation) has significant non-CO₂ emissions, these however have effects on global warming and cooling, with short-term cooling effects not outweighing the long-term warming effects (IPCC, 2011). The SEEMP provides “*the most efficient vessel operation method (optimum route selection, appropriate maintenance, slow steaming, ocean currents, and weather) to reduce CO₂ emissions, while ensuring safe operation and maintaining a strict operation schedule*” (Lloyds List, 2013).

However, reviewing the relevant literature, the writer of this paper identified some degree of scepticism expressed, concerning the validity of the relevant data released, concerning CO₂ emissions by shipping. For instance, Buhaug *et al.*, (2009) stated in their work that the International Energy Agency IEA (a Paris-based autonomous intergovernmental organisation established in the framework of the Organisation for Economic Co-operation and Development OECD). In order to have an idea of the emissions magnitude we could compare shipping emissions with that of aviation in 2005. Specifically, in 2005 aviation emissions has been around 0,63 GtCO₂ (indicating Gigatons CO₂ or the amount of CO₂ released into the atmosphere. With a giga-ton being equal to 1 billion tons) consisting 2.1% of global CO₂ emissions while shipping emissions (according to IMO Greenhouse Gas Study cited in: Buhaug *et al.*, 2009) presented a result of 0.96 GtCO₂ consisting approximately 3.2% of global CO₂ emissions, apparently much higher than the respective aviation percentage.

It is therefore very important and a great challenge at the same time (as it is reflected on the diagram 2.1 below) for the various shipping companies operating in the industry to take the appropriate action through consistent application of feasible and efficient policies and valid measures in order to improve their performance with respect to energy efficiency management complying with the latest conventions and regulations, demonstrating simultaneously a socially responsible 'face' in line with the latest requirements in the area of Corporate Social Responsibility CSR and decreasing their operational cost (Spanos, 2009).

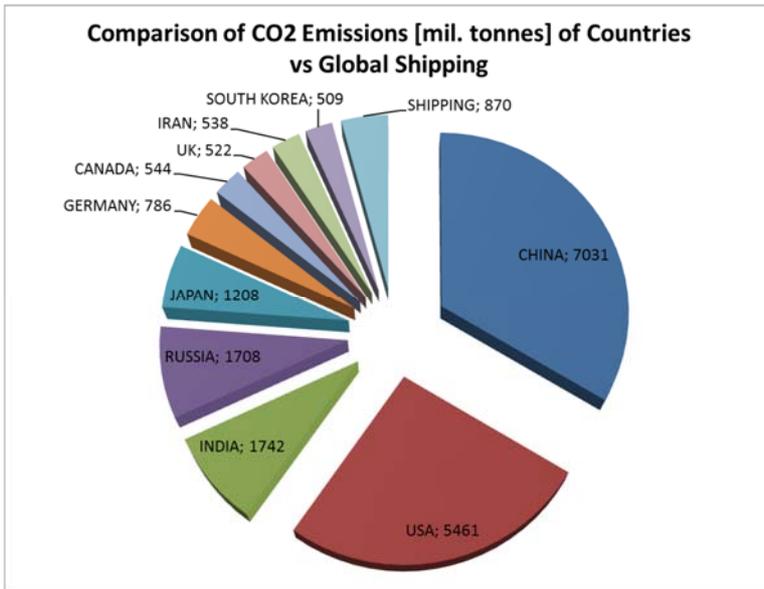
2.3 SEEMP WITHIN THE CONTEXT OF NEW REGULATIONS

In July 2011 the IMO Marine Environment Protection Committee (MEPC) adopting MARPOL's (Marine Pollution) amendments added a new chapter on 'Regulations on Energy Efficiency for Ships' rendering Energy Efficiency Design Index EEDI mandatory for new ships and SEEMP for all ships. This regulatory framework applies to all ships of 400 gross tonnages and above and has entered into force since 1st of January 2013. It has to be noted that from the review of the relevant literature, it becomes evident that there is a tendency for regulations and subsequent requirements to be incrementally and gradually tightened every five years (Hughes, 2013).

Within this context, it can be realised that shipping companies are under a great pressure than ever before, to use available resources as efficiently as they can. According to the specialists of the industry, this pressure may stem from a complexity of drives including complex regulatory requirements, increasing cost of fuels, as well as the increasing demand from shipping companies to

demonstrate to the public and mainly their stakeholders their social responsible ‘face’ through minimisation of CO₂ emissions and other harmful gasses (Pasin Marine Consultants INC, 2013). With that respect SEEMP is a valuable tool to assist shipping companies in their compliance with the respective regulations as well as managing their ongoing environmental performance of its fleet and achieve energy and hence efficiency and hence operational cost reduction.

Figure 2.1 Comparison of Shipping with most pollutant Countries



‘Source: Alpha Marine Consulting Ltd. (2012).’

This is in line with the arguments developed and presented by Lee and Hare (2011) in their work according to which the measures and potential emission reductions over and above BAU (Behavioural Analysis Unit) arising by economic pressures can only be driven by policies, put in place by governments and regulators and applied by shipping companies. In addition, the same authors suggest that some of these policies may reduce demand by increasing the cost of transport. However, the view of the writer of the present work is that the implementation of energy efficiency management policies should not end up in reducing demand (especially in a period of global economic crisis) since shipping companies are capacity constrained entities and as such they should try to make the most of their available capacity through wiser demand management tools and approaches. Furthermore, since the establishment by IMO of mandatory reduction measures for all ships from 2013 and onwards will lead to significant emission reductions and striking cost savings for the shipping industry. Increasing transportation cost by shipping companies is not a justified approach financially wise.

With respect to the new regulatory framework, all new ships are required to fulfil as a mandatory condition and demonstrate application of policies in line with Energy Efficiency Design Index (EEDI) while all ships (old and new ones) have to provide evidence that they have a Ship Energy Management Plan (SEEMP) in place supported with constant evaluation mechanisms (IMO, 2011).

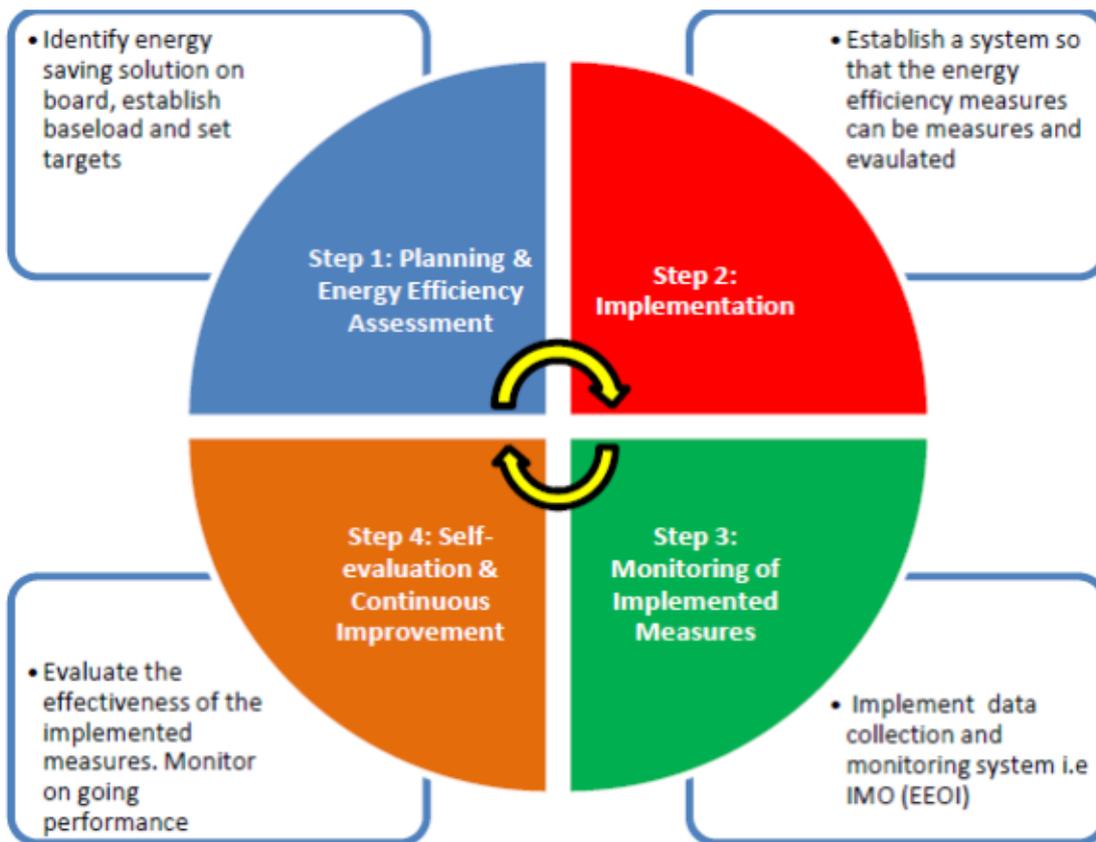
2.4 THE STAGES OF SEEMP COMPLETION

On the basis of the International Maritime Organisation IMO standards, a Ship Energy Efficiency Management Plan SEEMP is aiming at establishing a sound mechanism that will act as a guide for a shipping company and its fleet to improve the energy efficiency of their operations. A wide range of companies have already an environmental management system (EMS) in place and operate it in compliance with the requirements of ISO12001 Award requirements. Therefore, the development of a SEEMP plan should form an integral part of a shipping company's broader EMS.

Something that has to be pointed out and particularly stressed is the fact that a SEEMP should be developed on a 'ship-specific' basis since ships operate under a wide range of various conditions. IMO suggests that a SEEMP should be used as a managerial tool intended to assist and guide a shipping company in managing the environmental performance of its vessels hence every company that develops respective procedures to implement a SEEMP is recommended to do that in a manner that limits any on-board administrative and/or operational burden to the minimum possible level.

According to IMO (2009) the Ship Energy Efficiency Plan pursues to improve vessels' energy efficiency through four stages (see figure 2.2 below) which include: planning, implementation, monitoring and self-evaluation and improvement which compose an improvement cycle for a ship energy management strategy. These component stages of the cycle in question play a crucial role with respect to the dynamic nature of the SEEMP development and its continuous improvement. It should be stressed at this point that through the iteration of the cycle, some SEEMP elements will remain the same as before while some others will change.

Figure 2.2 The Four Stages of Shipping Energy Efficiency Management plan



‘Source: Pasin Marine Consultants Inc. (2012). Ship Energy Efficiency Management Plan Available at: http://ship-consultancy.com/?page_id=102’

2.4.1 Planning

Based on the review of the relevant literature, it becomes apparent that the stage of planning is considered as the most significant stage of a SEEMP as it both identifies the current status of ship energy usage as well as the expected improvement and optimisation in ship energy efficiency. Consequently, it is argued that sufficient time should be devoted to the stage of planning so that the most suitable, efficient and feasible plan can be designed and developed.

Ship-specific measures

According to IMO’s official guide for the development of a Ship Energy Efficiency Management Plan (2009c), there is a range of different options that can be followed by shipping companies to improve energy efficiency including weather routing, speed optimisation, hull maintenance etc. Nevertheless, there is not one best package of measures that suits to every situation and hence the optimum package of measures cannot be developed unless the particular type and current status of a

ship as well as the range of its different operation situations are specified and taken into consideration. In other words, there is a recognised need for a customised development of energy efficiency improvement measures for ships individually which specify the action that has to be taken by each particular ship type. At this stage of SEEMP development (planning) it is also very important that besides optimisation of voyage management and fuel efficient operation, particular consideration is also given to the minimisation of any on-board administrative burden.

Company - specific measures

Although, as it has been stated above, customisation of measures is required for an effective SEEMP to be developed and operate, the improvement of energy efficiency does not solely rely on single ship management. It may rather depend on different stakeholders, such as ship-owners, operators, cargo owners, charterers etc. According to IMO's (2009) guidance and as ABS (2012) argues, the better and smoother coordination among such stakeholders can be achieved the greater improvement can be expected. On this basis, it is suggested that a shipping company should establish a SEEMP to manage its fleet making the necessary coordination among its stakeholders at the same time.

Human resource development

In order for steady and effective implementation of the adopted measures to be accomplished, raising of the personnel awareness and providing them with the necessary training are two significant parameters of success. Therefore, human resource training and development should be encouraged and should be considered as an important constituent part and critical element of a SEEMP implementation.

Goal setting

Goal setting forms the last part of the SEEMP planning stage in order for the adopted measures to be implemented and met. This involves specification of targets as well as measures against which actual performance, in terms of energy efficiency management, will be monitored assessed and evaluated. Therefore, as it can be realised, the challenge for the shipping companies is to apply goal setting as a means to involve their intellectual capital, motivate and raise its awareness and commitment to the ultimate goal of energy efficiency improvement through proper and effective implementation of action designed to meet goals and specific measures set.

2.4.2 Implementation

The stage of a SEEMP implementation comes after the identification of the respective measures to be implemented, since as IMO argues it is essential to build and establish an implementation system

that will lead to the satisfaction of the selected measures through the development of suitable energy management procedures, specifying tasks and assigning responsibilities to qualified personnel. Hence, this part of a SEEMP planning stage should specify the way that each measure should be implemented assigning at the same time tasks, duties and responsibilities to the appropriate persons involved. A proper record-keeping system that would support each step of the implementation stage should be also in place as it is considered to be beneficial for the next stage of self-evaluation and improvement.

2.4.3 Monitoring

According to IMO's (2009) guidance, shipping companies should have a proper monitoring system in place in order to monitor the energy efficiency of their fleet quantitatively. This system, in order to operate meaningfully, should be based on the application of established methods and standards, preferably internationally acknowledged and established (Goulielmos and Gkiziakis, 2009). One of the internationally established monitoring tools is the Energy Efficiency Operational Indicator EEOI, a quantitative indicator that has been developed by the International Maritime Organisation in order to monitor performance of a ship or a fleet with respect to their energy efficient operation. Consequently, although other quantitative indicators and measures can be applied, EEOI is considered as the primary monitoring tool for that purpose (Goulielmos and Gkiziakis, 2009). Nevertheless, in addition to the Energy Efficiency Operational Indicator, other measurement and monitoring tools can be used and applied but no matter if one tool or a combination of monitoring and measurement tools is to be utilised this has to be determined at the planning stage of the SEEMP.

Another important parameter that has to be stressed is the fact that irrespective of the type and number of measurements that are used, consistent and continuous data collection comprises the foundation of proper monitoring (Vlahos, 2002). Moreover, in order for consistent and meaningful monitoring to be developed, the monitoring system should include and specify procedures for data collection as well as the assignment of responsible personnel. Such a system should be considered as a part of the SEEMP planning stage and hence it should be completed at this stage. According to the IMO report in order for unnecessary obstacles and burdens on ships' staff to be avoided, monitoring should be carried out, to a possible extent, by shore personnel making use of data obtained from current and existing records required, i.e. oil record books, official engineering log-books etc. If any additional data is required it should be obtained as appropriate (IMO, 2009).

2.4.4 Self-evaluation and improvement

Self-evaluation and improvement comprises the final stage of the SEEMP management cycle. The results from this stage are expected to provide meaningful feedback for closing the loop of one SEEMP improvement cycle and feed in with valuable information the planning stage of the next cycle of improvement. The aim of this stage is to appraise the degree of effectiveness of the planned measures and their implementation, to develop an insight into the characteristics and variables of ships' operation in order to draw sound and valid conclusions about measures that function or do not function effectively as well as the underlying reason for their degree of effectiveness, comprehend the trend of efficiency improvement of a particular ship and develop the next improved cycle of Ship Energy Efficiency Management Plan. In the light of the above, the necessity of self-evaluation stage is apparent, hence procedures for self-evaluation of SEEM have to be developed. Moreover, self-evaluation has to be periodically implemented through the analysis of the data collected. Furthermore, it is suggested that time should be invested in the identification of 'cause-and-effect' context of ship performance over the evaluation period in order to improve the next step of the management plan.

Finally, a very important aspect of the implementation and constantly revision of a SEEMP is related to the reporting of its results. A number of shipping companies and ship operators choose to make public the outcome and results of the actions that they have taken within the context of their SEEMP implementation and provide information on the actual impact of those actions on the improvement of their ship(s) efficiency. This in turn may have a series of benefits for those shipping companies that decide to disclose such kind of information to the public. Specifically, some ports or national administrators recognise this kind of efforts and reward leading ship-owners or ship operators through i.e. offering the benefit of reduced harbour fees and other rewards to ships that operate a SEEMP and qualify as 'green'. Another significant factor and drive that may motivate and lead shipping companies to the adoption and implementation of SEEMP is the fact that an increasing number of companies dealing with the trade of consumer products prefer to utilise only transportation option that have been verified as 'green' in order to move and dispose their products to the market. Therefore, the successful implementation of a SEEMP can act as a very effective marketing and promotional tool for the shipping companies that have implemented and operate.

2.5 BENEFITS THAT CAN BE REALISED THROUGH THE APPLICATION OF SEEMP

Increasing environmental awareness throughout the world could not leave shipping industry unaffected. Corporate Social Responsibility CSR adopted by a wide variety of companies in different industries reflects constantly raising public concern about environmental as well as social rights' protection. This reality in turn has resulted in respective requirements that have to be satisfied by the shipping industry through the operation of its companies which has to be in line with these requirements.

The improvement of Ship Energy Efficiency has been a major issue for the global Shipping Industry mainly for two reasons; primarily, because the fuel expenses of merchant ships are a major part of the ships' total expenses, following the continuous increase in bunker price (almost 50% of a ship's operational cost) (Hughes, 2013).

Secondarily, due to the fact that the conventional Diesel Engines and Gas Turbines emit great amounts of Greenhouse Gases (GHGs); these emissions have a dramatic impact on the atmosphere, as they dissolve the ozone layer, thus intensifying the Climate Change. Nevertheless, some scepticism has been expressed by the shipping industry as to the extent that ship owners that install new environmental technologies may reap the benefits they expect with respect to the cost involved and there is a growing concern that regulatory uncertainties are undermining the incentives that some owners have to install equipment ahead of regulatory deadlines. However, SEEMP seems to satisfy all parties' interest as it can ensure compliance with CSR requirements and cost efficiency for the operations of the shipping companies involved. Specifically, the benefits that can be realised for the companies that adopt and implement a SEEMP include:

- Compliance with IMO's mandate for SEEMP,
- Promotion of energy conservation on board vessels,
- Performance improvement while helping the environment at the same time through lower emissions,
- Achievement of cost savings helping to make vessels more competitive,
- Reduced maintenance cost,
- Fewer running hours.

However, it is important to be stressed that in order for the benefits above to be realised the SEEMP has to be effectively implemented since as Hughes (2012) argues the way that a SEEMP is implemented determines the degree of its success. Moreover, since energy efficiency

improvements are attainable with the best available technology and practices, the management of many shipping companies is concerned with the extent to which the required investment is going to pay back. This is something that is in line with the general view that barriers to investing in energy efficiency include lack of knowledge, lack of resources and limited capital. The system typically reduces energy consumption of vessels by 5 to 15 percent, but savings reduction as high as 25 percent has been recorded. Therefore, as Marantis (2012) argues energy efficient systems can payback for the required investment in the form of energy savings, sometimes within months, while they further reduce operational and maintenance costs in the long term.

Consequently, since the overall objective of having a SEEMP is to use less fuel, the benefits of a successfully deployed SEEMP include reduced maintenance costs, fewer running hours and lower CO₂ emissions, meeting thus shipping companies' benefit as well as environmental sustainability. Finally, emphasis should be put on the fact that a shipping company that implements a SEEMP that complies with IMO's mandatory requirements for energy efficiency management can use this achievement as a marketing tool to promote the high quality of its services to potential customers as well as its corporate socially responsible profile to beat competition since according to Det Norske Veritas DNV (2012), one of the most reputable international classification societies "*a Ship Energy Efficiency Management Plan (SEEMP) is intended to be a practical tool for helping ship-owners manage their environmental performance and improve operational efficiency while demonstrating ethical business practices*".

2.6 BEST PRACTICES FOR ENERGY EFFICIENT OPERATIONS OF SHIPS

The achievement of efficient operations across the whole transport chain in shipping takes responsibility beyond ship-owners and ship operators and places it also on a number of other stakeholders such as vessel and engine designers and manufacturers, ports, charterers, vessel traffic management services etc. Although the optimum operational efficiency requires standard performance of all of the stakeholders identified above, since the focus of the present is on the measures and action taken by Greek shipping companies to achieve optimum efficiency in their operations, therefore the best practice guidance presented in the following section is focused on the action that should be taken by individual shipping companies.

Based on the review of the relevant literature the author of the present study identified three main parameters of energy efficiency improvement included in a SEEMP. Although the SEEMP is applied to assist shipping industry and its companies to achieve energy efficiency and reduction in

CO₂ emissions, this can be pursued through three main performance axes: a. voyage planning, b. optimisation of ship and fleet management and c. maintenance of hull and propulsion system.

Combining suggestions and guidance on best practices for optimum performance in the three areas specified above provided by IMO as well as industry's specialists (OCIMF, Lloyds Register, etc) the author of this study concluded in the following main / best practices for the fuel efficient operation of ships:

a. Optimisation of voyage planning and its execution. Improved energy efficiency can be achieved through careful voyage planning, choice of the optimum route and effective execution of voyages. Although thorough voyage planning is a time consuming activity there is a number of various software tools available for purposes of voyage planning. Weather routing is another technique that can have a significant contribution to the achievement of energy efficiency ship; it helps to identify the most efficient track for ocean voyages on the basis of forecasts of sea and weather conditions with respect to ship's individual characteristics in relation to a particular transit and cargo that has to be transported. The main variables that have to be taken into consideration, in order to plan an as much an optimum voyage track as possible, include ship and cargo (ship size and its speed capability and type of cargo), weather (such as wind, wave height, fog, abnormal waves, ocean currents) route latitude. Therefore, the target is to plan and follow the optimum route evading bad weather, taking ship routing meteorologists' recommendation into consideration in relation to the ship type, size and speed capability, as well as to the type and size of cargo to be transported. Just in time is another approach based on clear and early communication with the next port so that the latter is given maximum notice of berth availability and hence facilitates optimum speed supported by port operational procedures. Speed optimisation is another technique that can be applied to achieve energy efficiency. Nevertheless, it should be made clear at this point that speed optimisation does not necessarily mean minimum speed but a speed at which the fuel consumed reach the lowest level possible as sailing at a speed lesser than the optimum can actually result in a higher consumption of fuel than it should. Therefore, efforts have to be made during the agreement of the transportation terms with a charterer to sign terms that encourage ship/s to operate at optimum speed that it will in turn maximize energy efficiency, since under many circumstances the speed of a vessel is specified by the charterer and not the ship operator. Optimised shaft power implies operation at a constant shaft RPM rather than adjusting speed continuously through manipulating engine power. Speed control through the use of automated engine management systems may be more beneficial than reliance on human intervention and judgment.

b. Optimisation of ship and fleet management

This axis of energy efficient management includes a series of approaches that probably require the most technical level of expertise such as optimum trim, optimum ballast, optimum propeller and propeller inflow considerations as well as optimum use of rudder and autopilots.

Trim has a significant impact on ship resistance through the water and hence optimisation of trim throughout a voyage can give significant savings in fuel, after taking into consideration ship design, its designated amount of cargo at certain levels of speed.

As far as optimum ballast is concerned, this has to be determined and adjusted after considering optimum trim requirements as well as ballast and steering conditions that can be achieved through application of effective cargo planning. It has also to be stressed that less ballast does not necessarily and automatically imply the highest level of efficiency.

With respect to propeller and propeller inflow, it is argued that although propeller selection is decided at the stage of construction, nevertheless, modern propeller design has made it feasible for retrofitting of later designs in order to deliver and thus achieve greater economy in fuel consumption. Although the propeller is just one part of the propulsion train, its change in isolation may result in increased fuel consumption. For example, the use of new advances in water inflow to propeller, such as fins and nozzles may increase propulsive efficiency and thus result in reduction of fuel consumed.

As far as rudder and heading control there have been advances achieved in producing automated systems or autopilots integrating command and navigation systems which in turn can achieve improvements in energy efficiency through savings in fuel by merely reducing the 'off track' distance sailed. According to Lloyd's (2011) the principle is straightforward: better control through smaller and less frequent corrections with minimal losses due to retrofitting of improved design of rudder blade which minimizes resistance.

In relation to ship / fleet management this carries a particular importance for the achievement of energy efficiency as well as the revenue of shipping companies since they operate in a capacity constrained industry therefore they have to make optimum use of their fleet available capacity for better voyage planning avoiding waste of fuels and redundant CO₂ emissions by avoiding in turn long ballast voyages. Improved utilisation of fleet capacity is also closely connected with the navigation based on the concept and practice of 'just in time' analysed above.

c. Effective maintenance of hull and propulsion system

Hull and propulsion maintenance comprises another contributing factor to the increase of energy efficiency. Lykos (2012) suggests that docking intervals should be combined with a ship operator's continuous and ongoing in-water appraisal and evaluation of ship performance stressing also that inspection on a regular basis of hull and propulsion condition is recommended. Zhang (2009) argues that coating systems can be used in order to achieve optimisation of hull resistance combined with cleaning intervals. Cleaning and polishing are also recommended in combination with suitable coating to increase fuel efficiency. As IMO (2009) suggests, propeller cleaning and polishing as well as appropriate coating may result in a significant increase of fuel efficiency, which is something that should be facilitated and recognised by port states.

Moreover, consideration should be given to the timely and full replacement and removal of underwater painting system so as to avoid possible hull roughness. In that context, a general principle that applies is that the smoother the hull the better the fuel efficiency.

Propulsion system maintenance in accordance with the manufacturers' specifications and instructions will also lead to higher energy efficiency. This can be achieved through minimisation of engines heat since marine engines have a very high thermal efficiency.

Summing up, it should be stressed that the applicability of many measures discussed above depends on the sailing area and trade of a vessel. As Bazari and McStay (2012) argue, the trade of a vessel will determine the degree that these measures are feasible and hence can be applied. For example, ships that perform sea services such as seismic survey, pipe laying, dredgers etc, are most likely to select and apply different methods of carbon reduction in comparison with conventional carriers. According to Hatzigrigoris (2011) it is most probable that the route to the most efficient combination of efficiency measures and relevant criteria is unique for each vessel of each shipping company.

2.7 THE CHALLENGE FOR THE GREEK SHIPPING COMPANIES

Although rising fuel prices and stricter legislation set a common context of requirements rendering improved energy efficient operations is a key issue for most ship operators today, these parameters present an even greater challenge for the Greek ship operators for two main reasons: firstly due to the fact that Greek economy is going through an economic depression period and its companies have to develop competitiveness through more efficient and socially responsible operations and secondly due to the fact that the Greek shipping industry is one of the two main 'engines' (the other is tourism) that can lead the country's economy out of the crisis through a developmental pathway taking advantage the forecasted growth . Consequently, it is very important for the Greek shipping

companies to apply Energy Efficiency Management EEM scheme and operating a constantly monitored and updated SEEMP (DNV, 2012). The cost savings that the Greek shipping industry can gain as a whole can be realised if one considers the figures that provide evidence about the fact that the Greek ship operators are among the top leaders on global seaborne transport and trade with 3,760 vessels controlling 22% of the global oil tanker fleet and 18 % of the dry-bulk ships currently in active service worldwide. Consequently, implementation and monitoring of EEM will have a considerable positive environmental impact as well as cost savings.

Carrying out the relevant literature review and in order to meet one of the main objectives of the current research project (as stated above) the writer of this work identified two very important papers that should be combined in order for a benchmarking basis to be established: a) the paper produced by IMO (2009c) which provides guidance for the development of a SEEMP and b) by Oil Companies International Marine Forum OCIMF.

The IMO paper (2009c) within the context of the energy efficiency regulations framework identifies the main areas that a SEEMP should cover, including the following:

- Fuel -Efficient Operations,
- Optimises ship handling,
- Hull maintenance,
- Propulsion system,
- Waste heat recovery,
- Improved fleet management,
- Improved cargo handling,
- Energy management,
- Fuel Type.

It should be noted at this point that the main measure applied will be the Energy Efficiency Operation Index (EEOI) which is an approach to assess the efficiency of a ship with respect to CO₂ emissions. $EEOI = (Emitted\ CO_2) / (Transport\ Work)$, which is the ratio of mass of CO₂ (M) emitted per unit of transport work (measured as grams CO₂ / tonnes x nautical mile)

On the other hand the paper developed by OCIMF (2011) is aiming at presenting a proactive approach to Energy Efficiency and Fuel Management through improving voyage and vessel efficiencies reducing CO₂ emissions by the application of auditable specific and prioritised methodologies. The significance of this particular paper lies in the fact that on one hand it specifies

a set of four areas of 'key performance indicators' while on the other it provides also clearly specified best practice guidance for each area of performance indicators.

Consequently, after having reviewed the respective literature the reasoning of the writer in combining the material presented by these two papers produced by the respective two organisations (IMO and OCIMF), is to design a framework with the main areas that a SEEMP should cover accompanied by the main performance indicators and the respective best practice, for each one of these indicators, to lead the evaluation process. In other words, the writer of this study will apply this combined framework to Greek shipping companies in order to carry out primary research and next evaluate the results of this research through a benchmarking approach, the context of which is explained just below.

2.8 BENCHMARKING

One of the objectives of this study, as stated above, is to conduct a 'Benchmarking' - a comparative analysis of the EEM (Energy Efficiency Management) practices used by the best practice shipping companies and the ones applied by the Greek shipping companies which are of interest to this study.

At this point, one could pose the question about the nature and parameters of this particular technique (benchmarking). According to Camp, (2006) in simple words, benchmarking is the continuous and systematic comparison of the business strategies, functions, procedures or practices applied by the best competitors and the followers in an industry or a sector.

The companies selected for the purposes of this benchmarking approach include a sample of the shipping companies at the port of Piraeus Greece that has taken on the implementation of energy efficiency management scheme that will be evaluated against best practice shipping companies that their EEM and SEEMP comply with specific best practice indicators (these will be discussed below). The application of benchmarking aims to help a company (in this case the Greek shipping companies at the port of Piraeus) to make improvements in the area of efficient energy management (UNIDO, 2010) and subsequently in the design and application of their SEEMP by giving them the opportunity to:

- Identify possible gaps in their performance with respect to energy efficiency management standard and best practice,
- Realise why these gaps/ differences exist,

- Specify the steps necessary to be taken in order to be recognised themselves as best practice shipping companies and receive the corresponding recognition that will strengthen efficiency of their operations and hence their competitive advantage (Boxwell, 1994).

The correct application of the Benchmarking reveals that the best practice applied in the industry or a market (in our case the shipping industry) urges managers to design and adopt such procedures. To put it differently, effective comparative modelling requires realising that the company has weaknesses that turn into business risks and identifying existing opportunities that can be exploited to reap the benefits that the 'best' of the industry gain (Camp , 2006). This technique has been applied by many of the largest and most successful companies in order to collect, process, and utilise information about competitors, procedures and their practices. It is important though to be noted as a necessary requirement that all personnel of the involved shipping companies have to be focused on improvement and have to have espoused the values underlining a best practice culture (Trompenaars, Hampden, Belbin, 2012).

So, through this technique the author of the study attempts to aid the sample of Piraeus shipping companies in Greece to identify the opportunities that the application of the EEM and respective SEEMP practices can offer to them.

Finally, the writer of the current work feels the need to stress that for the successful benchmark in this study the comparison should not be viewed as a theoretically ideal example, but should be carried out with respect to the already applied practices of other best practice companies operating in the same industry (the shipping). The most optimum means to determine the benchmark must combine:

- The specificities of the sector that the institution is operating in,
- The respective conventions and regulatory framework,
- The EEM areas and standards,
- The performance with respect to specified areas and indicators of the organisation presenting the best SEEMP performance (OCIMF, 2011).

All of the above will be combined in order to compare and contrast Energy Efficiency Management Operations and policies applied by the Greek shipping companies with respect to their best practice counterparts, identify gaps and areas where improvements and corrective action are required.

CHAPTER 3: RESEARCH METHODS & METHODOLOGY

3.1 INTRODUCTION

The purpose of this chapter focuses on the provision of an overview as well as the explanation of the methodological approaches and research design selected by the writer of this study for application, to carry out primary research, collect and gather the necessary data. Namely, on the basis of the objectives, the theoretical-analytical frameworks and tools reviewed and examined in the previous chapter of this study, the author will explain in this chapter the methodology that has been followed so as the data needs to be covered. Moreover, the underlying reasoning for choosing these specific research methods and the rationale that led the author to make that choice will also be explained. The measuring instruments and tools used and how these have been applied in order to secure the collection of as valid data as possible will also be presented. Data process, interpretation and analysis will follow, so that valid and meaningful conclusions can be drawn which in turn will assist the author to meet the study's objectives. The chapter will close with the main considerations taken into account as well as the assumptions made for the course of this particular research.

3.2 IDENTIFICATION OF THE TYPE AND NATURE OF THE RESEARCH

The writer, in order to meet the aim of this research as well as to satisfy the objectives of the present study, followed what is called by a number of scholars (Shuttleworth, 2008; Gustavsson, 2007), as the 'scientific' approach. According to Shuttleworth's (2008) definition, "*scientific research entails performing a methodical study in order to prove a hypothesis or answer a specific question*". Hence, it can be considered as an experimental process and as Shuttleworth (2008) supports, the focal point of an experimental process is finding a definitive answer by investigating into and discovering respective knowledge based on a series of principles which define the boundaries of the framework of what is acceptable. With respect to the nature of this research, this could be specified and characterised as 'exploratory' since its objectives aim to investigate and discover whether a phenomenon exists. As far as this study is concerned, the phenomenon to be explored is the extent to which Ship Energy Efficiency Management Plan SEEMP is effectively applied by the Greek shipping companies with respect to the best practice principles and the respective performance of their best competitors in the industry.

According to Schutt (2008) "*the main aim of exploratory research is to find out what is going on here*" as it is exactly the case with Greek shipping companies.

Moreover, due to its underlying nature, the exploratory research can lead to important as well as enlightening insight into the case of the sample under examination. Consequently, an exploratory research will be carried out for the case of the Greek shipping companies due to the absence of earlier relevant studies on the issue. The emphasis and focal point of this study and the conducted research will be to gain useful and meaningful insight and gather valid data which after being processed will be used to the extraction of meaningful conclusions which will in turn help to make valid and realistic recommendations.

3.3 RESEARCH METHODOLOGY CHOSEN

With respect to the choice of the appropriate methodology and research approach, the writer of this study had to choose from two types of research approaches: a) the qualitative and b) the quantitative one and apply them accordingly.

Both research approaches, either quantitative and/or qualitative, are based on a set of assumptions that underline the framework that constitutes 'valid' research, the methods of which differ in many ways. A clear differentiation between the two methodologies is provided by a great number of writers; for example, Glaser and Straus (1967) and Casebeer and Verhof (1997) argue that while quantitative approach is usually connected to the idea of science being an objective truth or fact that can be explored and revealed through this approach, qualitative approach is more often identified as a lived experience involving interpretation and subsequent explanation of concepts and paradigms involved with no clearly defined objectivity.

Through the relevant literature review one could easily identify many differentiations between the two methodologies. It is really worthy to refer to Miles and Huberman (1994) point of view, who argue that quantitative methodology involves an objective assessment, evaluation and measurement of hard data and numbers while qualitative methodology is more of a subjective approach that gives the ability to understand people's meaning as data is gathered through interaction with people and is analysed and interpreted. The extra challenge that the latter methodology has to meet is to ensure precise and right recording of subjective information usually expressed by a smaller sample than the former methodology. On the other hand, it enables the researcher to adjust to new issues and ideas as they emerge. Moreover, according to Sogurno (2002), "*the quantitative methodology is oriented to testing and confirming well-validated theories while the qualitative research seeks to understand human experiences based on their perspective of those who experienced them*".

Apparently, through reviewing the relevant literature one can realise that there is a great deal of controversy and disagreement between the supporters of the two research methodological

approaches with a number of them arguing for one type of methodology while being against the other. Nevertheless, as Neill (2007) supports, there are two kinds of arguments encapsulated in the following statements: “*All research has ultimately a qualitative basis*”, and: “*There is no such a thing as qualitative data. Everything is either 1 or 0*”. The relevant literature review also reveals that there is not such a thing as ‘either’ ‘or’ but there is a spectrum of research that encompasses these two methods (Neill, 2007).

Based on all the above, the author of this study espoused Neill’s (2007) view and instead of concentrating on their points of differentiation preferred to make practical and reasonable methodology decisions by combining and integrating both methodologies, as through the application of a mixed methodological research approach, the study and its results could benefit from the advantages offered by each methodological type.

3.3.1 The reasoning underlying the choice of a combined Methodological Research Approach and the Sampling approach applied

According to Creswell (2003), the adoption and application of a mixed methodological approach of research comprising a combination of both qualitative and quantitative methodologies has become a very popular approach in carrying out a primary research. Sogunro (2002) also is in favour of a combination of quantitative and qualitative research methods in order to achieve results of a stronger validity and degree of reliability. Consequently, as there was an increased need in this study for data currency, reliability and validity due to the lack of any prior similar research data collection concerning the application of SEEMP by Greek shipping companies, the writer chose the use of a combined methodological approach: a) quantitative through a survey and b) qualitative through semi-structured interviews.

As this study’s unit of analysis is examining phenomena at the level of a specific sector, the writer had the possibility to combine wide sampling from, as many as possible, different levels-positions in the target organisations with an in-depth analysis of the collected information.

Therefore, with respect to choosing the sample, a stratified approach was followed and a broad and diverse representation from the entire hierarchy of staff employed by these enterprises was secured.

3.4 RATIONALE THAT UNDERLINED THE DESIGN OF PRIMARY RESEARCH INSTRUMENTS

The primary research instruments (a questionnaire and an interview guide) were designed and used so that the primary data required was gathered and collected in order for the study's objectives to be fully met.

Following the respective academic framework (Brace, 2013) that provides guidance for the design of the primary research tools, the action taken was to:

- Define the different groups of the target population and determine the type of information and responses each group could provide in line with the requirements of the study's objectives.
- Decide on the design of the final content of primary research instruments which (as explained above) would cover quantitative and qualitative research methodology needs.

Consequently based on the aim and objectives of the dissertation as well as dissertation's supervisor guidance, the population that was decided to be targeted and was subsequently contacted, in order to gain 360 degrees information and feedback, includes:

1. Greek Shipping companies personnel,
2. Greek Flag State of Control,
3. Classification Societies.

Specifically, after the author's successful efforts it was managed the participation of the following populations to be ensured:

1. 60 people from 12 Greek shipping companies (5 people from each company: 1 Department Head of the HSQE from each company and 4 shore personnel members who are former on board members in order to make the most of their experience on these two disciplines) These people participated in the quantitative research – questionnaire filling.
2. 2 personnel from the Greek Flag State Control authority to take part in a semi structured face-to-face interview (see respective interview guide -Appendix B)
3. 1 personnel from each one of 4 Classification Societies : 1. American Bureau Society, 2. Hellenic Lloyds Register S.A, 3. Bureau Veritas, and 4. DNV Hellas) based in Greece, who took part in individual semi structured face-to-face interviews (see respective interview guide -Appendix C) ¹

¹ Please note that the two interview guides are pretty much the same except from the questions 3 and 13 which are suitably adapted for each situation. (following two experts' suggestions)

Next, based on the dissertation aim and objectives and in order to be able to design as much comprehensive research instruments as possible, the writer produced a matrix combining best-practice indicators and requirements with guidance provided by different recognized authorities and organizations operating in the field such as IMO, Lloyd’s Register and OCIMF. What the writer did next was to classify all these best practice indicators under the four main stages of SEEMP development and design a matrix that in turn led the development of the research instruments (questionnaire and interview guides) to ensure full coverage.

The matrix indicates which best practice indicator is met by which research tool.

Finally, following again the academic framework instructions for proper design of research tools, the primary research instruments were forwarded to two experts² in order to consult them for the questionnaire and interview guides design, carrying out at the same time a pilot study since the two experts identified some problems with the clarity of the questions stated and suggested corrections.

BEST PRACTICE CRITERIA UNDERLYING SHIP ENERGY EFFICIENCY MANAGEMENT PERFORMANCE	MET by Survey (Questionnaire)	MET by Interviews
1. Planning		
1.1 The company has planned for the design and implementation of a SEEM plan which complies with formal mandatory requirements for effective management of energy.	√	√
1.2 Targets for voyage management and vessel optimisation are set.		√
1.3 Specific criteria and specifications are		

² These two experts were chosen due to the fact that they both combine professional experience in the maritime field with rich academic performance. Besides their managerial position they hold in the writer’s shipping company they have also produced a range of academic studies.

set (in line with respective regulatory requirements) that fuel procurement has to meet.		√
1.4 Personnel is made aware of the content of the Ship Energy Management Plan (targets and performance criteria) by the use of appropriate training and communication.	√	√
1.5 New build processes embrace energy efficiency elements from conception to delivery.	√	
1.6 Effective and continuous communication and interaction with other authorities-stakeholders (such as charterers, classification societies etc.) is planned to enable implementation of operations' improvement (i.e. 'just in time' operation or traffic management services etc.).		√
2. Implementation		
2.1 A Ship Energy Efficiency Management Plan SEEMP is in place addressing voyage management and including appropriate measurement and reporting requirements ensuring compliance with respective conventions.	√	√
2.2 An Energy Management Plan demonstrates effective on board implementation of the company energy policy.	√	√

2.3 The Company implements a SEEM Plan according to which time and fuel consumption are fully accounted for on a voyage-by-voyage basis.	√	√
2.4 The quality of all fuel purchased against complies with the criteria and specification set in the planning stage.	√	√
2.5 Speed is optimised, where practical, by maintaining the most fuel efficient speed to minimise total fuel consumed throughout the entire voyage.	√	√
2.6 On-board fuel management procedures are in place considering fuel compatibility minimising sludge production and keeping the plant in optimum operational condition.	√	
2.7 The company utilises available technology to ensure that efficiency is maintained at the highest level.	√	√
3. Monitoring		
3.1 The company applies internationally established monitoring tools such as Energy Efficiency Operational Indicator (EEOI) (developed by IMO).		√
3.2 The company employs real-time performance and monitoring systems and procedures of data including: a. Fuel consumption of main engines, boilers and auxiliaries on a voyage-by-voyage basis, b. fuel daily consumption, c. vessel condition (laden or ballast),		√

<p>e. performance with respect to operating at optimal trim,</p> <p>f. performance with respect to optimization of shaft power,</p> <p>g. performance and maintenance of propulsion system,</p> <p>e. performance with respect to optimization of fleet management.</p>		
4. Self- Evaluation & Improvement		
<p>4.1 Regular performance reviews and assessment are undertaken including :</p> <ul style="list-style-type: none"> • calculation of specific time and fuel consumption trends, • hull condition and propeller fouling, • performance of main engines, boilers and auxiliaries. 		√
<p>4.2 The Company engages in external benchmarking exercises related to Energy Efficiency. Analysis by a third party compares management systems with similar companies and identifies areas for process improvement.</p>	√	√
<p>4.3 The company takes traceable action in order to feed the results of the assessment /improvement stage into the planning stage exhibiting thus a constant cycle of improvement.</p>		√
<p>4.4 The Company has a willingness to explore new ideas, technologies and engages in Technology Partnerships.</p>		√
<p>4.5 The Company actively seeks opportunities to cooperate with charterers</p>		√

to facilitate enhancements in vessel Energy Efficiency and respective improvements.		
4.6 The full implementation of SEEMP has contributed to the improvement of energy efficiency as well as the company's competitiveness.	√	

3.5 ADMINISTRATION OF THE SURVEY AND THE INTERVIEWS

3.5.1 The Survey

As Neill (2007) argues, the use of this statistical tool will assist in revealing key trends, patterns and facts, by processing the gathered data in order to obtain a better insight into the actions, attitudes and perceptions of participants for the issue under scrutiny. A 13-item questionnaire was designed (as described above) and copies were distributed by the writer himself to the participants from each company in a meeting arranged with each enterprise separately during which the researcher gave the necessary explanations and guidance and the participants filled the questionnaire (see Appendix A). According to Sekaran (2000), a Likert scale comprises a commonly accepted technique that reflects the amount of agreement and/ or disagreement concerning attitudes, beliefs, views etc of a research object. Based on this argument, the five point Likert scale was used to collect responses to the questionnaire items.

With respect to the processing of the data collected from the questionnaires this will be carried out through the use of the SPSS statistical software version 20 and the measures chosen to be applied include Frequencies, Descriptive (mean and standard deviation) and 'Cronbach alpha'.

As far as Cronbach alpha is concerned this was used since the particular research instrument (the questionnaire) was designed by the author himself and had not gone through any validation process. Consequently, in order for the quantitative results to be considered valid and reliable a Cronbach test had to be carried out. A Cronbach's alpha score is expected to be increased as the inter correlation among test items increase, and is thus known as an internal consistency estimate of reliability of test scores (Kelley, Clark, Brown, and Sitzia, 2003).

Cronbach alpha Internal Consistency scale that will be applied includes: $\alpha \geq .9$ Excellent, $.9 > \alpha \geq .8$ Good, $.8 > \alpha \geq .7$ Questionable, $.6 > \alpha \geq .5$ Poor, $.5 > \alpha$ Unacceptable.

3.5.2 The Interviews

In order for the interviews to be carried out effectively serving the purposes and objectives of the study, the two types interview guides which were designed as discussed above with 13 open-ended questions (see Appendix B and C), were used enabling the researcher to conduct individual ‘face-to-face’ semi-structured interviews that would offer triggers for further discourse.

Each interview opened with a brief introduction on its aim and usefulness carried out by the interviewer, so as interviewees would feel comfortable and open up so that a meaningful and honest discussion was carried out. The duration was tried though to be kept around to twenty minutes in order to avoid tiring the interviewees. The interviews were recorded with the permission of the interviewees and were later transcribed. Despite what Openheim (2001) claims, about being a rather elusive and unrealistic idea to try to achieve “stimulus equivalence”, the interviewer was aware of this inherent risk of interviewing and took appropriate action to avoid it. Specifically, this was achieved by expressing the questions in the same format and by avoiding leading the interviewees to predetermined answers. Gaining the trust of interviewees in order for them to respond honestly was another important point that required a very careful handling. This was pursued by the interviewer through establishing a good rapport with each interviewee as well as clear and open communication with all them.

3.6 MAIN CONSIDERATIONS

One of the key areas that were considered was the time element. In terms of time management and organisation, it was found that the process of carrying out the survey and interviews on site was extremely demanding. Finally, privacy and confidentiality of sensitive business data throughout the research and the writing up of this study had to be preserved and ensured as this was guaranteed by the author to the participating shipping companies.

CHAPTER 4: PRESENTATION, DISCUSSION AND ANALYSIS OF PRIMARY RESEARCH FINDING

4.1 INTRODUCTION

The aim of this chapter is to present and discuss the findings that has been collected and gathered through the application of primary research approaches, methods and techniques, including a survey and a series of interviews with the different categories of stakeholders that have been specified in the previous chapter (methodology chapter). Specifically, a) the data collected through the survey and after being processed through the application of SPSS statistical program (version 20) will be presented in a table format including descriptive and frequency tables . Next, as it has also been explained in the methodology chapter, the Cronbach a score will be also calculated in order to prove the existence of a satisfactory degree of questionnaire's internal consistency and therefore to confirm validity of the results drawn. The information gathered through the interviews and interviewees' responses will be presented, discussed and analyzed in a text format and next, both types of results (qualitative and quantitative) will be compared, contrasted and tested in relation to the objectives of the study and with the ultimate goal to draw valid conclusions with respect to the latter.

The reason that led the writer of this study to combine presentation of findings with their discussion and analysis is the production of a reader-friendly chapter so that potential readers can directly relate discussion and analysis text to the findings and statistical data analysis tables.

4.2 PRESENTATION AND ANALYSIS OF QUANTITATIVE RESEARCH FINDINGS

In this section the results of the survey will be presented and discussed on the basis of the participants' (Greek shipping companies' employees) responses.

Table 4.1: Q1 Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	40	66,7	66,7
	2,00	20	33,3	100,0
	Total	60	100,0	100,0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q1	60	1,00	2,00	1,3333	,47538
Valid N (listwise)	60				

The data presented on the tables above reflect the responses of the Greek shipping companies' employees, the majority of which (66,7) state that their companies implement a SEEMP fully. Moreover, the small standard deviation, much below 1 (0,475) reflects a congruence of respondents' opinion.

Table 4.2: Q2 Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	12	20,0	20,0
	2,00	48	80,0	100,0
	Total	60	100,0	100,0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q2	60	1,00	2,00	1,8000	,40338
Valid N (listwise)	60				

The second question relates to the degree of effective application of SEEMP by the Greek shipping companies of our sample. Apparently, although all of the participants agreed with the high degree of effectiveness of SEEMP implementation by their companies, what should be stressed out is the fact that only 12 out of the 60 respondents confirmed that they 'fully agree' with effective implementation of the SEEMP by their companies. This can be interpreted that there is room for

improvement within the context of effective SEEMP implementation. Again, a low standard deviation rate indicates a common belief shared by the respondents with no extreme views.

Table 4.3: Q3 Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	4	6,7	6,7
	2,00	20	33,3	40,0
	3,00	24	40,0	80,0
	4,00	8	13,3	93,3
	5,00	4	6,7	100,0
	Total	60	100,0	100,0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q3	60	1,00	5,00	2,8000	,98806
Valid N (listwise)	60				

The data reflected on the table above (4.3) is related to respondents' view about the improvement of energy efficiency of their companies brought about by the introduction of the SEEMP. Evidently the results present a particular interest due to the fact that the majority of participants appear to have a 'neutral' opinion and the standard deviation is rather high (close to 1) which shows a disagreement on the issue of energy efficiency improvement due to the SEEMP application. This is also confirmed by the min 1 and max 5 scores assigned to this particular questionnaire item, which cover the whole Likert scale spectrum.

Table 4.4: Q4 Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent

	2,00	8	13,3	13,3	13,3
Valid	3,00	44	73,3	73,3	86,7
	4,00	8	13,3	13,3	100,0
	Total	60	100,0	100,0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q4	60	2,00	4,00	3,0000	,52076
Valid N (listwise)	60				

Again neutrality of opinion (mean 3) has been expressed by respondents with respect to the contribution of SEEMP implementation to the increase of their company's competitiveness. This is evident on the one hand through the high concentration of scores in the middle of the rating scale (73 % rated this item with 3) and on the other through the low standard deviation rate.

Table 4.5: Q5 Frequencies and Descriptive

Frequencies

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3,00	8	13,3	13,3
	4,00	28	46,7	60,0
	5,00	24	40,0	100,0
	Total	60	100,0	100,0

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q5	60	3,00	5,00	4,2667	,68561
Valid N (listwise)	60				

The results presented in the tables 4.5 above show that Greek shipping companies employees (of this study's sample) believe that the process of SEEMP implementation has not led to a reduction of demand for their company. The mean score of 4,2 as well as the ratings of the majority of the respondents (86,7 % rating 4 'Disagree' and 5 'Strongly Disagree') provide evidence that SEEMP

implementation by the companies of our sample has not led to a reduction of demand for the companies involved.

Table 4.6: Q6 Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent
	2,00	4	6,7	6,7
	3,00	24	40,0	46,7
Valid	4,00	20	33,3	80,0
	5,00	12	20,0	100,0
Total	60	100,0	100,0	

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q6	60	2,00	5,00	3,6667	,87656
Valid N (listwise)	60				

With respect to the degree of easiness of SEEMP implementation in line with the respective regulatory framework and requirements, the majority (40%) of the Greek shipping companies' respondents assigned a neutral rate (3) which in turn has been supported by the mean rate (3,6) resulted from survey participants' rating.

Table 4.7: Q7 Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent
	3,00	52	86,7	86,7
Valid	4,00	8	13,3	100,0
Total	60	100,0	100,0	

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q7	60	3,00	4,00	3,1333	,34280
Valid N (listwise)	60				

Another interesting aspect concerning the view of the Greek shipping companies' employees (of the sample chosen) is the one connected with the facilitation of Paris MoU control processes. Respondents appear not to be confident about the degree of MoU compliance that the SEEMP implementation by their companies might lead to. This is reflected on the respective rate assigned (3) by the majority of the population (86,7%) and the very low standard deviation (0,34) which provides evidence for this commonly shared reservation.

Table 4.8: Q8 Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	48	80,0	80,0
	2,00	12	20,0	100,0
	Total	60	100,0	100,0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q8	60	1,00	2,00	1,2000	,40338
Valid N (listwise)	60				

The results presented on the table 4.8 above reflect the practice followed by the shipping companies of the majority of the respondents (80%) who confirmed through their rating the fact that their companies train their personnel on SEEMP framework and implementation. Nevertheless, another significant percentage of 20% of the respondents confirmed the lack of any SEEMP training.

Table 4.9: Q9 Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	40	66,7	66,7
	2,00	20	33,3	100,0
	Total	60	100,0	100,0

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q9	60	1,00	2,00	1,3333	,47538
Valid N (listwise)	60				

With respect to the issue of benchmarking practices applied, the majority of the survey participants (66,7%) responded that their companies carry out benchmarking with best practice operators in the industry while a significant percentage (33,3) confirmed a lack of external benchmarking practices. These results, however, will be compared and contrasted and further analysed and explained on the basis of the results drawn from the interviews with the classification societies that will be discussed and analysed in the following section.

Table 4.10a: Q10a Frequencies and Descriptive

Frequencies

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1,00	60	100,0	100,0	100,0

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q10a	60	1,00	1,00	1,0000	,00000
Valid N (listwise)	60				

Table 4.10b: Q10b Frequencies and Descriptive

Frequencies

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1,00	60	100,0	100,0	100,0

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q10b	60	1,00	1,00	1,0000	,00000
Valid N (listwise)	60				

Table 4.10c: Q10c Frequencies and Descriptive

Frequencies

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1,00	60	100,0	100,0	100,0

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q10c	60	1,00	1,00	1,0000	,00000
Valid N (listwise)	60				

Table 4.10d: Q10d Frequencies and Descriptive

Frequencies

	Frequency	Percent	Valid Percent	Cumulative Percent
1,00	36	60,0	60,0	60,0
Valid 2,00	24	40,0	40,0	100,0
Total	60	100,0	100,0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q10d	60	1,00	2,00	1,4000	,49403
Valid N (listwise)	60				

Impressive are the results presented on the tables 4.10a, 4.10b, 4.10c and 4.10d above reflecting participants' view about the extent to which their shipping companies follow a well structured approach with respect to the implementation of individual SEEMP stages. Specifically, while all of them confirmed a well structured implementation of the three SEEMP stages: planning, implementation and monitoring, 40% of them identified problems with the 'self-evaluation and improvement' stage of SEEMP. Again this will also be cross-checked with the interview results below.

Table 4.11: Q11 Frequencies and Descriptive

Frequencies

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1,00	4	6,7	6,7	6,7
2,00	32	53,3	53,3	60,0
3,00	24	40,0	40,0	100,0
Total	60	100,0	100,0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q11	60	1,00	3,00	2,3333	,60132
Valid N (listwise)	60				

As far as question 11 is concerned, the results presented in table 4.11 above show that 53% of the survey participants believe that their company's personnel support SEEMP implementation efforts while a considerable percentage (40%) remain neutral about the support provided by companies' human resource.

Table 4.12: Q12 Frequencies and Descriptive

Frequencies

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1,00	4	6,7	6,7	6,7
2,00	32	53,3	53,3	60,0
3,00	16	26,7	26,7	86,7
4,00	8	13,3	13,3	100,0
Total	60	100,0	100,0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q12	60	1,00	4,00	2,4667	,81233
Valid N (listwise)	60				

On the basis of the results presented in the table 4.12 above, it becomes obvious that although the majority 60 % (6,7 + 53,3) of the respondents agree with the fact that their company has benefited from the SEEMP implementation, it is also important to note that another considerable percentage

(26,7) are unsure about the benefits derived while another percentage of 13,3 do not believe that their companies have drawn any benefits.

Table 4.13a: Q13a Frequencies and Descriptive

Frequencies				
	Frequency	Percent	Valid Percent	Cumulative Percent
	1,00	24	40,0	40,0
Valid	2,00	36	60,0	100,0
	Total	60	100,0	100,0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q13a	60	1,00	2,00	1,6000	,49403
Valid N (listwise)	60				

Table 4.13b: Q13b Frequencies and Descriptive

Q13b				
	Frequency	Percent	Valid Percent	Cumulative Percent
	2,00	40	66,7	66,7
Valid	3,00	16	26,7	93,3
	5,00	4	6,7	100,0
	Total	60	100,0	100,0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Q13b	60	2,00	5,00	2,4667	,81233
Valid N (listwise)	60				

The results presented on the two tables above (4.13.a & 4.13.b) have to be considered together in order to draw some meaningful conclusions.

Specifically, the majority (60%) of the survey participants expressed their belief that SEEMP framework conditions impacts are not enough and also the majority of them (66,7 %) stated through their rating that ‘more action’ has to take place and ‘more should be done’ with that respect.

4.2.1 Reliability Testing

Carrying out the reliability testing through calculation of Cronbach alpha, the result (0,820) shows a ‘good level of internal consistency of the questionnaire therefore questionnaire results present a satisfactory degree of reliability and validity.’³

Reliability Statistics

Cronbach's Alpha	N of Items
,820	17

Cronbach's alpha Internal consistency

$\alpha \geq 0.9$	Excellent
$0.7 \leq \alpha < 0.9$	Good
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

³With respect to the Cronbach a measure this was used as the particular research instrument (the questionnaire) had not gone through any validation process therefore in order for its results to be considered valid and reliable a Cronbach test had to be carried out. A Cronbach's alpha score is expected to be increased as the inter correlation among questionnaire items increase, and is thus known as an internal consistency estimate of reliability and credibility of test scores.

Cronbach alpha Internal Consistency scale that will be applied includes : $\alpha \geq .9$ Excellent, $.9 > \alpha \geq .8$ Good, $.8 > \alpha \geq .7$ Questionable, $.6 > \alpha \geq .5$ Poor, $.5 > \alpha$ Unacceptable

4.2.2 Critical Discussion of Quantitative Research Findings

The aim of this particular section is to analyze the important issues raised from the survey results presented and discussed above, identify any contradictions and provide reasonable interpretation.

It should be noted that the author in this effort of his (to provide logical and mainly realistic interpretation) also consulted the classification societies that took part in the qualitative research so that they could contribute their insight, knowledge and expertise accumulated throughout their extensive and intensive auditing experience with Greek shipping companies as well as with international shipping enterprises.

The first interesting remark resulting from the findings presented and discussed above and that it needs further explanation is that although the companies that participated in the survey do have a SEEMP in operation (since this was the criterion on the basis of which they were chosen for the survey sample in the first place) there is a considerable percentage of almost 34% of participants who believe that their companies do not ‘fully’ implement the plan in question. This can be explained by the fact that even though Greek shipping companies (as it will also be discussed below analyzing the responses of classification societies) have been proactive with the implementation of SEEMP framework and its practices, generally this is a rather recent operational strategy and there is still not much evidence available on the extent of its implementation on one hand and on the other there is not much internal communication with respect to the issue of SEEMP implementation and its coverage of shipping companies’ operations.

The next finding that needs interpretation relates to participants’ responses with respect to questions 3, 4 and 7 which in turn reflect the fact that they are unsure about the energy efficiency improvement that the SEEMP brings about to their companies that implement it, the extent to which SEEMP implementation has increased their companies’ competitive strength in the market and the degree of compliance with MoU requirements that SEEMP implementation has ensured to their companies. With respect to the lack of awareness about the energy efficiency improvement that SEEMP implementation can bring about, this can be justified by the fact that currently the SEEMP requirements are not so strict and companies do not involve mandatory goal setting at the corporate level so that performance in energy efficiency enhancement cannot be clearly and accurately appraised and evaluated. Owners seem to be reluctant as far as the implementation of SEEMP requirements, since their position in the market does not seem to be effectively strengthened as :

‘these new patterns consist extra costs – my position in the market will not be affected thus I will not gain any extra freight out of this’ an owner could claim . Nevertheless, it should be stressed that according to the classification societies two broad categories of Greek shipping companies exist: the leaders and the followers.

The neutrality of participants about SEEMP contribution to the enhancement of their companies’ competitive position can be explained by the fact that except leading shipping companies that go beyond regulatory requirements the rest shipping companies make the minimum effort just to comply with regulatory framework and get the IEEC (International Energy Efficiency Certificate) issued. Hence mere compliance is not something that can promote a company’s competitive strength.

As far as the reservation-neutrality of the respondents in relation to the degree of their companies’ compliance with MoU framework through SEEMP implementation is concerned, this can be explained by the fact that currently MoU surveys focus on the availability of the SEEMP manual and relevant certificates. Later on it may be possible that proper implementation will be audited through ISM audits.

With respect to the apparent mixed views of Greek shipping companies’ employees about SEEMP training applied by their companies, this can be attributed (as classification societies officers pointed out) to the lack of the due significance assigned to training by the management of Greek shipping companies for an effective SEEMP implementation. However, it has to be clarified that this is a part of culture of the Greek shipping companies which act as followers while the leading ones apply proper SEEMP training and communicate its value duly companywide.

Another issue raised from the survey results and that needs further clarification is why all of our respondents confirmed a well-structured implementation of the three SEEMP stages: planning, implementation and monitoring, while a significant percentage (40%) of them identified problems with the ‘self-evaluation and improvement’ stage. As it will also be evident from the interview findings (see next section below) this issue can be related to and be partly explained due to the lack of external benchmarking data and with the goal setting process not been given the proper and required importance from these Greek shipping companies’ management.

Respondents’ answer to question 11 needs apparently an explanation as to why 53% of the survey participants believe that their company’s personnel support SEEMP implementation efforts while a considerable percentage (40%) remain neutral about the support provided by companies’ human resource.

A reasonable interpretation to this contradiction may possibly lie in the lack of proper policy of some Greek shipping companies to communicate the importance of SEEMP introduction to its operations as well as the lack of full awareness of its management team about the potential benefits that are derived from that. Consequently, it is reasonably expected from the Greek shipping companies that do not communicate SEEMP potential benefits not to have the respective support by their personnel.

Responses to question 12 raise another issue as to why the majority of respondents believe in the benefits that SEEMP can bring about, whereas another considerable percentage (26,7 %) are unsure about the benefits derived and another percentage of 13,3 do not believe that their companies have drawn any benefits. Again a logical interpretation of this reality, (based also on the valuable information provided by the classification societies -especially the ABS society-) is that such perceptions depend on the degree of effective implementation of all four SEEMP stages as well as the degree of importance that Greek shipping companies' management attach to this venture and acknowledge the potential benefits that can be derived which are then communicated to the respective personnel.

Finally, with respect to the fact that the majority (60%) of the survey participants expressed their belief that SEEMP framework conditions' impacts are not enough and also a 66,7 % of them stated through their rating that 'more action' has to take place and 'more should be done' the likely interpretation that could be given is that there is a general concern in the industry that the current SEEMP framework is loose and people in the industry (ship-owners and employees alike as well as senior officers) are concerned about SEEMP framework being rather loose and hence it should become stricter.

4.3 PRESENTATION AND ANALYSIS OF QUALITATIVE RESEARCH FINDINGS

In this section the results drawn from the qualitative research (interviews with the classification societies and flag state control) will be discussed and analysed in order for valid conclusions to be drawn that will in turn be used to meet the objectives of this study. As it was discussed in the methodology chapter, four classification societies were contacted and face-to-face semi structured interviews were carried out with:

1. The Principal Engineer from the ABS Class (the American classification society),
2. Marine Technical Manager from the Lloyds Register (the British classification society),
3. The Vice president of Bureau Veritas Class (The French classification society),
4. The Principal Marine Technical Manager of DNV (The Norwegian classification society).

It is important to note that these classification societies are non-governmental organisations that establish and maintain technical standards for the construction and operation of ships and offshore structures. The classification societies will also validate that vessels' construction is according to these standards and carry out regular surveys and inspections to ensure ships' operations compliance with the standards (Lloyds List, 2013). However, in order to avoid liability, classification societies explicitly take no responsibility for the safety, fitness for purpose, or seaworthiness of a vessel.

A first comment that the author would like to make before the main analysis of the interviews' results is that all four classification societies presented an overall agreement through their answers related to the performance of Greek shipping companies with respect to SEEMP application vis-à-vis their competitors and other international shipping companies, although Lloyds Register appears to be more critical (as it will become evident from the analysis below), something that gave a more useful insight into the case under examination.

As far as the approach followed by the Greek Shipping companies with respect to the compliance of their fleet with formal SEEMP requirements, the classification societies agree that the majority of Greek shipping companies are well informed about SEEMP requirements and implementation with their main drive being compliance with the rules and saving of capital. However, some of them are steps ahead (leading companies) formulating the implementation of own SEEMP according to IMO guidance prior to the due date to enhance also their competitive position while the smaller companies (followers) ask for the support of consulting offices. In general the interviewees confirmed that Greek shipping companies kept their required deadlines which means they started to work on SEEMP generation many months in advance.

The qualitative research proved that there is also a consensus among the interviewees (from classification societies and the Greek flag state control authority) about the provision in their SEEMP manual of all the Greek shipping companies inspected for the application of a PDCA cycle/methodology.

With respect to each of the four SEEMP PDCA cycle stages interviewees' responses pointed out that:

a) planning: most shipping companies' management have established relevant annual planning and ship specific measures regarding energy efficiency management plan according to their operational plan and capability. Nevertheless, Lloyd's answer indirectly indicated a weakness in the area of goal setting, stressing that only the shipping companies which have a corporate management system

with setting objectives also have a proper planning stage setting objectives and targets for their SEEMP.

b) doing: Greek shipping companies exhibit high standards of performance having established/amended the existing records and data keeping and implementation skills for energy efficiency management through improved fleet and voyage management techniques (weather routing, voyage optimisation, trim optimization, use of monitoring equipment, reform hull i.e. mewis duct etc). Again Lloyds' interviewees appear more skeptical stating that most of the companies have established just a simple implementation framework satisfying basic requirements and using monitoring systems such as noon reports, Kyma analysis etc.

c) controlling: All companies have their own KPI's (key performance indicators) in order to assess the effectiveness of specific measures with respect to their performance in energy efficiency management. However, the leading companies use a combination of EEOI and their own KPI's as the main and most comprehensive controlling tool in order to have a more objective and clearer picture of their energy efficiency usage and implementation so they go beyond Energy Efficiency Operational Indicators and combine them with their own KPI's. An important point raised in the interviews is that more often than not it is not easy to assess the effect of a measure because they are applied simultaneously (i.e. slow steaming, trim optimisation, voyage optimisation).

d) assessment: with respect to this stage of SEEMP PDCA cycle there has been a rather controversial stance adopted by classification societies. Specifically, three out of the four classification societies supported that the evaluation of the effectiveness of SEEMP implementation is normally carried out through the Greek shipping companies' management once a year, aiming to review the progress achieved and identify opportunities for energy savings and implement corrective actions for measures that did not work so that Greek shipping companies can go for the ISO 50001 certification. Again the Lloyds Register appear more critical stating that most of the Greek shipping companies have a rather static system of SEEMP implementation without real provisions for continually improvement (i.e. review, corrective actions, feedback).

With respect to consistency of Greek shipping companies' compliance with respective regulations, interviewees stated that on the basis of the rather "relaxed" current requirements, vessels certified with IEEC (international energy efficiency certificate) are easy to remain compliant. However, as we are moving to a stricter SEEMP framework in the future, Greek shipping companies will have to put more effort in order to remain compliant.

Moreover, it was supported that top quality Greek shipping companies are very proactive in this response and definitely they are above mandatory standards.

Finally, as far as Lloyds Register comments are concerned these implied that the main subject/ issue that will improve the SEEMP implementation will be goal setting and having a plan that it is really dynamic.

Next with respect to the evidence of Greek shipping companies' provision of the necessary training to their personnel, the interviewees agreed that leading companies assign the due importance and practice to the necessary SEEMP training, while smaller companies (followers) do not invest on the necessary training. According to the interviewees there is evidence regarding training of key-personnel about energy efficiency management with external bodies, despite the high cost per head that can reach the class of 3.000 Euros.

As far as the pace and degree of Greek shipping companies' compliance with SEEMP implementation requirements and regulations vis-à-vis other international shipping companies are concerned, the interviewees unanimously confirmed that there have been no gaps identified with regards to SEEMP compliance. Greek shipping companies usually perform above the market standards in energy efficiency issues and have shown a high degree of compliance in SEEMP application.

According to the classification societies' interviewees, Greek shipping companies comply with the regulation on time while the leading Greek shipping companies do it earlier than other international shipping companies.

With respect to the overall effectiveness of SEEMP implementation, Lloyds replied that Greek shipping companies in comparison with international shipping companies apply SEEMP equally effectively while the interviewees from the other three classification societies pointed out that many Greek leading companies perform even better than their international counterparts.

The same pattern of responding was exhibited by the interviewees with respect to the issue of deployment of new technologies for the reduction of CO₂ emissions, with the Greek shipping companies performing equally well or better in comparison with their international competitors. A point raised by ABS was that some Greek shipping companies are very much concerned about the cost of new technology and energy saving devices with this concern refraining them from becoming more competitive.

Regarding their performance monitoring system, the interviewees confirmed again the existence of two-speed Greek shipping companies. The leading Greek shipping companies have been more

proactive than their international competitors and took initiatives to introduce modern hardware and software (i.e. danaos software) in order to keep track of fuel consumption and hull operation with respect to ship energy efficiency of their fleet and take action for further improvement. These initiatives were taken before January 2013 when SEEMP implementation became mandatory, as Greek ship-owners/operators realized much earlier the cost savings potential. On the other hand, the followers in the Greek shipping industry apply a basic performance monitoring system with a wide room for improvement.

With respect to the benchmarking practices applied by the Greek shipping companies all the interviewees confirmed that these are carried out internally at the moment, which means that companies compare energy efficiency performance of their ships with others from their own fleet. To some extent this is reasonable since there is not enough data available yet for them to carry out external benchmarking on their own.

The following main areas of weaknesses have been identified by the interviewees:

- Non-systematic data collection and evaluation,
- Reluctance with regards the investment in new technologies due to current market situation,
- Lack of companywide training/awareness on SEEMP,
- Performance monitoring,
- Need for qualified staff for SEEMP implementation,
- Lack of SEEMP goal setting at the corporate level,
- The large amount of work that has to be generated and required for the SEEMP PDCA cycle implementation.

Regarding the question related to the degree and objectivity that the Greek flag state control carries out their inspections with respect to SEEMP implementation by Greek shipping companies the answers given by the classification societies could be characterized rather 'political' since they denied to make any comment except from the Lloyds interviewee who implicitly gave 'a picture of reality' stating that the lack of resources may cause the danger of superficial assessment of SEEMP implementation and operation.

Finally, all the interviewees agreed that what differentiates Greek from international shipping management is the decision making process based more on the instinct and intuition rather than calculation and logic⁴.

⁴ Answers given by interviewees to questions 11 and 12 will be presented and analyzed by the author in the next chapter in order to develop valid and feasible recommendations.

As far as the interview with the Greek flag state control officer is concerned, it has to be noted that due to the lack of resources (something that was acknowledged by all four classification societies involved in the research) this was a short interview with the officer agreeing with most of the responses of the four classification societies concerning Greek shipping companies performance.

Nevertheless, with respect to the two different questions included in the interview guide (questions 3 and 13) the important contribution made throughout this short interview was the differentiation between the work produced by the top ranking classification societies (i.e. ABS, Lloyds Register, B.V and DNV contacted for the purposes of the current study) and the ones that did not perform to the required standards with detrimental effects for the safety, quality and performance of the Greek shipping companies inspected. Specifically, the examples given by the Greek flag state control interviewee referred to a Russian classification society as well as a Greek one that the certification they issued upon completion of their inspection did not reflect the true safety and quality conditions and status of the Greek shipping companies under examination.

A summary of all the main conclusions drawn from this chapter will be presented in the next chapter and areas for improvement will be specified.

CHAPTER 5: CONCLUSIONS

5.1 MAIN CONCLUSIONS

Having completed secondary and primary research as well as the presentation, discussion and analysis of the respective findings the purpose of this chapter is to state the most important points that have arisen throughout the study that are directly connected to its aim and objectives and which are related to the evaluation and analysis of the effectiveness of Greek shipping companies' approach with respect to SEEMP implementation through a benchmarking analysis.

The SEEMP provides the most efficient vessel operation method (through trim optimisation, optimum route selection, appropriate maintenance, fuel quality, slow steaming, ocean currents, and weather routing) to reduce CO₂ emissions, while ensuring safe operation and maintaining a strict operational schedule. After having become a mandatory requirement by IMO as of 1st January 2013 a series of international organisations such as the International Energy Agency (IEA) as well as fields specialists (i.e. OCIMF, Lloyds Register etc.) support that shipping companies should place the highest priority on becoming energy efficient since the fuel expenses of ships are a major part of their total expenses which reaches the level of 50% of a ship's operational cost. Nevertheless, as stated in the Literature Review chapter around 60% of ship owners, operators and charterers are unaware of the scope for potential fuel savings that the implementation of IMO ship energy efficiency management plan (SEEMP) could trigger, according to surveys (Ship Management International, 2012). Hence the need to examine Greek shipping companies' practices since the shipping industry is considered to be one of the two main 'economic engines' (tourism is the other one) that could drive the Greek economy out of its current economic depression.

The results of the primary research of the present study with respect to its aim and objectives have provided us with a series of important data which after being statistically processed and analysed revealed a series of facts on which Greek shipping companies could build their future development with respect to their SEEMP implementation and hence the improvement of their energy efficiency performance, reduction of operational cost and enhancement of their competitive strength.

One main conclusion drawn is that Greek shipping companies can be distinguished into some type of 'two-speed' companies, with the first one (the leading companies or 'the leaders') being proactive with respect to SEEMP implementation (they actually proceeded with its implementation even before this became mandatory) going beyond mere compliance with regulatory requirements,

while the other (the following companies or ‘the followers’) proved to be rather reactive with respect to all the actions required for the effective completion of each of the four SEEMP stages of the PDCA (Planning, Doing, Controlling, Assessment) cycle.

Generally, Greek shipping companies usually perform above the market standards in energy efficiency issues and have shown a high degree of compliance in SEEMP application. With respect to the overall effectiveness of SEEMP implementation, Greek shipping companies apply SEEMP equally effectively in comparison with international shipping companies while Greek leading companies perform even better than their international counterparts applying IMO’s best practice guidance for each of SEEMP’s four stages (as these have been presented in chapter three).

However, there is a lack of intra-company communication about SEEMP significance for performance improvement and its savings potential for shipping operations which in turn has led Greek shipping companies’ employees to be uncertain about the SEEMP’s contribution to the enhancement of their companies’ competitive strength in the industry. Besides that, except from the leading Greek shipping companies, the rest follow a mere compliance approach, with respect to SEEMP implementation which in turn cannot reinforce a company’s competitive position and strength in the market.

Existence of interdepartmental friction is another important conclusion drawn, which has resulted from the high drive of shipping companies Health, Quality and Safety department to enhance their performance, with the rest departments feeling rather annoyed and stressed from the extra workload they have to cope with in order to ensure SEEMP’s proper implementation and operation, hence the feeling of employees that there is a lack of proper support by all companies’ personnel.

With respect to SEEMP training, Greek leading shipping companies apply relevant schemes companywide based on the goals set at the corporate level so that investment in training is essential and worthwhile and performance appraisal can be facilitated by producing reliable and useful results for further improvement and development.

As far as the proper implementation of the four SEEMP PDCA cycle is concerned while with respect to planning, doing and controlling the Greek shipping companies comply and perform better than their international competitors (through improved fleet and voyage management techniques - weather routing, voyage optimization, trim optimization, use of monitoring equipment, reform hull i.e. mewis duct etc.-) Greek shipping companies present a weakness with respect to the proper implementation of the final stage of assessment and feeding its results to the planning stage of the next PDCA cycle so that the requirements of a dynamic cycle is constantly served.

As far as the deployment of new technologies for the reduction of CO₂ emissions, classification societies commonly agreed that the Greek shipping companies are performing equally well or better in comparison with their international competitors.

Nevertheless, there have been weaknesses identified in the context of the final stage (assessment and self-evaluation stage) of the SEEMP cycle which according to the classification societies this is a rather static stage without real provisions for continually improvement (i.e. review, corrective actions, feedback).

Moreover, at the time being only internal benchmarking practices are applied by the Greek shipping companies since there is not enough data available for external benchmarking approach to take place.

Finally, it should be noted that the leading Greek shipping companies have been more proactive than their international competitors in the introduction of the most modern hardware and software for monitoring purposes, while at the same time there is much room for improvement identified for the 'followers' of the Greek industry.

Therefore the areas that need improvement include:

- Better implementation of Just – in time arrival/ reducing congestion i.e. drifting and anchoring time (Awaiting time outside of the port),
- Installation of energy saving devices for propulsion and resistance improvement applicable to existing vessels without hull optimized forms,
- Good new buildings vessel with new hull no need any installation of energy savings,
- Companywide training / awareness on SEEMP implementation and beneficial prospects,
- Performance monitoring,
- Development of qualified staff form SEEMP implementation,
- Goal setting beyond compliance at the corporate level,
- External benchmarking,
- Reduction of fuel consumption of the order 200% is not impossible through LNG,
- More systematic data collection for proper analysis,
- Performance Engineer to analyze SEEMP related data,
- Closing the 'loop' of SEEMP PDCA cycle through proper assessment and evaluation of SEEMP implementation and feeding back respective results to the planning stage of the next cycle, applying thus a dynamic approach,

- Further investment by the whole Greek shipping industry in new technologies due to current market situation,
- Synergies with universities and other scientific organization for better implementation of SEEMP and statistical analysis of its results that will justify and reinforce further improvements and corrective action.

5.2 SUGGESTIONS FOR FURTHER RESEARCH

The author believes that two main suggestions for further research on the issue might include:

- a) Expansion of the basis of research by increasing the size of the sample of the Greek shipping companies and the number of classification societies that can contribute valuable insight from their valuable auditing experience and
- b) Repeating the research in a year or two so that more data will be available and safer conclusions can be drawn with respect to SEEMP implementation by Greek shipping companies as well as international best practices.

Completing this study the author wishes to make a final comment/suggestion to the Greek ship-owners/operators which is based on the author's belief that there must be a combination of intuition and the congenital instinct that Greek ship-owners/operators have exhibited so far with a scientific appraisal of the respective trends and environment in order to decide upon the consecutive strategic movements. A counterargument to that could be that it is this intuition that led Greek ship-owners/managers to differentiate their action from their international competitors so far.

Nevertheless, this unprecedented global crisis and turbulent times on the one hand and the movement towards a continuously stricter SEEMP framework on the other require a sound combination of intuition and scientific reasoning and planning in order for the Greek shipping companies not only to remain compliant but more crucially to outperform their competitors in the international shipping arena.

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APPENDICES

APPENDIX A: SHIPPING COMPANIES QUESTIONNAIRE

Please complete the questionnaire below by either ticking the right box or circling the number that represents your views most closely.

1. My company has in place a fully implemented Ship Energy Efficiency Management Plan SEEMP

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

2. My company has implemented and operates SEEMP effectively

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

3. The energy efficiency of my company has improved due to the introduction of the SEEMP

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

4. The introduction and implementation of SEEMP has increased the competitiveness of my company

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

5. The implementation of the SEEMP requirements has led to a reduction of demand for my company

Strongly	Agree	Neutral	Disagree	Strongly
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Agree Disagree
 1 2 3 4 5
 6. Please evaluate the degree of difficulty with respect to SEEMP implementation by your company in order to comply with respective regulations

Very high High Moderate Low Very Low
 Degree Degree
 1 2 3 4 5

7. The implementation of SEEMP by my company facilitates Paris MoU Control carried out by the respective port authority in charge in every country our fleet are visiting

Strongly Agree Agree Neutral Disagree Strongly Disagree
 1 2 3 4 5

8. Does your company operate a training program for seagoing/ shore personnel with regards to the purpose, content, and implementation of the Ship's Energy Efficiency Management Plan?

Yes No

9. Does your company carry out any SEEMP benchmarking with best practice operators in the field?

Yes No

10. To what extent does your company follow a well structured approach to SEEMP implementation following its discrete stages of:

a) Planning – setting goals for continuous improvement

Yes No

b) Implementation- designing and implementing the necessary systems

and processes

Yes

No

c) Monitoring – Collecting and analysing data on energy efficiency and reporting

Yes

No

d) Self-evaluation and improvement- Utilising third part audit and verification results on SEEMP effectiveness review

Yes

No

11. The personnel of my company support the successful effort of SEEMP implementation and its operation with old and new vessels

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

12. My company has been benefited by the SEEM Plan introduced

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

13. Do you think that the present SEEMP framework conditions impacts are enough?

Yes

No

or more should be done?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

Please feel free to write any further comments that you wish to add. Use the space below.

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Πανεπιστήμιο Πειραιώς

APPENDIX B: INTERVIEW GUIDE WITH THE FLAG STATE CONTROL

Based on the results of your audits of the Greek Shipping Companies vessels:

1. How would you comment on the approach followed by the Greek Shipping companies with respect to the compliance of their fleet with formal SEEMP requirements?

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2. Do they apply the required SEEMP procedures ashore/on board to ensure compliance on board with the respective IMO requirements with respect to the PDCA stages:

- a) Planning

(i.e. target setting with respect to Energy efficiency management , annual planning, ship & company specific measures, training & HR development and reporting)

- b) Doing

(i.e. establishment of an implementation system, record keeping for implementation, use of available modern technology)

- c) Controlling

(i.e. establishment of a monitoring system , identification and collection of data, establishment of official measurement tools, e.g. EEOI developed by IMO)

- d) Assessing.....

(i.e. review of the progress made, identify deviations, feedback, and corrective action)

3. Does their certification issued by respective classification societies respond to reality?? If not please specify areas of deficiencies and give more details...

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4. Do they have evidence of providing their personnel with the necessary training?

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5. How would you rate/ assess the pace and degree of Greek shipping companies' compliance with SEEMP implementation requirements and regulations vis-à-vis other international shipping companies?

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6. How would you comment upon the degree of the overall effectiveness that Greek shipping companies apply SEEMP in comparison with international shipping companies that you audit ?

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7. How would you comment on the practice applied by the Greek shipping companies with respect to the deployment of new technologies to achieve CO₂ reduction practices (always in comparison with respective practices applied by international shipping companies) ?

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8. How would you comment upon the performance monitoring system Greek shipping companies operate in order to keep track of fuel consumption and hull operation with respect to ship energy efficiency and further improvement?

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9. Do they carry out any benchmarking?

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10. Could you identify any areas of weakness with respect to the Greek shipping companies implementation of SEEMP

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11. Could you identify any Energy Saving Potentials (ESPs) for the Greek shipping companies in achieving best practice in energy efficiency improvement ?

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12. What kind of general and /or specific improvement/s could you suggest?

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13. On the basis of the new reality in Greece with flag state control delegating a great deal of its role to classification societies (due to decreasing number of employees while responsibilities increase) please assess the contribution of the latter with respect to providing guidance and objective evaluation of Greek shipping companies with respect to the SEEMP they operate.

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APPENDIX C: INTERVIEW GUIDE WITH CLASSIFICATION SOCIETIES

Based on the results of your audits please comment on the following with respect to the performance of Greek Shipping Companies vis-a-vis their international competitors:

1. How would you comment on the approach followed by the Greek Shipping companies with respect to the compliance of their fleet with formal SEEMP requirements?
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2. Do they apply the required SEEMP procedures ashore/on board to ensure compliance on board with the respective IMO requirements with respect to the PDCA stages:
 - a) Planning

(i.e. target setting with respect to Energy efficiency management , annual planning, ship & company specific measures, training & HR development)

 - b) Doing

(i.e. establishment of an implementation system, record keeping for implementation of fuel management, fleet and voyage management with the use of available modern technology)

 - c) Controlling

(i.e. establishment of a reporting and monitoring system , identification and collection of data, establishment of official measurement tools, e.g. EEOI developed by IMO)

 - d) Assessing

(i.e. review of the progress made, identify deviations, feedback, and corrective action)

3. Once you issue a relevant certificate, to what extent Greek Shipping companies remain compliant with its requirements? If not please specify areas that Greek Shipping companies

lapse in their certified performance and in relation to their best practice international competitors

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4. Do they have evidence of provision of their personnel with the necessary training?

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5. How would you rate/ assess the pace and degree of Greek shipping companies' compliance with SEEMP implementation requirements and regulations vis-à-vis other international shipping companies?

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6. How would you comment upon the degree of the overall effectiveness that Greek shipping companies apply SEEMP in comparison with international shipping companies that you audit?

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7. How would you comment on the practice applied by the Greek shipping companies with respect to the deployment of new technologies to achieve CO₂ reduction practices (always in comparison with respective practices applied by international shipping companies) ?

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8. How would you comment upon the performance monitoring system Greek shipping companies operate in order to keep track of fuel consumption and hull operation with respect to ship energy efficiency and further improvement?

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9. Do they carry out any benchmarking?

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14. Could you identify any areas of weakness with respect to the Greek shipping companies implementation of SEEMP

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15. Could you identify any Energy Saving Potentials (ESPs) for the Greek shipping companies in achieving best practice in energy efficiency improvement ?

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16. What kind of general and /or specific improvement/s could you suggest so that Greek Shipping companies could meet best –practice performance criteria?

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17. On the basis of the new reality in Greece with flag state control delegating a great deal of its role to classification societies (due to decreasing number of employees while responsibilities increase) please assess the degree and objectivity that the Greek flag state carries out their inspections with respect to SEEMP implementation and operation.

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