ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 9 Number 1 (September)
http://doi.org/10.9770/jesi.2019.9.1(40)

Publisher
http://jssidoi.org/esc/home

LNG MARITIME ENERGY CONTRACTING MODEL*

Eunice Omolola Olaniyi [1*], **Laima Gerlitz** [2]

[1] *Tallinn University of Technology, Akadeemia tee 3, 12618 Tallinn, Estonia*

[2] *Wismar Business School, Hochschule Wismar, University of Applied Sciences*
Philipp-Müller-Str. 14, 23966 Wismar, Germany

E-mails: [1] *eunice.olaniyi@taltech.ee (corresponding author);* [2] *laima.gerlitz@hs-wismar.de*

Received 11 January 2019; accepted 10 July 2019; published 30 September 2019

Abstract. To meet the global 2020 low sulphur demand and beyond, the supply of low sulphur fuel must increase and expand. So far, the world bunker market is split between the different compliance solutions increasing demand for sulphur compliant fuel. The work examines the implementation of an innovative business model initially designed to meet energy needs. The developed model facilitated a sustainable LNG supply/distribution process economically and was further tested with a real-life case example that shows the cost structure for the proposed model. Both quantitative and qualitative data approaches were used to collect data. The illustrated modified features of the LNG maritime energy contract model accentuate an analytical and unconventional strategy embedded in experimentation.

Keywords: SECA regulations, Baltic Sea region, clean shipping, sustainability, LNG, global suphur cap

Reference to this paper is as follows: Olaniyi, E.O.; Gerlitz, L. 2019. LNG Maritime Energy Contracting Model, *Entrepreneurship and Sustainability Issues Entrepreneurship and Sustainability Issues* 7(1): 574-594. http://doi.org/10.9770/jesi.2019.7.1(40)

---

* *This work is in principle linked to the EnviSuM – Environmental Impact of Low Emission Shipping: Measurements and Modelling Strategies project sponsored by the European Regional Development Fund.*

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

JEL Classifications: G31, G32, L26, L98, M1

1 Introduction

The sulphur emissions regulations have two different sections namely the sulphur emission areas (SECA) and the global sulphur standard. The SECA concept was created in 2005, and it forces shipowners only to use fuel with low sulphur content when they travel within these controlled areas. Presently, there is a restriction of 0.1% that applies in the BSR, the North Sea, and the English Channel, America /Canadian coastlines (IMO 2009, 2015). Already in the SECA, sulphur emissions from ships are not allowed to be above 0.1%, a law enacted from January 2015 (Lindstad & Eskeland, 2016). Other SECA related regulations are the Chinese regulation for coastal waters (published in December 2015 and came into effect in 2016) and the EU directive 2005/33/EC (Olaniyi, 2017). The global sulphur standard on another hand applies to areas that are not SECA although it was first targeted at ships coming into or leaving MARPOL-treat countries (Seo et al., 2016). Now it applies to all non-SECA area and with this standard, the MARPOL Annex VI necessitates all vessels outside SECA all over the world to use fuel with a sulphur content not more than 3.5% w/w of sulphur and 0.5% w/w from 1 January 2020 (CE Delft, 2016). At the initial time of the regulation, there was much pressure to push it further to 2025 on the basis that it could save the maritime industry between $30 billion and $50 billion annually (Platts, 2016) but this has been refuted to be unlikely to happen.

Since shipowners are considered as the heart of the maritime industry as they influence the demand and supply for services within the industry, it is within the right to say that their SECA compliance activities are strategic not only to their overall business but to the whole industry (Fiksdahl & Wamstad, 2016). Already, the strict SECA law has compelled them to make a serious decision regarding their choice of fuel for bunkering (Seo et al., 2016) and the incoming of the 2020 global sulphur cap has certainly escalated the urgency of solutions for compliance and clean shipping globally. Shipowners have become frantic about their options and worried about the economic optimisation of their decisions (Abadie, Goicoechea & Galarraga, 2017). Fact is that the sulphur regulations have come to stay and they might as well begin to think about the sustainability of their compliance choices.

The SECA regulation compliance approach can be summed up in three different frameworks: economic, operational and strategic (Morris, Schindehutte & Allen, 2005). For the shipowners, it is not possible to ignore the economic significance of the compliance activities as they mean significant financial commitment directly connected to the operational aspect since fuel cost and consumption are an integral part of shipping and makeup to about 50 - 60% of voyage operational cost (Stopford, 2009; Bialystocki & Konovessis, 2016). Other factors that affect the operational costs of shipping are sailing patterns of vessels like the routes, change of routes, vessel speed and type of vessels (Gu & Wallace, 2017) but they can only be considered as supplementary when compared to fuel influence. That was why at the onset of SECA some ships changed their vessels to bigger ones; some increased the number of their routes while some reduced the numbers of their routes to reduce costs.

The choice of sulphur regulation compliance determines the strategic stance of individual ship owner (Sys, Vanelslander, Adriaenssens & Van Rillaer, 2016) and there are different alternatives considered as being economically feasible to meet the SECA regulations (Seo et al., 2016). Currently, shipowners are exploring the economically viable options for the SECA and the global sulphur law - especially post 2020. In the BSR, the popular choices for ship compliance are switching from heavy fuel oil (HFO) to low sulphur fuel i.e. marine gas oil (MGO), maritime diesel oil (MDO) or the ultra-low sulphur fuel (ULSFO), the use of scrubber plus HFO an abatement technology and the use of alternative fuel like the liquefied natural gas (LNG). All approaches have their pros and cons, and different shipowners have built their compliance strategies around one or more of them with most of their decisions weighed between their capital expenditures and their operational expenditure (Gu & Wallace, 2017). Hoping to solve this critical challenge, many studies have proposed different approaches to help the choice of the

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

compliance approaches ranging from multi-criteria approach (Ren and Lützen, 2015), stochastic programming (Schinas & Stefanakos, 2012), cost-benefit analysis (Jiang et al., 2014), costs function of emission abatement alternatives (Lindstad et al., 2015) and value at risk (VaR) analysis (Atari & Prause 2017). All studies point to the urgency for more sustainable solutions for regulatory compliance.

Since bunkering plays an essential role for each voyage, the most solution would revolve or evolve around bunker fuel demand and supply. No wonder, the world bunker market is split between the different compliance solutions (Semolinos, Olsen & Giacosa, 2013). Already, IMO appointed CE Delft (2016) to assess the availability of fuel oil with the stipulated requirement of a 2020 focus. Their results showed a balanced supply and demand for fuel around the world. However, regional surpluses and shortages are projected to occur from 2020. It is evident that the demand trend in the maritime industry of today is erratic, i.e. the volume of production of fuel is growing, and so is the demand. There appears to be a shift in demand especially from developing economies; the middle class is increasing across the globe, so preferences are changing (Kadavias & Kostas 2015). The collapse of the oil price in 2014 introduced a downturn to the oil and gas industry where most fuel companies have had to face high-pressure from their customers (Prause et al., 2019). Many predictions became useless affecting the supply chain, although most companies have taken on the road of reducing their CAPEX and OPEX (i.e. stopping substantial investment and reducing overheads) there is no telling on where this would lead anyone in the future (Rack, 2017).

For this reason, to generate a successful and sustainable match between escalating demands and supply there should be a successful match of the combination between technology, innovation and strategic business model (van der Vliet, 2017). The same applies to develop value for the ever-increasing volume of customers. Thus, the pressure to innovate and evolve is unavoidable. The current market predicament where bunker suppliers and shipowners are "waiting to see" what would happen or who would make the first move needs to be broken to forge current stalemate ahead (Wang & Notteboom, 2015). The intensive investment involved these activities should be thorough and well organised to reduce the risk, and the system must take into consideration the ever-changing environmental regulations landscape (Castillo & Dorao, 2012).

Matching novel technologies to market needs through compelling commercial offerings can help an industry pursue productive and cost-effective approaches to supply such as collaborative and risk resilient supply chains. As it is, the highest share of ships that spend 100% of their time in a SECA plies the Baltic Sea. Already, the fuel demand/supply in the BSR totals up to about 25% of the total SECA demand/supply (Danish Maritime Authority, 2012). There is much attention on the region to improve and upgrade bunkering infrastructure in the ports for SECA complaint fuel that has exposed logistics and distribution needs to match fuel demand across the globe and most especially the SECA area such as the BSR (Semolinos et al., 2013).

Against this background, the core objective of this study is to propose a shift in the LNG distribution business model to improve LNG distribution capacity and to transform its markets for efficiency. The study uses the concept of Maritime Energy Contract (MEC) business model (Olaniyi, Gerber, Prause, 2018a); (Olaniyi, Atari, Prause, 2018b); (Olaniyi, Prause, Bakkar, 2019) to offer the delivery of emission reduction to increase the LNG business performance and exploit the business opportunities for the LNG distribution in the BSR. Few records exist on LNG use as opportunity and value proposition leading towards emerging value chains (Gerlitz et. al., 2017; Paulauskas et al., 2017). As a result, the present paper addresses this research gap of marginalised focus on business modelling and value generation from LNG business.

Knowing that supply chain optimisation is a proven way to ensure the interconnectedness, a significant hurdle for LNG bunkering (Kadavias & Kostas 2015); the MEC model is used as a stimulus for value creation and the realisation of competitive advantage in the maritime industry for a new entrepreneurial process. The research raises the question: How can the MEC model transform the LNG distribution process to create value for the maritime

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

industry? What is the value delivery and linkages? How to control the transactions between the entities involved and what incentives are there for the parties?

The study is presented in the following manner: the next section is the literature review, and it gives an overview of the maritime fuel demand and supply landscape given the SECA compliance. It also introduces the change of business model as a way to achieve optimisation of the LNG value chain for the maritime industry. The third section presents the methodology used for the work. The fourth section discusses the result while the last part concludes.

2 Literature review

Compliance methods in the Baltic Sea Region (BSR)

Realistically, without considering economic aspects, switching to the use of MGO/MDO remains the most comfortable pathways for shipowners, because they are readily available worldwide and in the most ports (Semolinos et al., 2013) although, the cost MGO/MDO is considerably higher than other types of fuel (Lindstad & Eskeland, 2016). Another type of low sulphur fuel that is used as an alternative to the HFO is the ultra-low sulphur fuel (ULSFO), a by-product of hydrodesulphurisation (HDS). HDS is a multi-catalytic chemical process that removes sulphur compounds from refined fuel (Lin, Hong, Jianhua & Jinjuan, 2010). Since 2014, the HDS process has gained increased momentum and has steadily found its way to the bunkering world with increasing acceptance by shipowners (Lee, Ryu & Min, 2003). While the effect of long usage is only speculated and not mainly known or proven, most shipowners are drawn to it because it is cheaper than the MGO and close to the cost of the HFO (Semolinos et al., 2013).

Unfortunately, on the upstream refining process, its growth might likely be undermined by the cost of refinery upgrade required for fuel producers who already are plagued with low fuel costs. While shipowners have shown their desire for this probable solution, the refiner is unwilling to commit to it because of the high capital investment required for production plant upgrade (Livanos, Theotokatos & Pagonis, 2014).

Even though maritime transport is far less regulated than land-bound transport, there are still specific apprehensions commonly voiced with the costs that arise from regulatory compliance because they could run into millions of euros (Gollop & Roberts, 1983). This is also true for shipping regulations whose implication on the activities of the maritime sector stakeholders are directly or indirectly linked to the economic decision that will ensue in their efforts to comply. Most authorities start regulatory projects believing that the investments are economically justified, i.e. the benefits to society supersedes the costs (Renda, 2017).

The use of scrubbers looked very promising for the sulphur emissions prevention solution, but there are still many debates on its ecological usefulness and investment worthiness. Although, the scrubber technology has been one that has amassed so many high stakes enough for solution-driven contemplation (Semolinos et al., 2013). The scrubber technology is a sulphur abatement technology that allows the use of the HFO by “scrubbing” out the sulphur emission from the exhaust of the ship up to 98% (Kristensen, 2012). There are 3 types of scrubber technology. These are the open loop, (uses only seawater), closed loop (uses the reaction of caustic soda and fresh water) and hybrid (combined both the opened and the closed technology) (Olaniyi & Viirme 2016). The open loop has been demonstrated to be cheaper and smaller. However, it has been subjected to several debates on the environmental implication of using a device that flushes "chemical" back into the sea. Running a closed loop scrubber is most expensive because of the broad treatment of the closed loop circulating water (Lindstad & Eskeland, 2015). The actual costs of the scrubber, i.e. its operating costs and maintenance costs depend primarily on the ship's size, engine capacity and the scrubber technology itself (Atari & Prause 2017).

With the much talk about climate warming and environmental issues, the use of renewable energies like the LNG has become a formidable competitor to the other usual sources of fuel oil (Rack, 2017). While two of the compliance options, i.e. MGO and the scrubber's installation on board the ships are favourite to ensure a sulphur free shipping, only the LNG solution has proven to have enough ability, in theory, to comply with other regulations such as the NOx (tier III) regulations. The satisfactory conclusion seems to be that when the NOx regulation is finally enacted, the shipowners would not need to install additional systems to prevent NOx emissions (Semolinos et al., 2013). SOx is emission is non-existence with the LNG combustion since LNG does not contain sulphur, while NOx is reduced at least by 85% since the fuel combustion is at about 2.1 to 2.3 air-fuel ration. CO_2 combustion emission also is reduced by 25-30% because of the low hydrogen content of the LNG fuel (Burel et al Taccani & Zuliani, 2013).

The LNG combustion is clean, so there are no smoke or sludge neither are any particulate matters (PM) released. It is not a gainsaying that the LNG seems to meet all the MARPOL standards for operations for SECA, incoming global sulphur cap and other forthcoming emissions regulations since it reduces the SO2, NOx, PM emissions from the ships principally (Det Norske Veritas & MAN Diesel & Turbo 2011). Another reason for the increasing LNG popularity is the seemingly low costs of bunkering; the LNG option is seen as the cheapest in this regard. Unfortunately, other emission compliance alternatives like electricity are said only to remove emissions but increase the greenhouse gases (GHG) effects which further reduces the safe environment (Nerć-Pełka, 2010). Given its recognised successes, many shipowners are deliberating the advantage of using the LNG over other types of compliance options (Adamchak & Adede, 2013) as a universal acceptance that running an LNG powered ship is technically and environmentally friendly (Livanos et al., 2014).

Unavoidably, the adaption of LNG as a cleaner bunker fuel has also put the LNG supply chain under much demand. Suppliers are finding it difficult to create the capacity for the current regasification terminals for broader access to the market, exposing the need for new investors and business models that can play supporting roles to this dynamic market (Talus, 2008). Already in Europe, many ports are working towards the adaptation of their ports to accommodate the LNG facilities, transport and transfers, while new ports are taking initiatives to work on safety and regulations (Wang and Notteboom, 2015). In addition to this, there is project underway in ports like Dunkirk, Antwerp, GATE on the possibilities for building or developing LNG terminals/bunker barge/leading facilities. Baltic Ports Organization (BPO) (2014) also initiated support to improve LNG bunkering facilities across seven ports in the BSR – a project funding of about 3.5 million euro. Other feasibility studies are being carried out on ferry projects in the North Sea, the Baltic and the Mediterranean regarding the LNG use (Semolinos et al., 2013).

Regrettably, even though the use of the LNG is getting more popular in the shipping industry, the infrastructural development has been rather slow especially in taking proper actions to overcome the pressing challenge of growth and distribution (van de Bunt, 2017). A situation that needs a pragmatic, innovative approach to improve the supply and increase the minimal numbers of "players" that marks the LNG industry (Ruester & Neumann, 2009).

The LNG Growth Challenge

Many issues are surrounding the LNG supply have prevented it from gaining broader acceptance in the maritime community. One of such is an economic-related issue, which has always generated controversy when the cost to build an LNG powered engine or retrofit is considered (Ruester & Neumann, 2009). The interest for newly built LNG ships is not so popular among the shipowners because most of them do not have the financial capacity to invest in the project. Although there a lot of newly built ships on order, they are not enough to cover the challenge of increasing the usage of LNG as favourite bunker fuel, more so, this is mostly limited to bulk and containers - a very narrow sector even for the shipping industry (Océane, 2014). Likewise, LNG retrofit does not seems to be favourable among ship owners as well and primarily because of the cost of retrofit (Kumar et al., 2011). On top of

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

this is the large needed space for the tanks that is about 4 times higher than is required for other fuel signifying less space aboard for passengers/cargos making LNG retrofitted vessels hard to come by (Semolinos et al., 2013). The major remodelling, the safety requirement and the space needed for the storage tank make LNG option a more suitable capital investment for newly built ships (Burel et al., 2013).

A much-discussed downside of the LNG fuel as a bunker fuel is related to the methane slip caused by the incomplete combustion of methane in the fuel. Methane has been advised to have a 100 year more warming potential compared to CO_2 and about 25% higher than CO_2 in the fuel combustion. If a proper control or elimination technology is not soon discovered, the potential of the LNG as bunkering fuel may be completely erased (Burel et al., 2013).

Ship functionality is heavily dependent on fuel usage, and the fuel usage is dependent on routes flexibility, storage and bunkering especially for bulk carriers and large crude carriers (VLCCs) but for some shipowners, the hardest challenge regarding the LNG is the bunkering (Ruester & Neumann, 2009). Even though the recent fall of oil price has increased the broader economic reach of the LNG, ports infrastructure, cost-effective bunkering and apt expansion provisions needed to improve the offering of the LNG as a realistic option for ship bunkering is lacking (Molitar, 2011). So far, the current existing potential for the LNG fuel infrastructure growth appears only to be within the SECA, and while the use of LNG as a fossil-free fuel for bunkering is gaining ground around the world, a higher percentage of this growth is noticeable across SECA regions (Ikonnikova et al., 2009). The current existing bunkering infrastructures are majorly located within the emissions control areas (ECA) such as SECA but account for only about 24% of the total bunker fuel purchase every year (Adamchak & Adede, 2013).

Distributing the LNG depends mainly on the available market and its size as well as the port size and in doing this, ports are categorised into small or large port. According to Semolinos, et al., (2013), small ports for the LNG supply are ports with the capacity to supply 1 to 5 vessels of about 20 knot LNG fuel consumption such as ferry ports. In small ports, LNG is supplied by trunk or ship because it is cheaper to use the truck for smaller ship supply (Ruester & Neumann, 2006). However, Seo et al. (2016) argued that it is better to build a supply barge to supply all ports whether they are considered small or significant in an economic sense. Pushing this forward, Seo et al. insisted that from the safety point of view, the reduction of the numbers of trucks in the port is essential and this should be a near future consideration when ports clusters are equipped similarly. There seem to be some exceptions for ferries on short sails, which would need to be supplied directly by the truck because of their small storage capacity. The large ports on another hand experience high record LNG fuel bunkering usually higher than 100-knot fuel consumption vessels. These ports need more extensive facilities for bunkering (approximately 15 000 – 30 000 m3 storage) to load bunker truck/ship and to enable ship-to-ship supply (Nerć-Pełka, 2010).   Loosely speaking, there are two major groups of participants in the LNG market: the producers and the exporters/importers (Livanos et al., 2014). Usually, the producers are engaged in the upstream chain of the LNG distribution value chain. The importers/exporters are involved in the downstream chain and deal with either some third parties or directly with the ship owners. Depending on the case, the producer goes into agreement with the exporter/importer and may be able to buy according to the terms of the agreement, which can be long or short term. In any case, two significant terms of the agreement usually include the right to resale and payment method (Ikonnikova et al., 2009).

In a detailed manner, typical investors for the LNG downstream distributions are project partners such as states either an unincorporated joint venture structure, incorporated entity, ports, gas expansion operator (a flexible structure that facilitates expansion). There are also companies from the maritime cluster industry that form some profit centre mechanism (as a part of an integrated or partially integrated venture). Sometimes, suppliers form what is called "marketing arrangement" where LNG production is made available to all members for detached marketing (Castillo & Dorao, 2012). However, the conventional structure for the LNG project partnership is the 'Project Company' where all participants form an incorporated company in the fuel gas country where LNG is situated and jointly own the LNG export plant. Here, the project company procure gas from upstream producers, liquefies the gas and resells the LNG to third-party buyers.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

Consequently, the newly formed company becomes the entity that receives proceedings from the LNG sales through dividends. On another side are the gas reserve owners who make their profit from the feed gas sale or on a netback of the LNG sale price from the liquefaction process (Weems & Hwang, 2013). Since it is established that a significant bottleneck for LNG bunkering is the unavailability of smaller receiving facilities to serve the maritime demand as well as the lack of small-scale LNG tanker ships/trucks to distribute LNG to smaller facilities (Castillo & Dorao, 2012), the LNG sector can take advantage of this situation to increase the LNG market share and demand. If the impending 0.5% global sulphur cap is considered, the LNG infrastructural development is expected to pick up (CE Delft, 2016). There are already speculations that by 2030, LNG demand would be as high as 65 million tonnes (Adamchak & Adede, 2013).

Going forward, the maritime industry must find a way to increase the current capacity of the LNG distribution. Most importantly, while ensuring that LNG is available as at when needed, shipowners need the reassurance of bunkering compatibility. Reliable future supply is a critical enabler to ensure shipowners commitment to any agreement or even the uses of LNG fuel for bunkering (Semolinos et al., 2013). For the downstream LNG developments, a shift in a business's strategy is necessary as a significant alteration in the business model that reinforces tailored fitted supply and distribution.

3 Methodology

Principally, this study set out to build a BM that would demonstrate the integration of an existing infrastructure into a new model to deliver value for the LNG bunkering. Reliable future supply is a crucial enabler to increase LNG supply. Consequently, to capture the market structure, the study looks into the main factors affecting the LNG downstream value chain and integrate them into the $MEC_{LNG.}$ It considers the terms and the length of contracts bearing in mind the most suitable contract for the proposed model (i.e. long-term or spot trade). It furthers considers the cost savings from the LNG model in correlation to other types of diesel fuel. Along these lines, the integrative model and testing were put forward for a regional LNG market. The study used different phases of BM development for research namely: The design phase, the development phase and the validation phase.

Design phase consists of data gathering based on ad hoc research for secondary data (i.e. business reports, websites, news, literature) according to Al-Debei & Avison (2010). Together with structured experts' interviews, profound appreciative insights on the current value chain and the distribution of LNG downstream industry and the energy service contracting (ESC) industry – by extension the MEC was gained. The different LNG business model templates observed in the ad hoc research were used to generate discussions. Interviews were recorded and transcribed for the report. Other information need that came up after interviews were received through emails and phone calls. The companies' representatives corroborated all reports. All mentioned activity led to the first concept of the model.

The combination method for business model development was considered according to Baden-Fuller & Haefliger (2013). With this approach, the Energy Service Company (ESC) business model is re-introduced as the maritime energy contract (MEC) for the LNG supply. Subsequently, elements of the transferred MEC model are combined for the new model. The disadvantage of this method is its risky nature since the model is like a new construction so it can be tricky and complicated. However, according to Rack (2017) transferring a known BM strategy to another likely give room to fill up the loopholes in the concept making it easier to deploy. The work uses the elements of the MEC project design (development, planning, contractual LNG retrofitting, LNG supply, maintenance, maximisation, user incentive, quality monitoring and controlling, price bond and risk, and technical contracting). The model targets the retrofit of an originally MGO-driven ship into an MGO-LNG dual engine vessel.

The MEC is used as the unit of analysis for this research. The proposal is that the LNG downstream actors: importer/exporter/project partners/states/intermediaries/ contractor/ supply services/ local energy companies

/investor/supplier/contractor (herewith called Project Company for the remainder part of the study) split their supply activities into two to become:

- Fuel supplier: by continuing to import, bunker and supply LNG to shipowners.
- Energy servicing: By providing specialised services to shipowners such as investing in the LNG, retrofit creating dual driven ships that can alternate between fuelling with MGO and LNG.

The development phase explores Fiksdahl & Wamstad (2016) concept of joint planning that opens room for potential partnerships and innovative growth in the maritime industry between the Project Company and shipowners. Although different possible frameworks could be used to analyse and build a strategic BM (i.e. SWOT analysis, Porter's five forces model, McKinsey 7S Framework), Burel et al., (2013) argued that they do not fit the needed intricacies of the maritime industry. To this end, this work focuses on the Business Model Canvas (BMC) by Alexander Osterwalder & Yves Pigneur (2009) framework to build its MEC_{LNG} case.

Osterwalder & Pigneur (2009) proposes a business model canvas that includes a nine-building block of business models to enhance the proposed change. It involves the customer considerations, their value propositions, the channels to raise awareness, relations with the customers or clients, the type of revenue to expect the resources needed the key activities and the type of cost structure most suitable for their plans. The blocks provide perceptivity to essential aspects of the company that has the potential for greater efficiencies and clarifies the internal changes that need to occur. By this means, this study considers the core elements of the proposed model MEC_{LNG} to be in four categories:

1. Customer segments & value proposition made with the future and continuation in mind. Building on this is tapping into a new segment that the customers and the company can enjoy sustainability.
2. Channels that determine how the products are delivered, through whom and in what avenue. How would this be communicated? How can it improve performance?
3. Key activities & resources angle is choices of the partners or cooperation that are needed, i.e. physical, intellectual, informational, human, and financial. Considered partnerships for key resources allocation to create or deliver capture or communicate value.
4. Financials involves transactions, service payment, licensing and costings. How to reduce costs and what channels are most expensive?

The validation phase evaluates the practicability of the proposed model, as it is important to deliberate on the economic characteristics of a chosen model — this consist of empirically refining the research output. Usually, case examples are suitable methods to gather information regarding how business models are implemented (Yin 2003, Baden-Fuller & Haefliger 2013). A ferry ship with an itinerary of the voyage between the Tallinn and the Helsinki ports was used to this end.

For the newly built ship, it is most common to make the comparison between the investment annuity and the anticipated fuel cost savings, while the popular costing methods for retrofits is the evaluation of the payback time (CE Delft, 2016). However, investment appraisal of this work considers the analysis of price trends for the LNG gas fuel and the diesel fuel (MGO) as explained by Atari & Prause (2017). The historical MGO and the LNG fuel prices were based on historical spot market prices in the Port of Rotterdam in the period January 2018 to December 2018. Economic assumptions regarding the LNG-MGO dual powered ship were made compared to the usage of a diesel driven ship normal according to WSF (2011), Semolinos et al. (2013) and Océan (2014).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

4 Results

The LNG Maritime Energy Contracting Business Model (MECLNG)

Producing SECA complaint fuels require high investments, so also is the investment costs for abatement technologies. Current figures indicate a decrease in scrubber installations due to low bunkering prices and low freight rates. Many shipowners are also not financially buoyant to build new LNG powered engines or pay for the LNG retrofit. Diminishing these investment setbacks as well as their business risks demand radical business thoughts and innovations.

The maritime energy contract (MEC) adapted from the Energy Supply Contract (ESC) concept is used to create a business model in the maritime industry using the LNG retrofit on ships for sulphur emissions compliance. It uses the contextual idea of a project company pre-financing the LNG retrofit for a ship through a contractual agreement with shipowner for the constant supply of the LNG to protect the sulphur emission compliance. As with the MEC, the central stimulus for the MEC_{LNG} is lowering the costs of complying with the sulphur regulations for the shipowners and increasing the business scope for the Project Company (PC).

With the MEC_{LNG} business model, the PC delivers not just bunker fuel but provides ‘‘energy solutions" using the LNG retrofitting installations on ships. The PC achieve the energy service package at its expenses according to the precise project prerequisite needed by the shipowner.

First, only MGO-driven ships are eligible for this contract; otherwise, there would be a need for another abatement retrofit on board or a complete remover of the HFO driven engines, a not so desirable outcome. Second, the project will be targeted towards building dual engine driven ship, a bonus for such shipowners who would have added the security of another possibility of sulphur regulations compliance. The project will commence with the contractual agreement between the supplier and the shipowner and is tenable throughout the contract period.
The MEC_{LNG} package as presented to the shipowner and run in the following sequence:

- Project development – planning, costing, agreement and contract
- LNG retrofit
- Running, troubleshooting & optimisation and maintenance

The projected profit is based on the costs of the LNG supplied to and consumed by the ship, costs of retrofit per metric ton and additional costs that include the cost of running and maintaining the LNG engines and other costs defined in the contracts such as risk costs (i.e. technical, outsourcing) and monitoring and control. The contract will also include assurance of quality of service and product that address issues like the methane slip number. As soon as the contract comes to effect, it not only guarantees the supply of fuel but also guarantees a stable price of fuel throughout the contractually agreed period.

Business Model Development

4.2.1. Planning phase

Currently, the LNG sector is small compared to other bunker fuel in maritime with few players, so the study made some assumptions along this line. Even though the LNG looks like the most appropriate compliance option, the economic considerations do not favour its growth. Songhurst (2014) mentioned that one of the ways to cut costs for the LNG downstream is the cooperation between different project owners primarily in the sharing of facilities. The proposed business model project could involve a group of Project Company incorporation or one large PC undertaking the project. The project itself involves the project company dealing directly with the shipowner cutting out the intermediaries or in some cases; the intermediaries could by themselves take up the project if they have access to funding. Of course, it means massive investment, but this group of investors have better access to funding than the shipowner would.

Project assumptions

The project asset (LNG engine), its features (i.e. pros and cons) and possible opportunities are first considered as shown in Table 1. Funding an LNG driven ship may seem capital intensive, but the pros in building one and the opportunities combined far outweigh its negativity. Among the cons, the capital investment intensity seems to be the aspect with the highest stake for most ship owners, which is not strange.

Table 1: Features of an LNG retrofitted engine that shows opportunities for the shipping sector

Features		Opportunities
Positive features	**Negative features**	
▪ Reduces SOx, PM, NOx, CO2 ▪ Complies with EEDI (Energy Efficiency Design Index) ▪ Potential for a positive NPV: operational savings can be significant, i.e. economically feasible (Low OPEX) ▪ Dual engine possibilities ▪ Engine efficiency ▪ Opportunity/potential for massive growth ▪ Political support ▪ Does not need the installation of SCR ▪ Low engine maintenance	▪ Expensive CAPEX for newly built ▪ Expensive and difficult retrofit ▪ Engine needs lot space for installation ▪ Underdeveloped infrastructure ▪ Underdeveloped experience ▪ Require new trainings for staff for unskilled staff ▪ Safety issues that compound the supply chain ▪ Potentially dangerous Methane slip	▪ Pricing ▪ De coupling from oil price ▪ Expansion ▪ Bunkering points can be increased ▪ Efficient spacing ▪ Significant cost savings ▪ R&D, technology improvement/development ▪ Improved regulatory framework

Source: Authors' construct

The technical project assumptions for a dual LNG/MGO dual engine retrofit are then considered which are different depending on the type of ship. They are:

i. LNG availability within the region
   - Costs of the LNG bunkering facilities
   - Economic comparison of an LNG driven ship to an MGO driven ship
   - Availability of engines and process equipment, as well as maintenance services

ii. Locations of engines installation (important for existing and possible future regulations)
   - The need of full steel casing (to fortify or reinforce the ship, tanks placed on deck)
   - Ship stability when removing, adjusting and installing the LNG engine
   - Other considerations like safety measures, control rooms, piping, and insulation

iii. Cargo space
   - Availability of space to place the engine and tanks
   - Availability of extra space that can be created for cargos/container at locations around or directly on steel casing.
   - Other space (for the cold box and tank inspection)

iv. Local or regional regulations on sea traffic.

4.2.2. Business design phase: MEC_{LNG} modelling

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

The Osterwalder & Pigneur (2009) 9 business model building blocks are grouped into four categories to enhance interactive integration. These are customer segments and value proposition; distribution channel; key activities & resources and the financial elements.

a. Customer segments and value proposition

Value proposition will shift from or combine economies of scale approach towards/with an economy of scope concept. The model provides free initial capital investment and scalable investment for the shipowners. It also means cheaper energy solutions delivery to shipowners who do not have technical solution or expertise on the LNG compliance option or its maintenance. Energy is provided cheaper with an offer of regular maintenance. The relationship between the Project Company and the shipowners becomes a co-formulation of a coalition. Services offered and rendered are personalised, assisted and matched to suit each customer.

The model targets ship owners who are financially constrained to fund an LNG engine retrofit for their vessels as key partners/customers. Other possible customers are contractors who can work between different project companies to create a liaison for LNG bunkering infrastructure development. The costs reduction made for the shipowner is cost savings model due to the removal of intermediaries.

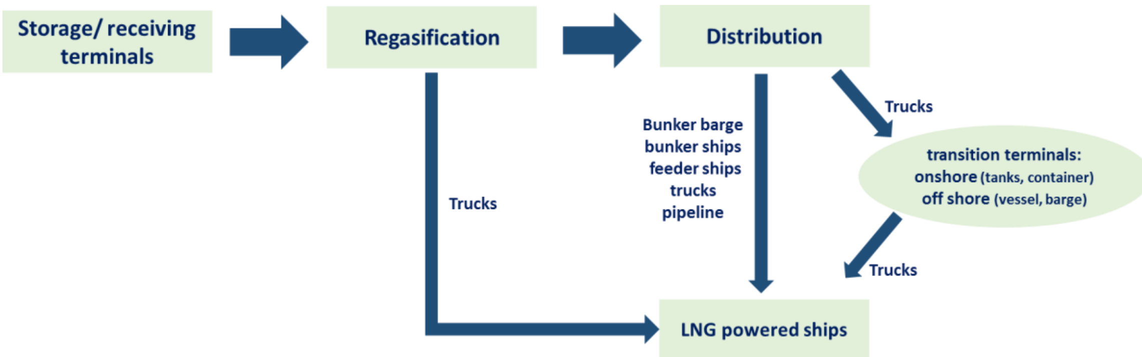
b. Channels

The channels of distribution focus on the downstream LNG value chain and becomes vertically integrated or wholly owned except in cases where it becomes necessary to deal with an extra or more parties/intermediaries. The MEC_{LNG} PC have the choice to own distribution from three points: the storage/receiving terminals, the regasification point for example like cases seen in Europe where LNG bunkering services are possible at regasification terminals, the distribution starting point could be at such facilities using trucks. The third point choice is from the large terminal. The small-scale plant is completely removed for this model. The reasons for starting the model at the termination of the upstream value chain is because the upstream stage of the LNG value chain is in most cases heavily politically inclined and often are state-owned or belonging to national oil companies. If private companies are involved, they are usually substantial and integrated. Even though the regasification stage in the downstream is also costly, it is still less expensive than liquefaction and requires less explicit infrastructures than the liquefaction facilities (Boscheck, 2006). Additionally, in liquefaction stage, the assets specificity are very complicated due to the many chains of bureaucracy and political stance of project owners, so third-party access or integration is difficult for the upstream stage making deployment of asset almost impossible.

As commonly practiced and likewise for this model, in the case where the LNG import terminal is far from the final destination or not feasible, a transition terminal (for example stationary onshore LNG tanks and containers) can be established because in most cases, the acceptable nautical regulatory distance for moving trucks are usually not more than 600 km. Offshore terminals can also be used as transitional terminals using vessels or barges although this may not be suitable for small ports, which have much lower fuel supply capacity. Howbeit, small ports can consider permanent bunkering point that fuel straight to the ships but small vessels are not encouraged because according to Semolinos, et al. (2013) there are challenges regarding available slot form small sized vessels. The transitional terminal arrangement can help to decrease investment and logistics costs, shorten logistics time and serve other local customers' needs thereby increasing the PC income. The general distribution can be monitored by the use of electronic data exchange (EDI) for inventory and supply chain management to have a simplified chain like shown in figure 2.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

Figure 2: The MEC_{LNG} Integrated Value Chain



Source: Authors' construct

c. Key activities and resources

Key activities will develop into LNG fuel supply with a broader service orientation that aims at sulphur emissions compliance, maintenance and data information exchange and information management. The project company key resources will increase from port bunkering infrastructure for both onshore (LNG tanks, LNG containers) and offshore (ships, truck, barges) to now include LNG engine and its accessories. Intellectual and financial resources will include LNG engineers and experts, service personnel and the engine asset itself. The remaining activities are covered in the LNG maritime energy contract terms and conditions.

d. Financial elements - MEC_{LNG} Costing

As in a standard MEC, considering that the fact that ships are mobile assets that move across the globe especially outside the home country territory, it is advised that five years is used for the contract and adjusted from time to time when the situation calls for them. The LNG maritime energy contracting will consist of three part: (1) supplied energy (2) adjustment costs (3) asset costs - the cost of LNG retrofit and maintenance over the contract period. All calculations contain components connected to current prevailing indices so can be adjusted accordingly within an agreed band of high and low.

The work uses a cruise ship that has an example itinerary of the voyage between the Tallinn and the Helsinki ports. The ship has a dual MGO-LNG engine with the propulsion equipped with five engines - 3 Wärtsilä 12V50DF (11.4 MW/machine) and 2 Wärtsilä 6L50DF (5.7 MW/machine) running about 6.000h/yr. and the engines can be switched automatically from MGO to LNG at 80% of the full load. Fuel switch over takes about a minute. For this study, it is assumed that the LNG is run through the year. Each leg of the journey is an average of 2.5 - 3 hour three times a day. The vessel uses a total fuel consumption of 60m/t a day of LNG.

Assuming the ship operates 340 days a year since it is a cruise ship and both ports are within SECA with the ship sailing 100% within SECA without fuel switch. The model calculation does not combine other system calculation, i.e. energy need for power generation like the battery saving method/system. All investment costs are calculated in nominal euros.

Cost of supplied fuel gas (LNG)/mt:

The cost of energy (CFP_{LNG} [€/mt]) is as the average range calculation of the LNG baseline price according to official statistics between the 1-12/2018 and the spot price for LNG supply per metric tonne €/mt at 1/12/2018 which is 438.60/mt.

Annual asset costs

The LNG system retrofit initial investment costs (i.e. engine design, costs for main engines, gas storage and supply systems) is 5.4 million euro (Océan, 2014). By using a linear depreciation period of 20 years and a 6 % interest rate

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

p.a., the annual nominal asset value is calculated to be 556,000 euro p.a. Together with the annual maintenance costs (i.e. lubrication oil consumption, maintenance and repair of the engines and gas systems) of 282, 585 (WSF, 2011), the annual project asset costs will be 841,585 €/a. In order to calculate the minimum asset price per metric tonne, the annual asset cost (841,585 €/a) is divided by the total annual cost of the LNG consumption multiplied by the daily LNG consumption and multiplied by the number of operating days (i.e. 438.60€/mt x 60mt/day x 340 days). The resulting calculation equals to 8 947 440 €/yr. which is ≈ 9.4% of NLG price/mt approximately yielding 41.2 €/mt.

Adjustment costs

The adjustment costs (AAC_{LNG} [€/a]) is calculated as an adjustment for November 2018 based on the current Estonian consumer goods index at 01.01.2018 (TE, 2018a), the average salary index at 01.01.2018 (TE, 2018b) at a fictive fuel price of 438€/mt from 01.01.2018.

Using: $$\mathbf{AAC\ [€/a] = LP_0\ [€/a] \times (0.5 + 0.3 + \frac{I}{I_0} + 0.2 \times \frac{L}{L_0})} \quad (1)$$

I_0: for the 01.01.2017 - 196.76 (i.e. TE, 2018a)
I: based on the same index for 1.11. 2017: 204.16
L: based on November 2017 - 126.69 (i.e. TE, 2018b)
L_0: based on the same index for 01.11.2017: 122.26
Cost of asset [€/a] * [0.5 + (0.3*204.6/196, 76) + (0.2 *126.69/122.26)]
=841,585 *1.01856407
=858,416.7€/a
= 42.02 €/mt

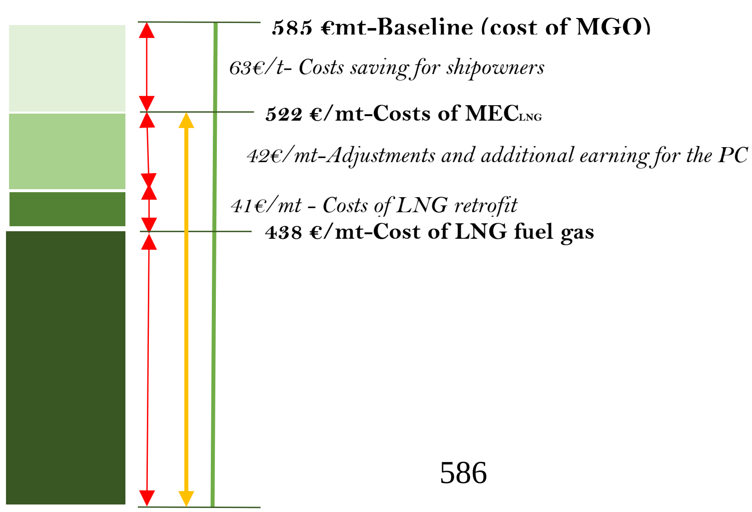
TOTAL COST OF MEC_{LNG}

The total costs of LNG Maritime Energy Contract (MEC_{LNG})
Thus, the MEC_{LNG} costs in the sum of the defined three components will be:

$$\mathbf{MEC_{LNG} = CFP_{LNG} + CA_{LNG} + AAC_{LNG}} \quad (2)$$

Where:
CFP_{LNG}: Cost of energy supply [€/mt]; CA_{LNG}: Cost of asset [€/mt]; AAC: Adjustments [€/mt]
LNG_MEC Price/tonne = (438.60 + 41.20 + 42.02) = 522€/mt
The MGO price at the same time (1.11.2018) 585 €/mt is used calculate the cost savings
Cost saving for shipowner = 585.08 – 522 = 63€/mt

Figure 3: Cost savings in MEC model (Authors' calculations)



ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

Although there is a substantial gap between commercial contracts for HFO bunker and LNG, the authors have carefully adapted the MEC energy contract on a short-term bases so that as it slowly evolves, situations become clearer and elaborated, adjustment can be made, and the contract terms and conditions redefined as needed when situations call for it. In addition to this, the assets functionalities are supported by different elements of the business model (table 2) that makes distribution less complicated, and if this were to be successfully transferred to LNG, the demand for LNG would certainly increase since supply issues have been taken care off. The model implies that it is very different and radical from the usual distribution models.

Table 2: Business Model framework for MEC_{LNG}

Customer segments & value proposition	Channels	Key activities & resources	Financials
Value Economies of scale += economics of scope Cheaper emission reduction Price differentiation (Cheaper energy supply) Service differentiation (Full custom built service) Risk reduction **Key customers** Ship owners /shipping companies/shipping operators Suppliers (long term contract) **Customer relationship** Co-formulation/alliance Long/mid-termed contract Personal Efficiency	**Distribution** Supply chain Vertical integration (sometimes horizontal) Increased efficiency **Communication** Monitored by EDI Personal	**Supply Distribution** Innovation Service Economics of scales **Resources** Expert staff LNG engines Tanks Containers Trucks Bunker barges bunker ships feeder ships trucks	**Cost structure** Low cost Hedged costs Shared profit **Revenue streams** Sales Service Innovation Shared profit

Source: Adapted from Osterwalder (2004)

5 Discussions

Naturally, LNG supply is in fierce competition with other sources of energy like battery, coal, oil, nuclear energy and other renewables like Hydropower, solar power and so on. Hence, its survival in the oil and gas and maritime

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

sector is heavily reliant on business models that are diversified and flexible and can guarantee reliable supply. This will be a type of supply diversification within a market that can increase energy, security and protect the environment and at the same time open new innovative opportunities for enhanced and quality living. Along these lines, the MEC_{LNG} combines two purposes: lowering sulphur regulations compliance costs for the shipowners and increasing the supply and distribution of the LNG as a compliance option that guarantees an environmentally friendly maritime sector.

The proposed innovative MEC_{LNG} business model is created as a central approach to achieve extraordinary events in the maritime sector because it is actionable. The reasons are that since the LNG/MGO dual engine ship is foremost a transferred land-based power plants experience and technology to shipping and likewise, the practicable MEC_{LNG} model principle can be projected as a successful energy concept that instils this transfer. The concerted activities and structure will ensure (a) an environmental benefit to achieve remarkable emissions reduction. (b) Money savings on initial costs of investment for the shipowners that exposes them to minimise risks. (c) Employment possibilities (d) Reduced operational costs where the shipowners can concentrate on the transport business. (e) Shipowners are free from the energy efficiency responsibility like the methane slip, which is passed over to the owner of the LNG engine. (f) Cheap technology and expert support for the shipowners. (g) A scalable investment opportunity for the shipowners (h) Earnings are increased for both parties (i) Customised contract for each project as suitable for both contractual parties. (j) The LNG project company can attract more customers by shifting investment risk to themselves, so the shipowners are more opened to the delivery of the model. It is common knowledge that various industry operations increase knowledge and improve economies of scope that leads to positive outcomes. In other words, the success of the MEC_{LNG} can be a direct success for LNG distribution, as more players become active in the value chain, the ability to break the insistent monopolistic nature in the LNG sector increase and the process that enhances the hitherto low transaction rate intensify.

Although Océane (2014) explained that a main engine dual tank retrofit reduces the engine output significantly, be it as it may, according to experts if the vessel is considered for a 100% full LNG load operation, then its efficiencies can be increased. This summation can be because even though the LNG has a high investment expenditure, in the short or long-term reasoning, the savings are significant. Washington State Ferries (2011) made the same judgement. Therefore, a modification of an existing diesel engine to a gas-operated vessel will bring a significant reduction to the vessel's operational costs. Most experts interviewed agreed that a dual engine can save up to 1 million dollars per vessel when compared to a regular diesel-powered engine. Although the modification process is high in capital costs, different literature (i.e. Burel et al., 2013; Océane, 2014; CE Delft, 2016) also agree that the reduced operational costs negate the initial high capital costs and they all placed the payback period to about 3 to 5 years.

Considering the new global sulphur cap, the demand for the MGO/MDO will increase and cascade into an urgent need to increase diesel bunkering infrastructures in the ports, a case that is likely to regrettably take precedence over other infrastructural development such as the LNG's (Semolinos et al., 2013). Admittedly, nothing is certain yet, but the cost of fuel may yet rise again, and supply may be hindered. However, despite this, the sulphur rules will be continually be upheld so that the onus lies on each related stakeholder to find ways to comply as the discussions on enforcement, default and penalties have increased in recent times.

Unfortunately, the reduced fuel prices have wasted many compliance investments made by the shipowner. If the MEC_{LNG} were to be successfully transferred to the LNG, it is expected to increase demand for LNG and consequently improve the supply channel. Yes, the LNG project may look complex when the number of the stakeholders involved are considered, but, the managerial implications of the MEC model in this context is the harmonisation of different value networks that would enhance functionalities supported by different elements that make LNG distribution less complicated. This demand that the parties involve develops adaptable project portfolios.

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

A further inference of the model is an experimental form of distribution model. Since the oil and gas landscape has grown and changed with more changes expected in the future, the customarily exclusive club of LNG players can no longer be restricted to only a few multinational integrated oil companies. Small and medium-sized companies now have the potential to have a place in the club or collaborate to improve flexibility. However, for a successful implementation, new bunkering standards have to be enacted globally so that it would be possible for LNG driven ship especially deep sea ship to easily bunker anywhere in the world.

Concisely, the prospect of LNG becoming a competitive fuel in the maritime industry would entail more medium and small-scale ports establishing and investing in LNG bunkering facilities as explained by Nerć-Pełka (2010) and then directly collaborate with the shipowners. For example, the port of Helsinki is known for its separated quays with different structures and functionalities for bunkering the ship-to-ship system, and this has seemed to work for the LNG distribution in the port (Castillo & Dorao, 2012). Considering this, project companies who invest in port infrastructures may go a step further to install the contractual LNG engines on ships to secure their investment. They are then able to attract loyal and consistent customers and can hedge their investments. They not only get their full money back, but they also do so with interest rates that double their investment within 1-3 years of investment. The LNG distribution challenge is a situation interconnected to the different element: first is the availability of port facilities that can produce stock and supply LNG the next is the availability of ports with fuelling quays, line-haul boats or barges that can transport heavy goods such as the fuel gas for bunkering. Without the assurance of a guaranteed, supply and low cost of bunkering, shipowners would not be interested in investing in LNG powered vessels. The same goes for investors for LNG infrastructure development. The proposed model can be used to create and enlarge the market and at the same time harmonise the collaboration between port developers / investors / suppliers and ship owners.

Paradoxically, most times, too much attention is on the expensive nature of retrofitting ships for LNG that discourages investment in the LNG option for sulphur compliance but, the unsung message that needs to be loud and clear is that yes, retrofitting ships to LNG is possible and is economically viable. It is true that industrial and economic development are major sustainability issues that need to be carefully worked out to ease any industry transition (Marolt et al., 2016). An advantage of this business model is the increase of the competitiveness of the LNG to improve the economies of scale and technology development along all LNG value chain.

Conclusion

This paper advocates for small and medium companies to create a niche for themselves to boost the availability of LNG bunkering in the maritime industry, the fact is, this business is not for the faint at heart or the undercapitalised. The proposed short-term trading contract can is used as a tool to reduce the costs and risks along the value chain by creating and increasing diversity in the supply chain in an industry known for its rigidity. Flexibility and dynamism can create healthy competitiveness in a complex supply chain.

A direct contract with shipowners can remove the LNG quality issues regarding the methane slip; this is an essential aspect because the methane number is also said to be related to the engine efficiency. The likely risk of not fulfilling this bunkering specification can be reduced / curtailed / covered in the contractual agreement connoting that the contract will be based on product specifications clauses and other clauses.

The uncertainties that surround the LNG regulatory framework is an obvious impediment its growth. Sadly, gas fuel is still not finding more extensive use outside shipping, although the growth and availability are slowly increasing. So far, the most substantial use of natural gas outside shipping is in the industrial heating followed by electric power generation. A precise and established regulatory framework can ensure a particular development of the LNG market. This framework should put into consideration in the entire value chain of the distribution process.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2019 Volume 7 Number 1 (September)
http://doi.org/10.9770/jesi.2019.7.1(40)

As long as there is no specific framework for the LNG, the risk /stake on investments will always be high due to a potential non-compliant ex-post.

References:

Abadie, L. M., Goicoechea, N., & Galarraga, I. 2017. Adapting the shipping sector to stricter emissions regulations: Fuel switching or installing a scrubber?. Transportation Research Part D: Transport and Environment, 57, 237-250. https://doi.org/10.1016/j.trd.2017.09.017

Adamchak, F., & Adede, A., 2013. LNG as a marine fuel, 17th International conference and exhibition on Liquefied Natural Gas (LNG 17), Houston, 17th April 2013 .

Al-Debei, M. M., & Avison, D. 2010. Developing a unified framework of the business model concept. European Journal of Information Systems, 19(3), 359-376. https://doi.org/10.1057/ejis.2010.21

CE Delft 2016. Assessment of Fuel Oil Availability Final report Delft, CE Delft, July 2016

Atari, S. and Prause, G., 2017. Risk assessment of emission abatement technologies for clean shipping. In International Conference on Reliability and Statistics in Transportation and Communication (pp. 93-101). Springer, Cham. https://doi.org/10.1007/978-3-319-74454-4_9

Baden-Fuller, C., & Haefliger, S. 2013. Business models and technological innovation. Long range planning, 46(6), 419-426. https://doi.org/10.1016/j.lrp.2013.08.023

Baltic Ports Organization. 2014. LNG in Baltic Sea Ports - Stakeholders Platform. http://www.oresundskraft.se/helga

Barroso, L. A., Rudnick, H., Mocarquer, S., Kelman, R., & Bezerra, B. 2008. LNG in South America: the markets, the prices and the security of supply. In Power and Energy Society General Meeting-Conversion and Delivery of Electrical Energy in the 21st Century, 2008 IEEE (pp. 1-6). IEEE. https://doi.org/10.1109/PES.2008.4596232

Bialystocki, N., & Konovessis, D. 2016. On the estimation of ship's fuel consumption and speed curve: A statistical approach. Journal of Océan Engineering and Science, 1(2), 157-166. https://doi.org/10.1016/j.joes.2016.02.001

Boscheck, R. 2006. Assessing "new" upstream business models. IMD International, 1501, 2006-06.

Burel, F., Taccani, R., & Zuliani, N. 2013. Improving sustainability of maritime transport through utilization of Liquefied Natural Gas (LNG) for propulsion. Energy, 57, 412-420. https://doi.org/10.1016/j.energy.2013.05.002

Castillo, L., & Dorao, C. A. 2012. Consensual decision-making model based on game theory for LNG processes. Energy conversion and management, 64, 387-396. https://doi.org/10.1016/j.enconman.2012.06.014

Danish Maritime authority 2012. North European LNG Infrastructure Project. A feasibility study for an LNG filling station infrastructure and test of recommendations.

Det Norske Veritas AS, MAN Diesel & Turbo 2011. Quantum 9000 two stroke LNG. Available from: http://www.mandieselturbo.com/files/news/filesof16391/5510-0108-01ppr_low.pdf

Fiksdahl, M., & Wamstad, M. G. 2016. Business models in the maritime industry-A study of how Norwegian maritime actors apply and innovate their business models (Master's thesis, NTNU).

Gerlitz, L., Philipp, R., & Beifert, A. (2017, October). Smart and Sustainable Cross-Sectoral Stakeholder Integration into Macro-Regional LNG Value Chain. In *International Conference on Reliability and Statistics in Transportation and Communication* (pp. 112-126). Springer, Cham.

Gu, Y., & Wallace, S. W. 2017. Scrubber: A potentially overestimated compliance method for the Emission Control Areas: The importance of involving a ship's sailing pattern in the evaluation. Transportation Research Part D: Transport and Environment, 55, 51-66. https://doi.org/10.1016/j.trd.2017.06.024

Ikonnikova, S., Volkov, D., Gulen, G., BEG, C., & Foss, M. 2009. Strategic model of LNG arbitrage: analysis of LNG trade in Atlantic Basin. In 32nd International Association for Energy Economics Conference Proceedings.

IMO 2009. Regulations for the prevention of air pollution from ships, revised MARPOL Annex VI. London

IMO 2015. Guidance on the application of regulation 13 of MARPOL annex VI Tier III requirements to dual fuel and gas-fuelled engines. MEPC.1/Circ.854. London. http://www.imo.org/en/MediaCentre/PressBriefings/Pages/MEPC-70-2020sulphur.aspx

Jiang, L., Kronbak, J. and Christensen, L.P. 2014. The costs and benefits of sulphur reduction measures: Sulphur scrubbers versus marine gas oil. Transportation Research Part D: Transport and Environment, 28, pp.19-27. https://doi.org/10.1016/j.trd.2013.12.005

Kadavias, S., & Kostas, L. 2015. Six degrees of innovation Predicting transformative business models. A white paper produced in collaboration with AT&T. university of Cambridge. Judge Buisness School.

Kristensen, H. O. 2012. Energy demand and exhaust gas emissions of marine engines. Clean Shipping Currents, 1(6), 18-26.

Kumar, S., Kwon, H. T., Choi, K. H., Cho, J. H., Lim, W., & Moon, I. 2011. Current status and future projections of LNG demand and supplies: A global prospective. Energy Policy, 39(7), 4097-4104. https://doi.org/10.1016/j.enpol.2011.03.067

Lee, S.W., Ryu, J.W. and Min, W., 2003. SK hydrodesulfurization (HDS) pretreatment technology for ultralow sulfur diesel (ULSD) production. Catalysis Surveys from Asia, 7(4), pp.271-279. https://doi.org/10.1023/B:CATS.0000008166.74672.db

Lindstad, H. E., & Eskeland, G. S. 2016. Environmental regulations in shipping: Policies leaning towards globalization of scrubbers deserve scrutiny. Transportation Research Part D: Transport and Environment, 47, 67-76. https://doi.org/10.1016/j.trd.2016.05.004

Lindstad, H., Sandaas, I., & Strømman, A. H. 2015. Assessment of cost as a function of abatement options in maritime emission control areas. Transportation Research Part D: Transport and Environment, 38, 41-48. https://doi.org/10.1016/j.trd.2015.04.018

Livanos, George A., Theotokatos, Gerasimos, Pagonis, Dimitrios-Nikolaos 2014. Techno-economic investigation of alternative propulsion plants for ferries and RoRo ships. Energy Conversion and Management. https://doi.org/10.1016/j.enconman.2013.12.050

Marolt, M., Lenart, G., Maletič, D., Borštnar, M. K., & Pucihar, A. 2016. Business model innovation: insights from a multiple case study of Slovenian SMEs. Organizacija, 49(3), 161-171. https://doi.org/10.1515/orga-2016-0015

Molitar, E. 2011. Infrastructure development for access to LNG bunkering in ports. SSPA.Sweden AB https://www.sspa.se/alternative-fuels

Morris, M., Schindehutte, M., & Allen, J. 2005. The entrepreneur's business model: toward a unified perspective. Journal of business research, 58(6), 726-735. https://doi.org/10.1016/j.jbusres.2003.11.001

Nerć-Pełka, A. 2010. Logistics and supply chain effectiveness measure areas in LNG companies. Electronic Scientific Journal of Logistics, ISSN. http://www.logforum.net/vol6/issue3/no7

Océane B., 2014. LNG – A Cost-Efficient Fuel Option? Drivers, Status and Economic Viability. A DNV-GL presentation 15.05.2014

Olaniyi, E.O., Atari, S, Prause, G. 2018a. Maritime Energy Contracting in clean shipping, Transport and Telecommunication Journal, 19(1), 31–44, ISSN (Online) 1407-6179. https://doi.org/10.2478/ttj-2018-0004

Olaniyi, O.E., Prause, G., Bakkar, Y. 2019. Entrepreneurial compliance opportunities for maritime fuel producers. *Entrepreneurship and Sustainability Issues*, 6(4), 1550-1565. https://doi.org/10.9770/jesi.2019.6.4(1)

Olaniyi E.O., Gerber P., Prause G. 2018b. Strategic Energy Partnership in Shipping. In: Kabashkin I., Yatskiv I., Prentkovskis O. (Eds) Reliability and Statistics in Transportation and Communication. Lecture Notes in Networks and Systems, 36: 102-111. Springer, Cham. https://doi.org/10.1007/978-3-319-74454-4_10

Olaniyi, E. O. 2017. Towards EU 2020: An Outlook of SECA Regulations Implementation in the BSR. Baltic Journal of European Studies, 7(2), 182-207. https://doi.org/10.1515/bjes-2017-0016

Olaniyi, E.O. and Viirmäe, M. 2016. The Economic Impact of Environmental Regulations on a Maritime Fuel Production Company. Research in Economics and Business: Central and Eastern Europe, Vol. 8, No. 2, pp. 58-84. 41. http://www.rebcee.eu/index.php/REB/article/view/93

Osterwalder, A. 2004. The Business Model Ontology-a proposition in a design science approach. http://www.hec.unil.ch/aosterwa/PhD/Osterwalder_PhD_BM_Ontology.pdf

Osterwalder, A. and Pigneur, Y. 2009. Business Model Creation. Modderman Drukwerk: Amsterdam.

Paulauskas, V., Paulauskas, D., Placiene, B., Barzdziukas, R., Maksimavicius, R., Ronkaityte, I., & Henesey, L. (2017). Optimization modelling of LNG supply chains for development: Case study of Lithuania and Latvia. In International Scientific Conference Transport Means, Juodkrante, Lithuania (pp. 762-765). Kaunas University of Technology.

Platts (2016). Platts 2016. The IMO's 2020 Global Sulfur Cap: What A 2020 Sulfur-Constrained World Means for Shipping Lines, Refineries and Bunker Suppliers. https://www.platts.com/IM.Platts.../SR-IMO-2020-Global-sulfur-cap-102016.pdf

Prause, G.; Reinhold, K.; Järvis, M.; Olaniyi, E.; Tint, P. 2019. The Socio-Economic Impact of Green Shipping: A Holistic View from the Baltic Sea Region. In: Kabashkin, I.; Yatskiv, I. Reliability and Statistics in Transportation and Communication. Berlin: Springer. (Lecture Notes in Networks and Systems). https://doi.org/10.1007/978-3-030-12450-2_59

Rack, V. 2017. Business model innovation in the oil and gas supply industry (Master's thesis, Nod University). 47.

Ren, J. and Lützen, M. 2015. Fuzzy multi-criteria decision-making method for technology selection for emissions reduction from shipping under uncertainties. Transportation Research Part D: Transport and Environment, 40, pp. 43-60. https://doi.org/10.1016/j.trd.2015.07.012

Ruester, S., & Neumann, A. 2006. Economics of the LNG Value Chain and Corporate Strategies An Empirical Analysis of the Determinants of Vertical Integration. In 10th Annual ISNIE Conference.

Ruester, S., & Neumann, A. 2009. Linking alternative theories of the firm–a first empirical application to the liquefied natural gas industry. Journal of Institutional Economics, 5(1), 47-64. 1) https://doi.org/10.1017/S1744137408001215

Schinas, O. and Stefanakos, C. N. 2012. Cost assessment of environmental regulation and options for marine operators. Transportation Research Part C: Emerging Technologies, 25, 81-99. https://doi.org/10.1016/j.trc.2012.05.002

Semolinos, P., Olsen, G., & Giacosa, A. 2013. LNG as marine fuel: challenges to be overcome. In 17th International Conference & Exhibition on Liquified Natural Gas.

Seo, S., Chu, B., Noh, Y., Jang, W., Lee, S., Seo, Y., & Chang, D. (2016). An economic evaluation of operating expenditures for LNG fuel gas supply systems onboard ocean-going ships considering availability. Ships and Offshore Structures, 11(2), 213-223. https://doi.org/10.1080/17445302.2014.984389

Songhurst, B. 2014. LNG plant cost escalation. Oxford Institute for Energy Studies.

Stopford M. 2009. Maritime economics, Routledge 2nd Edition, London and New York.

Sys, C., Vanelslander, T., Adriaenssens, M., & Van Rillaer, I. 2016. International emission regulation in sea transport: Economic feasibility and impact. Transportation Research Part D: Transport and Environment, 45, 139-151. https://doi.org/10.1016/j.trd.2015.06.009

Talus, K. 2008. Access to Gas Markets: A Comparative Study on Access to LNG Terminals in the European Union and the United States. Hous. J. Int'l L., 31, 343.

TE 2017a. Consumer Price Index/Estonia. https://tradingeconomics.com/estonia/consumer-price-index-cpi

TE 2017b. Labour costs/Estonia. https://tradingeconomics.com/estonia/labour-costs

Van de Bunt, L. L. 2015. Strategic and tactical decision making in a dedicated transportation service in the chemical cluster of Rotterdam–A business model.Masters' thesis Department of Industrial Engineering & Innovation Sciences. tue.nl.

Van der Vliet, L. 2017. The business model of Dutch container trucking companies–an analysis of internal change for 2016-2021. Masters' thesis Urban, Port and Transport Economics, Erasmus University Rotterdam.

Wang, S., & Notteboom, T. 2014. Shipowners' structure and fleet distribution in the liquefied natural gas shipping market. International Journal of Shipping and Transport Logistics, 6(5), 488-512.

Wang, S., & Notteboom, T. 2015. The role of port authorities in the development of LNG bunkering facilities in North European ports. WMU Journal of Maritime Affairs, 14(1), 61-92. https://doi.org/10.1007/s13437-014-0074-9

Weems, P. R., & Hwang, M. 2013. Overview of issues common to structuring, negotiating and documenting LNG projects. Journal of World Energy Law and Business, 6(4), 267-299. https://doi.org/10.1093/jwelb/jwt016

WSF, 2011. Life Cycle Cost Analysis: Car Ferry LNG Fuel Conversion Feasibility Study for Washington State Ferries Seattle, WA, July 2011. The Glosten Associates, Inc.

Yin, R. K. 2003. Case study research: design and methods (3rd ed.). Thousand Oaks, Calif.: Sage Publications, 364p.

Aknowledgement

This work is in principle linked to the EnviSuM – Environmental Impact of Low Emission Shipping: Measurements and Modelling Strategies project sponsored by the European Regional Development Fund.

Eunice Omolola OLANIYI, PhD is a researcher and an EU Project Manager at the Tallinn University of Technology. Research interests are in sustainable transport, maritime operations/logistics, SME management & internationalization, regional development and innovation.
ORCID ID: orcid.org/0000-0002-2181-9328

Laima GERLITZ, PhD is the head of European Project Centre at Wismar University of Applied Science: Technology Business and design. Her research interests are in design and innovation, strategic design management for enterprise competitiveness and value creation from design-driven approaches in organisational setting, particularly in the context of small manufacturing and high-tech enterprises and start-ups.
ORCID ID: orcid.org/0000-0002-7127-7678

Register for an ORCID ID:
https://orcid.org/register

Copyright © 2019 by author(s) and VsI Entrepreneurship and Sustainability Center
This work is licensed under the Creative Commons Attribution International License (CC BY).
http://creativecommons.org/licenses/by/4.0/
Open Access