04-038

STAKEHOLDER ANALYSIS AND DECISION-MAKING OF SHIPOWNERS FACING THE COMING IMPLEMENTATION OF IMO SULPHUR 2020 POLICY

Aragonés-Beltrán, Pablo [(1)]; González-Cruz, Mª Carmen [(1)]; Bastante-Ceca, Mª José [(1)]; Li, Yirong [(1)]

[(1)] Universitat Politècnica de València

The main type of oil used as fuel in ships is heavy fuel oil, derived from the residue of crude oil distillation. Crude oil contains sulphur which, after combustion in the engine, is released into the atmosphere along with the rest of the ship's emissions. In order to reduce SOx emissions from ships so that they can improve air quality and protect the environment, the OMI decided on 27 October 2016 that the sulphur limit under Annex VI to MARPOL would enter into force on 1 January 2020. Because of this, shipowners must implement projects to adapt to the new regulations. This study identifies the stakeholders who should support the decision-making process to select the best option for the shipowner in this situation.

Keywords: stakeholder analysis; multicriteria decision making; AHP; marine bunker fuel; IMO Sulphur 2020

ANÁLISIS DE INTERESADOS Y TOMA DE DECISIONES DE LOS ARMADORES DE BUQUES FRENTE A LA PRÓXIMA POLÍTICA “IMO AZUFRE 2020”

El principal tipo de hidrocarburos usado como combustible en los buques es el fueloil pesado, derivado del residuo de la destilación del petróleo crudo. El petróleo crudo contiene azufre que, tras la combustión en el motor, es liberado en la atmósfera junto con el resto de las emisiones del buque. Con el fin de reducir las emisiones de SOx de los barcos para que puedan mejorar la calidad del aire y proteger el medio ambiente, el 27 de octubre de 2016, la OMI decidió que el límite de azufre conforme al Anexo VI de MARPOL, entraría en vigor el 1 de enero de 2020. Debido a esto, los propietarios de los barcos deben de poner en marcha proyectos para adecuarse a la nueva normativa. Este estudio identifica las partes interesadas que deben apoyar el procedimiento de toma de decisiones para seleccionar la mejor opción para el armador en esta situación.

Palabras clave: análisis de partes interesadas; análisis multicriterio de decisiones; AHP; abastecimiento de combustible marítimo; IMO Azufre 2020

Correspondencia: Pablo Aragonés Beltrán aragones@dpi.upv.es

1. Introduction

Maritime transportation is the most important and economic way of transportation in global trading with significant scale, which depends on millions of vessels sailing across oceans every day. The main type of bunker oil for vessels is heavy oil. Basis the current policy, vessels are allowed to consume bunker with the Sulphur content below 3.5% m/m all over the world basis ISO 8217:2012 except of 4 North American Emission Control Area (ECA), which require ships to use bunker with Sulphur content below 0.10% m/m on and after 1 January 2015 (IMO,2015).

IMO (International Maritime Organization) developed MARPOL (International Convention for the Prevention of Pollution from Ships) regulations, which is the main international convention covering prevention of pollution of the marine environment by ships from operational and accidental causes, to limit main air pollutants contained in ship exhaust gas, including Sulphur oxides (SOx) and nitrous oxides (NOx), and prohibits deliberate emissions of ozone depleting substances (ODS).

In order to reduce SOx emissions from ships so that can improve air quality and protect the environment, on October 27, 2016, IMO decided that the Sulphur Limit under MARPOL Annex VI would enter into force from January 1, 2020, which limits Sulphur content in fuel oil used on board to be reduced to 0.50% m/m. The implementation of the new policy will significantly reduce the amount of Sulphur oxides emanating from ships and should have major health and environmental benefits for the world, particularly for populations living close to ports and coasts.

With the releasing of the new regulation in details, global shipowners have to develop their own project to decide how they would act to meet the requirement. The project will include following stages: 1. Investigation of the bunker market and ship industry; 2. Decision-making with the consideration of company strategy; 3. Evaluation and contraction in ship transforming; 4. Transforming and maintenance; 5. Close of the project. So, this work would focus on the early stage of the project, that is the stakeholder analysis as part of the investigation and decision-making.

Due to the background of the project, the stakeholders would be made by parties from maritime transportation market and bunker industry from upstream to downstream, including shipowners, charterers, refinery and physical supplier, shipyard, national authorities and international organizations.

According to the recommendation and guideline provided by IMO, shipowners are mainly facing two options to make sure to be compliant of the new regulation. One is to install exhaust gas cleaning systems on board, which also is known as “scrubbers”. These scrubbers are designed to remove Sulphur oxides from the ship’s engine and boiler exhaust gases. The other option is waiting to use the new grade of cargo provided by physical supplier, which meet the requirement directly.

The study would use the methodology of stakeholder analysis to support the decision-making process on the role of shipowner by applying methodology of power/interest grid to identify and analysis those stakeholders and use AHP to find out which is the best option to be compliant with the coming regulation related with Sulphur content.

2. Objectives

The general objective of this work is to identify key stakeholders and establish a decision support process, using the Analytic Hierarchy Process (AHP), to select the best technological solution that allows shipowners to reduce the sulfur content (SOx) issued by vessels to adapt them to the new MARPOL regulation.

3. Brief review of the theoretical framework

In this work, the theoretical framework is based, on the one hand, on the techniques of stakeholder analysis and, on the other, on the Analytic Hierarchy Process (AHP). Regarding the analysis of stakeholders, the simplest techniques are qualitative and it is worth mentioning the salience model (Mitchell, Agle, & Wood, 1997) and the mapping (Bourne & Weaver, 2010), (Reed & Curzon, 2015). The prominence model classifies the stakeholders according to their power (ability to impose their will), urgency (need for immediate attention) and legitimacy (adequacy of their participation as a stakeholder). The mapping places each interested party in a two-dimensional matrix whose axes evaluate parameters such as: power (level of authority over the project or matter of interest), interest (level of concern for a project or matter of interest), influence (active participation in the project or issue of interest) or impact (ability to produce changes in the project or issue of interest). The most widely used is the power-interest matrix (Olander, 2007).

Other more elaborate techniques are based on Social Network Analysis (SNA), which allows the identification of key stakeholders based on the exchange of information between them and the analysis of their interdependencies (Zheng, Le, Chan, Hu, & Li, 2016), or on the prioritization of stakeholders through the Analytic Network Process (ANP) (Aragonés-Beltrán, García-Melón, & Montesinos-Valera, 2017). This method attempts to "measure" the influence of stakeholders in a project or area of interest.

El Analytic Hierarchy Process (AHP) is a well-known multicriteria decision analysis method, developed by Th. Saaty (Saaty, 1980). AHP is using the hierarchic structure to deconstruct the decision-making problem into multiple levels, the top level is the overall goal of the problem, then is the level of criteria and sub-criteria if needed, and the bottom level is the alternatives. When the hierarchic structure has been well defined by the decision maker, it moves to the step that is to determine the relative importance of different attributes or criteria with respect to the goal. By this process, we can get the pairwise comparison matrix regarding to criteria. Basis on the number of the matrix, after the normalization, the weight allocation within criteria can be get. And with further calculation, the consistency index and consistency ratio can also get as well. Then the result of pairwise comparison between alternatives can also lead to the matrix of alternatives regarding to each criterion. By doing the calculation of normalization, the priority of alternatives well be clear as well. After combined all these results together, the decision maker would be able to get a clear idea on the best option of the problem.

The global shipping market is made by three parts, international shipping, domestic navigation and fishing. In this work, we will focus on the international shipping part. In this sector, there are several types of vessels including Vehicle, Ro-Ro, Refrigerated bulk, Other liquids tankers, Oil tanker, Liquefied gas tanker, General cargo, Ferry-RoPax, Ferry-pax only, Cruise, Container, Chemical tanker and Bulk carrier. All the operation of these international ships will be affected by the implementation of the new regulation that for ships operating outside of ECA, the limit for sulphur in fuel oil used on board has been set as 0.50% m/m (mass by mass) from 1 January 2020.

As the definition by the International Convention for the Prevention of Pollution from Ships (MARPOL), Fuel oil means any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including distillate and residual fuels. In current bunker market, marine fuel can be distinguished as following:

- Petroleum fuels with a Sulphur content of 0.10% m/m or less.
- Petroleum fuels with a Sulphur content of more than 0.10% m/m but equal to or less than 0.50% m/m.

- Petroleum fuels with a Sulphur content of more than 0.50% m/m but equal to or less than 3.50% m/m.
- Liquefied Natural Gas, LNG
- Methanol
- Biofuels
- Liquid Propane Gas, LPG
- Dimethyl Ether, DME

Among all these above, LNG, Methanol, Biofuels, LPG and DME can also be called as alternative fuels. Even LNG is the one has the biggest market share within them, generally used simply on LNG carriers, still cannot compare with the market share of petroleum fuels. The use of them plays a negligible role in the entire market.

Following ISO 8217 2010, marine fuel can be divided into marine distillate fuels and marine residual fuels. The blends of distillates and residuals frequently used in practice are described as marine diesel oil (MDO) or intermediate fuel oils (IFO). In marine distillate fuels, DMA is mostly used in market that is pure distillate petroleum product, also normally called as Marine Gasoil. It is used in smaller medium to high speed auxiliary units or auxiliary engines of a ship. They can be further grouped following different limit of sulphur content, such as MGO, LSMGO (with low Sulphur content less than 1.0%), ULSMGO (with low Sulphur content less than 0.1%). In marine residual fuels, RMG and RMK are mostly used. During the distillation process of crude oil, the remaining residue that does not pass into gas phase is referred as residual fuel or heavy fuel oil. They can be further categorized by viscosity to be known as RMG 380 or RMK 500 etc. They can also be categorized by Sulphur content, such as FO, LSFO (with low Sulphur content less than 1.0%), ULSFO (with low Sulphur content less than 0.1%).

4. Methodology and case study

With coming of the new regulation into implementation, it is necessary for shipowner to well understand the requirement of IMO and set a strategy for all his fleet to make sure the smooth and safe operation of this company after 1 January 2020. It is essential for shipowner to set its own company strategy and finish his action accordingly before the new regulation entering into force that to make sure all fleets would be compliant to the limit which set by IMO.

The project is of a medium-small size shipowner company mainly focused on dry bulk carriers and general cargo ships, which need to set their company short term plan and put it into action for those vessels under operation, to make sure they would be compliant in bunker consuming under the new regulation. The main reason for selecting this project is because by general practice in bunker industry, such decision-making problem normally would be left in business balance and negotiation without using any methodology to get a conclusion. By doing this study, it has been chosen to show how the decision-making process would be done under the project environment when adopting those tools and methods from project management.

The main source of information, in this case study, was interviews with various stakeholders in the project, including project owners, refinery, physical supplier, shipyard etc. The interview was conducted as semi-open interview. The main topic, question and structure of the interview, has been prepared before starting. In addition to the interviews, official reports and guideline relating with the problem, published by international organization, have also been examined in order to get the official opinion and suggestion on structure of the interview.

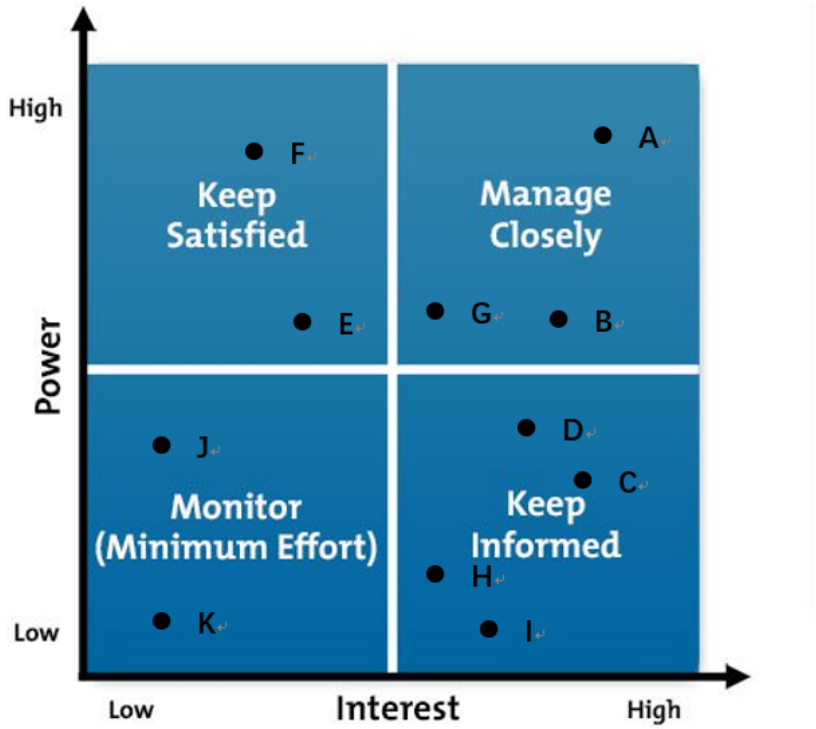
4.1 Stakeholder analysis

Considering the objective and the environment surrounding of the project, there are following stakeholders related with the project:

- A Shipowner
- B Charterer
- C Refinery
- D Physical supplier
- E Maritime Safety Authority
- F Customs
- G Shipyard
- H Maker of Exhaust Gas Cleaning Systems (EGCS)
- I International Maritime Organization
- J International Organization of Standardization
- K Environmental group

After the identification of the stakeholder, the method Power/ Interest grid will be used to analyze them accordingly so that can help the following step of decision-making. As shown in Figure 1, those stakeholders have been put into the according position in it.

Figure 1. Power/Interest grid of stakeholders



The stakeholders selected as decision-makers are those positioned in “Manage closely” area. They are:

- A *Shipowner*. By talking with shipowner through the interview, and sharing their opinion

regarding this project, they are the one who has both high power and high interest in this project. As the promoter of the project, the objective of the project is to select the best option for the company and archive the best performance of the project. They explained that the project is part of the short-term strategy of the company, which related with quite number of investments recently and also would influence the financial performance of the company in following years. As it is a medium-small size shipowner company mainly focus on dry bulk carriers and general cargo ship, the action taken during the project will affect their rentability of the company in the coming years. So, they are highly interest-related in the project. At the same time, they have the definite power in whatever decision and action to be taken during the entire project life circle, no matter on the early stage of decision-making or the coming process of contraction and transformation.

- B *Charterer*. All the fleets of shipowner, if they are not left on own operation then would be put into chartering market so that charterer will be responsible for the operation issue including bunker arrangement accordingly to the statement of charter party. After communicating with the staff of shipowner in chartering department, over half of their vessels are in the chartering market so that the attitude from charterer, regarding to this case, has a lot influence related with decision and action of decision maker. From this side of view, charterer as a stakeholder in this project has high interest related of the case, since they will be responsible as the future bunker bill payer depends on the charter party agreement. In chartering market, not most of charterers have showed their general opinion like Hudson Shipping Lines that they would refuse to charter any vessel with EGCSs installed after the implementation of the IMO Sulphur 2020 regulation. But the preference of charterer between different options can be treated as their power to influence the business environment of the project. So, with the concern of all above facts, charterer has been put at the category of Manage Closely in the grid. Even they are also in this category, but comparing the power with shipowner, charterer has been put in lower position at the figure.
- C *Refinery*. The predicted supply from refinery is a very essential part in the research and investigation of the project, as it is the foundational information that to support the running of the project. Basis on the news already in market, some of big global refinery company including BP, ExxonMobil, Sinopec and others have announced that they will provide compliant product to bunker fuel market in order to meet the demand of the market regarding to the new regulation that would be enter into force soon. According to the information and prediction released by IMO, the global refinery would be able to supply sufficient compliant low-sulphur fuel oil after the implementation of the new regulation in theory. Through the comments get from staff of refinery, to provide compliant product in market would need them to add another procedure during their process which is called as desulfurization, which is related to the investment of equipment in refinery side.

Once the problem has been defined, the group of experts to make the decision is also confirmed. The group includes three experts and they are experienced operator of the shipowner company with focus on different business area. The experts are:

- *Expert A* has rich experience in shipowner operation and he also worked on physical supplier company so that he has deep understanding on how to cooperate with local marine authorities and port authorities.
- *Expert B* is selected due to his previous working experience in chartering area so that he has much clearer idea about what will be influence to be brought into chartering market and give his suggestion from this side of view.

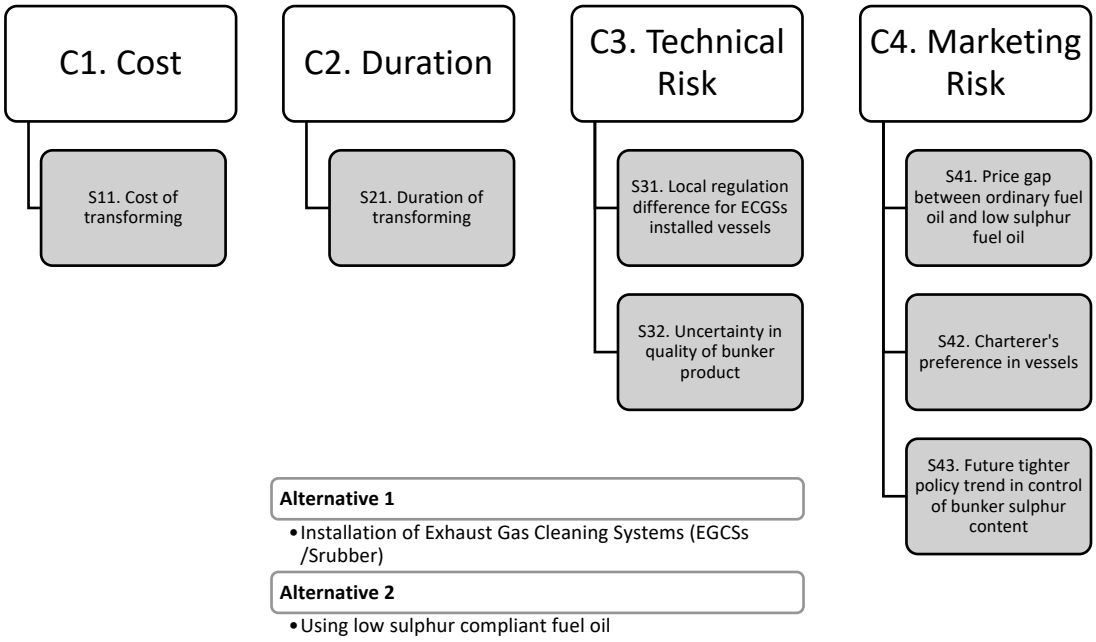
- *Expert C* works as the purchaser for bunker in the shipowner company, who is familiar with global bunker market in general and also is well-noted about the shipping routes of their company fleets under operation, the local regulation of the calling ports and also the predicted supply ability of fuel oil.

The communication with those three experts was realized by a short video conference at first to gather their personal idea from different side of view about the problem. And the results of questionnaire were collected by email to support the further calculation under the AHP approach.

4.2 Structure of the decision-making problem

After communication with those stakeholders of this project, by taking their opinion regarding to the problem, following structure, criteria and sub-criteria of the problem have been defined accordingly as shown in Figure 2.

Figure 2: Decomposition of the problem into a hierarchy



4.3 Criteria

Identifying the criteria and sub-criteria of the problem requires the most thorough understanding of the problem itself and also of the surrounding environment. In this case, four first-level criteria have been identified, which are broken down into second-level criteria or sub-criteria. The criteria identified are as follows:

- C1 The financial cost.
  - S11 - Cost of transforming. The economic cost for installation of EGCSs system or tank cleaning process.
- C2 Time cost
  - S21 - Duration of transforming. The Time cost for installation of EGCSs system or tank cleaning process.
- C3 Technical risk.

- S31 - Local regulation difference for ECGSs installed vessels. For example some of the ports like Singapore, the Maritime and Port Authority of Singapore has announces ban on vessel with the use of open loop scrubber to discharge scrubber wash water in port, which means even those vessels with scrubber system is compliant when burning regular bunker fuel according to the regulation, they still need change to use compliant low-sulphur fuel oil when calling Singapore.
- S32 - Uncertainty in quality of bunker product. On the side of regular bunker fuel, there are well developed quality standard to follow, that is the ISO 8217. But when looks to the compliant low-sulphur fuel oil, due to the extra process of desulphurization to reducing the sulphur content in fuel oil, it will bring the change of quality in flash point (for storage safety) and viscosity (to easy move through pumps and piping of vessel). So far, there is no international standard for this product. From the opinion of market, both physical supplier and vessel side will follow the existing standard plus the updated sulphur content limit. But it may also bring negative impact to ship machinery systems which is still unclear.

- C4 Marketing risk.
  - S41 - Price gap between ordinary fuel oil and low sulphur fuel oil. According to the research and investigation of IMO, they did all the calculation about the impact of the new policy basis the price gap around USD 128/MT of fuel oil. On the other side, from the latest news in market, it will have big chance that especially on the beginning days after the implementation of the new regulation, there won not be sufficient compliant low-sulphur fuel oil supply in the whole market, which might widen the price gap than expected and no one can predict when would the situation become better.
  - S42 - Charterer's preference in vessels. As known from the market, there already has been big charterer company like Hudson Shipping Lines announced that they would stop chartering vessel with EGCSs after the IMO sulphur 2020 entering into force. At the same time, there are also other charterers who support the use of EGCSs considering the increasing fuel cost with the rising of crude price.
  - S43 - Future tighter policy trend in control of bunker sulphur content. From the concern of anti-pollution and maritime environmental protection, the policy of sulphur content control would be tighter and tighter in coming future and it is under discussion in IMO as we all known. In this field, the installation of EGCSs and the use of compliant low-sulphur fuel oil would act differently.

The reason why no "opportunity" criteria have been taken into consideration is because the application of the new regulations, already confirmed by the IMO, is mandatory and does not admit any delay. On the respect to this regulation, according to the responding voice from shipping market it is confirmed that positive influence would be brought into environment protection field and it would also push the technology development of ship engine design to be more efficiency and environmental-friendly. But the action that should be taken by shipowner in short term, which is the problem being studied now, is obligatory for them to act compliantly in bunker consuming. From the view of shipowners, whatever action they would take according to the decision made in this project it would lead to have an investment on equipment once at this time or continuous higher cost for compliant bunker in future, which shows nothing in opportunity for the company itself no matter in financial side or business side so far.

4.4 Alternatives

According to the recommended action from the guideline issued by IMO and the opinion from experts, there are following two alternatives of the problem.

- A Installation of the Exhaust Gas Cleaning Systems (EGCSs / Scrubber) and continuous using of ordinary fuel oil
- B Directly using compliant low-sulphur fuel oil

The Alternative A is together with the keep using of ordinary fuel oil to install the Exhaust Gas Cleaning Systems (EGCSs / Scrubber) into the vessel by using the water to wash the exhaust gas to confirm that vessel operation is compliant to the IMO regulation. The scrubber wash water would be storage in separate tank on board and be discharged when vessel calling to a discharging port under the instruction of port authority accordingly. There are three types of EGCS: open loop, closed loop and hybrid. Generally, all these three types scrubber are working following the same principle. The installation of EGCSs requires vessel to set a plan of entering into shipyard, but vessel would not need to do extra tank cleaning process.

- Open loop EGCSs is the cheapest option that wash water is taken from the sea, used for scrubbing, treated and discharged back to sea, with the natural chemical composition of the seawater being used to neutralize the results of SO2 removal.
- Close loop EGCSs use freshwater treated with an alkaline chemical, such as caustic soda, for neutralization and scrubbing, so that it would be more expensive as it requires additional pumps, tanks of sludge and so on.
- Hybrid EGCSs is the system can work both in open and close loop mode, which means it requires two sets of pumps and piping.

The Alternative B, on the respect of directly using the compliant low-Sulphur fuel oil, it requires vessel to be prepared especially in technical part. It is necessary for vessel to go through the process of tank cleaning according to the suggestion from IMO before changing to use the compliant fuel oil. Vessel need to be sure on its technical capability to handle different types of fuel due to the concern of higher or lower viscosity fuels. And also, it will be essential that during the beginning period after the implementation, ship crew is able to handle Sulphur non-compliant fuels even in the situation of non-availability of Sulphur compliant fuels. Once vessel starts to consume the compliant fuel oil, it requires vessel crew to closely verify machinery performance on compliant fuel oil.

4.5 Weights of the criteria

The decision maker is composed by a group of three experts described in section 4.1. They have large experience in operation of the vessels and also with deep knowledge in different field related with different stakeholders' area in this project. The individual judgments of experts will be combined following AHP to represent the idea of all of them. Table 1 shows the weights of the criteria obtained applying AHP.

Table 1. Weights of the criteria

	EXPERT A	EXPERT B	EXPERT C	GROUP
C1	0.04990	0.10396	0.06816	0.06310
C2	0.12956	0.12823	0.09514	0.12097
C3	0.59979	0.52063	0.27008	0.46282
C4	0.22075	0.24717	0.56662	0.35312
S11	0.04990	0.10396	0.06816	0.06310
S21	0.12956	0.12823	0.09514	0.12097
S31	0.11996	0.39047	0.23632	0.29378
S32	0.47983	0.13016	0.03376	0.16904
S41	0.14514	0.17079	0.33808	0.22898
S42	0.05856	0.06158	0.18673	0.09907
S43	0.01704	0.01480	0.04182	0.02507

4.6 Evaluation of alternatives

With the respect to the criteria C1 – Cost and C2 - Duration, the recommended predicted number from IMO will be used for comparison between two alternatives. Detailed number could be found in Table 2.

Table 2. Evaluation of alternatives

	Cost (millions $)	Duration (days)	Local regulation difference	Uncertainty in quality	Price gap	Charterer's preference	Future policy trend
Alternative A	2.8	80					
Alternative B	0.5	7					

For remained sub-criteria, the preference of each expert and the preference of group were obtained by pairwise comparison. The group judgments are shown in Figure 3.

Figure 3. Group pairwise comparison matrices

Matrix of Group

S31	A	B
A	1	0.1842
B	5.42884	1

S41	A	B
A	1	0.4932
B	2.0274	1

S32	A	B
A	1	0.6437
B	1.55362	1

S42	A	B
A	1	0.4642
B	2.15443	1

S43	A	B
A	1	0.2321
B	4.30887	1

The group decision making matrix in obtained following AHP and is shown in Table 3.

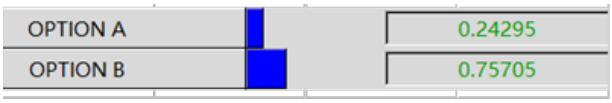
Table 3. Group decision making matrix

	S11	S21	S31	S32	S41	S42	S43	SUM
Weights	0,063	0,121	0,294	0,169	0,229	0,099	0,025	
A	0,152	0,080	0,156	0,392	0,330	0,317	0,188	0,243
B	0,848	0,920	0,844	0,608	0,670	0,683	0,812	0,757

4.7 Results

Based on the mathematic result shown by program SuperDecisions© with the approach AHP, Alternative B to use the compliant low Sulphur fuel oil will be the better option for the shipowner company. Figure 4 shows these results.

Figure 4. Results



5. Conclusions

Shipping is a traditional industry that has close relationship with world trading and transportation market. Considering the massive scale of maritime merchant scale and combining with the increasing attention been paid to global environmental problem and anti-pollution problem, the trend of tighter control in Sox and NOx emission from ships to realize the sustainable development is quite clear in recent decades.

The implementation of the IMO Sulphur 2020 is not an end, but as a starting to point out the direction of the industry. The long-term technical development is expected in not only better refinery production, but also wider use of LNG vessel engine system, more efficient in performance of vessel fuel oil engine system and so on. More alternative fuel products are been waiting to keep the good acting in vessels serving operation, but less harmful to the maritime environment and air quality.

It brings a chance to different parties in this industry to think about what they should do, or what they can do in limiting the emission from ships. Expect for those long-term investment and company plan need to be thought about including investment in newbuilding vessels with LNG consumed engine system, or strategy plan on newbuilding vessel with EGCSs system installed etc., most of the shipowners are facing the problem on how to make a decision for their vessels underserving now.

To perform a better management of this problem, it is necessary to put it under the environment of project, as its fully fit with the definition of a project that is temporary and unique. The main goal of this project is to make a decision on what is the best option for shipowner under such situation. As there are so many parties get involved in this thing, both public authorities and private companies, they all have their positive or negative impact to the project. Considering this, major stakeholders need to be well identified and by doing the analysis of them, to support the further procedure in decision-making.

As each stakeholder has their own position in the power/ interest grid, which can also be considered as their various preference and different opinion towards those possible alternatives are shown in the market. There are enormous information spreading in the market with latest report on technical side, official guideline issued by international organization, prediction report or assessment from professional consultant and attitude from private companies are full of the market. The facts need to be considered when doing the decision making is also keep increasing, which makes the problem to be more and more complicated for all.

The decision in one large shipping company will influence the market's prediction of this problem, but their preference cannot serve as a reference to another shipping company, as they face a totally different situation. The company we have considered in the case study is a medium and small shipowner with bulk carriers and general cargo ships, and almost half of its ships are on charter, or would be put on the charter market, so the decision is likely to be totally different with liner companies, which consider different criteria.

In order to simplify the decision-making process in the project, the method AHP has been defined as the best tool in such problem. By using the hierarchy structure to deconstruct the problem, can give a clear picture to support the decision maker. Instead of combining all facts together and getting more and more confused in the decision-making process, by following the method AHP to do those steps of weight allocation, prioritization of alternative regarding to different criteria and sub-criteria, it helps decision maker to quantify those intangible facts in the problem.

7. References

Aragonés-Beltrán, P., García-Melón, M., & Montesinos-Valera, J. (2017). How to assess stakeholders' influence in project management? A proposal based on the Analytic Network Process. International Journal of Project Management, 35(3), 451–462. http://doi.org/10.1016/j.ijproman.2017.01.001.

Bourne, L. M., & Weaver, P. (2010). Mapping stakeholders. In E. Chinyio & P. Olomolaiye (Eds.), Construction Stakeholder Management (pp. 99–120). Blackwell Publishing Ltd.

International Maritime Organization. (2015). Third IMO GHG Study 2014. London, UK: International Maritime Organization.

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. Academy of Management Review, 22(4), 853–886. http://doi.org/10.5465/AMR.1997.9711022105

Olander, S. (2007). Stakeholder impact analysis in construction project management. Construction Management and Economics, 25(3), 277–287. http://doi.org/10.1080/01446190600879125

Reed, M. S., & Curzon, R. (2015). Stakeholder mapping for the governance of biosecurity: a literature review. Journal of Integrative Environmental Sciences, 12(February 2015), 15–38. http://doi.org/10.1080/1943815X.2014.975723

Saaty, T. L. (1980). The Analytic Hierarchy Process. McGraw-Hill.

United Nations Conference on Trade and Development. (2018). Review of Maritime Transport 2018. Geneva, Switerland: UNCTAD secretariat.

Zheng, X., Le, Y., Chan, A. P. C., Hu, Y., & Li, Y. (2016). Review of the application of social network analysis (SNA) in construction project management research. International Journal of Project Management, 34(7), 1214–1225. http://doi.org/10.1016/j.ijproman.2016.06.005

Comunicación alineada con los Objetivos de Desarrollo Sostenible