CHALMERS

Short-delivered bunkerings

Can a buyer take any precautionary actions to minimizing the risk of a quantity discrepancy when buying bunker fuel in Singapore?

Bachelor Thesis in the Shipping and Logistics Programme

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CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden, 2013
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ABSTRACT

The bunker market in Singapore is currently influenced by a small pool of dishonest suppliers and barge operators. This is causing problems for bunker buyers worldwide due to not delivering the full quantity of stemmed bunker but later charging for it. This is creating additional costs for shipping companies and distrust between the actors on the Singaporean market.

The purpose with this thesis was to identify if there are any precautionary actions a bunker buyer can take to minimise the risk of getting a short deliver while taking bunker fuel in Singapore. The study will comprise the identification of the problem, possible strategies and if the strategies are working in a satisfactorily manner.

The method chosen to evaluate the problem was a case study based on secondary data from articles and books and primary data from semi-structured interviews. The selected respondents are from different parts of the business and have extensive knowledge of the market.

From the results of the study, a conclusion can be made that there are no foolproof ways to prevent a short delivery. The identified strategies needs a closer collaboration and the market needs be more transparent.

This report is written in English.

Key words: Bunker fuel, bunkering, Singapore, Cappuccino bunker, bunker surveyor, short-delivery

SAMMANFATTNING

Bunkermarknaden i Singapore påverkas för tillfället av en liten grupp med oärliga leverantörer och pråmoperatörer. Detta orsakar problem för bunker inköpare över hela världen på grund av att den beställda kvantiteten inte levereras men debiteras. Detta skapar merkostnader för rederier och misstro mellan aktörerna på den singaporianska marknaden.

Syftet med denna avhandling var att identifiera om det finns några förebyggande försiktighetsåtgärder en bunker inköpare kan vidta för att minimera risken för att få en kortleverans vid köp av bränsle i Singapore. Studien kommer att omfatta identifiering av problemet, möjliga strategier och om strategierna fungerar på ett tillfredsställande sätt.

Den metod som valts för att utvärdera problemet var en fallstudie baserad på sekundärdata från artiklar och böcker och primärdata från semistrukturerade intervjuer. De utvalda respondenterna är från olika delar av verksamheten och har stor kunskap om marknaden.

Från resultaten av studien, kan en slutsats dras att det inte finns några åtgärder som garanterat kan förhindra en kortleverans. De identifierade strategier behöver ett närmare samarbete och marknaden behöver bli mer transparent.

Denna rapport är skriven på engelska.

Nyckelord: Bunkers, bunkring, Singapore, Cappuccino bränsle, kortleverans, bunkringsproblem

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The author would like to thank all the people that been with me along the way and taken the time to help me writing this thesis. I would like to start to thank Lars Malmbratt and Ida Fredriksson from the Stena Bulk Bunker Division for their help, support and endless supplies of information. Also for the patience with all my questions and all the time taken to discuss the subject with me. I would also like to say a massive thank you to Stena Bulk for making all my travels possible and allowing me to participate in different trade events. Another important person is Mr Ewoud Kamminga from Inspectorate that helped me get started and helped to understand the extent of this issue.

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And last but not least a thank you to my mentor/supervisor and my examiner for your time, all your feedback and advice. I've learnt a lot during this process!

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LIST OF ABBREVIATIONS

BDR	Bunker delivery receipt
HSFO	High sulphur fuel oil
STS	Ship-to-ship transfer
MPA	Marine and Port Authority of Singapore
USD	United States Dollar
Stem	Quantity of ordered bunker fuel, the bunker fuel order.
ARACON	The Amsterdam Rotterdam Antwerp Conference

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”The efficient bunkering of merchant ships requires skill, perception, and the development of the ability to consider simultaneously a whole range of factors before reaching an optimum decision – all this leads to the purchase of the highest quality product commensurate with and economic cost”

-William Packard

1. Introduction

In this study the aim is to investigate if there are any precautionary actions that a buyer of bunker fuel can take to minimize the risk of not receiving the quantity of fuel ordered, while taking bunker in Singapore.

In 2010 an estimated 140 million tons of bunker fuel was sold and delivered to shipping companies worldwide (Fisher & Lux, 2004). The shipping industry is a fast paced market and is expanding quickly with more advanced vessels and new techniques. The bunker market is also growing and the general price of fuel has increased with over 40 percent during the last 10 years (Bunkervision, 2013). However the techniques used while bunkering are not evolving in the same pace (Cockett, 1997). Quantity is still hand-measure by sounding the tanks, errors in measured values could be developed by undulation in the tanks and the equipment could be tampered with (Cockett, 1997).

Singapore is currently the largest bunkering port in the world; in 2012 the port provided 42.7 million tons of fuel (Fisher & Lux, 2004) . The development from a governmentally ruled port to an open market was quick and attracted a large amount of new suppliers and as a result the competition is very high. With high competition the margins can be tight which potentially could result in a few suppliers turning to unscrupulous activities (Fisher & Lux, 2004) such as short deliveries.

Short-deliveries can be performed in several different ways. In Singapore a specific problem has occurred that is called “The Cappuccino effect” or “Cappuccino bunkers”. This is developed when air is being pushed into the fuel, giving it the appearance of the frothy milk in a Cappuccino. The volume of the fuel is then expanding but not in proportion to its mass. The result of this is that the bunker buyer is paying for fuel that is not delivered (Kamminga, 2013a) According to Neil Cockett (1997), David Fischer and Jonathan Lux (2004) Singapore is a specific problem market that needs to be highlighted.

For the shipping company the bunker fuel is the largest operational cost. It stands for 50-70 percent in some cases as high as 80 percent (McLoughlin, 2013). With an average price of USD600 per metric tons of high sulphur fuel oil (Bunkervision, 2013)even small quantities of fuel amounts to significant sums of money. A bunker buyer’s main task is to purchase good quality bunker fuel to a low price and reducing the risk of not receiving the stemmed quantity and of paying for non-delivered bunker.

This thesis will identify the most common ways for a supplier to short-deliver a vessel and then the strategies a bunker buyer could use to try to minimize the risk. It will also look at how the strategies work in effect and if they are economically viable for the bunker buyer to apply.

1.1 Purpose

The purpose of this case study is to find out if there are any functioning precautionary actions a bunker fuel buyer can take to prevent a discrepancy in the delivery of the stemmed bunker from the barge/supplier. It is based in identifying the most common ways of performing a short delivery and then finding the strategies or options available on the market today that could possibly prevent the issue.

1.2 Questions

What can you as a bunker buyer do to minimize the risk of getting a discrepancy of quantity when buying HSFO in Singapore?

- What different ways are the short-deliveries performed?
- Identifying the strategies or options to prevent short delivery and are available on the market today?
- Are the available strategies working in a satisfactory manner?

1.3 Delimitations

The case study is geographically limited to Singapore since some specific problems only occur here. It will also focus on the effects of the Singaporean legislation.

The strategies that will be considered in this study must be widely available to the market in Singapore and only the high sulphur fuel oil (HSFO) will be considered in this study.

Due to limited time the problem was restricted to concern only supplier/barge and buyer.

1.3.1 Target audience

This thesis is focused on those working in the bunker fuel industry and shipping companies that would like to take a bigger interest in the bunker buying procedure.

2. Theory

2.1 How do you bunker a vessel –Loading procedure

There are two ways to bunker a vessel;

1. At quay (ex-wharf) and
2. Ship-to-ship transfer.

When bunkering ex-wharf a hose is connected to the manifolds on the vessel to the manifolds on shore and the bunker fuel is transferred between land and the vessel. There are not many ports that can provide this service (Malmbratt, 2013), and as such it is not relevant to this thesis.

Ship-to-ship transfer (STS) is more common of the two bunker fuel loading methods, where a bunker barge is loaded at quay and then delivers the fuel to the vessel where she is anchored.

Before the transfer of bunker fuel commences the crew of the vessel make the appropriate preparations to receive the bunker fuel. The quantity remaining on board should be calculated before the bunker barge arrives and the owners and charterers advised on the final volume. The volume remaining is controlled toward the ordered bunker fuel to ensure that the vessel will have enough for the planned trip. The technical chief will try to arrange it so that the receiving tanks are empty, this will simplify the process and no comingling tests will need to be performed. (Fisher & Lux, 2004)

The chief engineer ensures that the documentation is in order and then completes the pre-delivery documents. The crew prepares the vessel for the delivery and pre-arrival and pre-loading checks are performed (Bracken, 2000). The volume in the tanks of the bunker barge is then able to be controlled; which is detailed further in the next chapter

Once this is complete, the vessel is ready to commence the transfer. The chief engineer, together with the barge master check that the bunker transfer hose is correctly attached to the vessels manifold by the appropriate equipment and control the use of the bunkering systems. Then a permission to start the delivery is given from the vessel to the bunker barge. The manifolds should be monitored at all times during delivery and it should be controlled so that the fuel is delivered to the right tank. A tank is never loaded to more than 98 percent due to characteristics of the oil. When a tank is close to this it will be topped off and the next tank will be filled up. The chief signals the barge master when the transfer is due to finish and will then complete a full shipboard bunker survey of the vessel and tanks before the hoses are disconnected (Bracken, 2000).

Normally the HSFO will be heated to over 40 degrees Celsius during delivery (Bracken, 2000). The higher temperature decreases the viscosity creating better flow characteristics of the oil and it is easier to deliver (Cockett, 1997).

2.2 How is the delivered quantity decided?

There are a few ways to decide the delivered quantity of bunker fuel to a vessel; this chapter will discuss the most common method of measuring.

Once the bunker barge has arrived to the vessel and the preparation procedures have been completed, the tanks of the barge shall be measured. This is done by gauging or "sounding" the tanks. The two most common methods of doing this is either by a measuring tape with a heavy bob attached to the end or with a handheld radar. There are two ways of measuring a tank, measuring the distance from the top of the tank down to the surface of the oil (ullage) or from the surface of the oil down to the bottom of the tank (sounding) (Fredriksson, 2013).

In Singapore the barge volume is applicable for the bunker delivery receipt (BDR), so the bunker barge tanks are the most important to measure. The chief engineer (or equivalent) should always attend the tank measuring to control the accuracy and correctness (Fisher & Lux, 2004). When the tanks are measured the received values are compared to a sounding/ullage table or a calculation form and recalculate in to a volume. This must be corrected to a standard temperature since the volume of the oil changes with temperature (Bracken, 2000).

The sounding table is a chart where you can find most of the technical information regarding the tank, the construction and capacity and also the volume in regards to the depth of the sounding. The tables are different to all vessels and all tanks since no two vessel tanks are the same. (Marine Insight, 2013) The bunker barge should always have the most recent tables to ensure that the right volume is calculated (Maritime and Port Authority of Singapore, 2013)

After the delivery is completed the tanks of the bunker barge are measured again to establish the delivered volume (Fredriksson, 2013).

There are a few more advanced techniques for measuring the tanks but the gauging is the most commonly used. The method is quite sensitive as the oil in the tanks is liquid and can undulate due to surrounding conditions (Fredriksson, 2013).

2.3 The bunker market

Different types of bunker are traded all over the world and more often than not, sold in a country far away from their origins (Fisher & Lux, 2004). Different ports work in different ways and have different backgrounds and legislations. Some works better than others and have less reported discrepancies (Kamminga, 2013a). There are also many parties involved in a vessel which obstruct the deals and transparency of the business

2.3.1 The development of the Singaporean market

Before 1985 Singapore was a market controlled by the government that only allowed a few players that worked in a cartel. They had together built up the port to be one of the top three ports in the world. In the early 1970s Singapore was already selling over 5 million tonnes a year, which back then was a significant amount (Pinder, 1997).

While the economics grew so did the transportation of goods. In Singapore the focus was on

the trans-shipment and its efficiency, and not much interest was directed towards the bunkering functions. As a consequence concerns were raised regarding supply standards and the quality of the fuel. The Singaporean Government had an idea of Singapore as a "total shipping centre" and decided to deregulate the monopoly that reigned for years. Their idea was that an open market would attract more bunker suppliers to the port, create a healthy competition that in the long term would bring down the prices, increase the quality and retain the high supply standards (Pinder, 1997). Pinder (1997) makes following statement regarding Singaporean bunker market *"...the aim was to create in the market an image of Singapore as the ultimate bunkering port, unmatched on service standards, product quality or price, in order to bolster significantly the ports overall reputation for excellence"*

The market was, in a way, released on the 2nd September 1985 and opened to all would-be suppliers of bunkers in Singapore. It was believed that the market would regulate itself and achieve the policy's goal with the free trading so no monitoring of the trade was put in place. The amount of suppliers increased rapidly, from a handful in the 70's and 80's to 140 in 1992. With the competition between players the prices fell 10-15 percent below any other regional supplier which led to a growth of Singapore as a bunker port until it was the largest one in the world. Even though it was the biggest port it still obeyed the market fluctuations and followed the ups and downs as all the other ports in the region (Pinder, 1997)

A free market without any regulation might not be the best option to stimulate the market after the economic climate has evolved. The competitors are fighting for their market share and brought along some less welcome consequences. It was at this point both quantity and quality claims started to arise from buyers in the market. The largest part of the claims involved smaller entrants to the market, companies that stepped in to make a quick buck but even the bigger player had their fair share of complaints. Since there was no regulation or no way to solve the disputes there are today no exact numbers on how big the problem truly was. A few unscrupulous suppliers put a bad stamp on the entire port. (Pinder, 1997)

Today the Marine and Port Authority of Singapore (MPA) are working slowly to improve the situation. Now there are only licensed suppliers and barges allowed to trade in the Port of Singapore. On the MPA-website a buyer can find lists over licensed suppliers and barging companies (Maritime and Port Authority of Singapore, 2013).

Prior to the release of the market the buyers were often given a discount when they bought fuels of one of the big suppliers (Pinder, 1997). An assumption can be made that the previous discount has been transferred in to paying lower than market value (see further explanation in chapter 2.4.2 The Pricing of bunker), so that the buyer still get their "bargain".

2.3.2 Code of practice in the Port of Singapore

In Singapore, the code of practice used is the SS600:2008 and the authority of this is implemented by the MPA. The code of practice covers everything regarding to the bunkering process when the bunker fuel is delivered by a bunker tanker or a barge. This includes the process, the documentation and pre-delivery checks, the delivery and post-delivery. It also covers the documentation, verification and equipment that are used during the bunkering.

The issue with the SS600:2008 standard is that the only numbers or measures that can be taken in account if a problem or a disagreement would occur are the barges numbers. This is discussed in Section Two (Pre-delivery checks and documentation) and Section Four (Post-

delivery checks and documentation) of the practice. The chief engineer of the receiving vessel is strongly advised to be on-board the barge as the gauging of the tanks is done, both before and after the bunkering. But this is the only part that allows the receiving vessel to have an opinion regarding the received amount.

The above is a problem if the receiving vessel discovers a discrepancy in the delivered volume. If the barge claims that they have delivered the full amount, the receiving vessel has only a few options to proceed with the claim.

2.4 The bunker purchase

Buying bunker fuels are more often than not an international affair. The operator or bunker department are most likely based in another country from where the vessel is situated. The success of a purchase is based on a systematic approach of the market.

Larger shipping companies often have a separate bunker department that is focused on the purchase of bunkers to a large fleet. In smaller companies the vessels operator may be responsible for the buying. This chapter will discuss the buying process through a separate bunker department to show the many steps and parties involved.

2.4.1 The process

The process begins with an order of fuel, decided by the vessels master and the operator, to the bunker department. The bunker department then put the order out in the market, either through a broker, a trader or direct to suppliers. The difference between using a broker and a trader is that a broker organises the deal between a buyer and a supplier and charge the buyer for it. The buyer buys the bunker fuel on the supplier's terms and conditions. The broker should help the buyer to maximize their position in the market, but are not taking the risk or responsibility for the delivery. A trader should also maximize the buyer's position in the market but instead they buy the fuel and sell it on to the buyer with a slight supplement charge on the traders' terms and conditions. This has the effect that if any problems occur during delivery, the buyer can turn to the trader (Cockett, 1997). For this reasons using a trader is an easier option for a buyer and will be used in the following example.

A buyer will most likely contact a few traders to ensure the best available price on the market, the traders will in their turn contact a few suppliers to ensure the same. Some negotiations will most likely be made and some haggling back and forward until the buyer chooses the trader with the best price and a deal is made. The deal is called a "stem"

A port agent is then appointed to liaise with the different parties, vessel, Oil Company and the vessel operator, to ensure a smooth delivery. The oil supplier arranges a barge to deliver the oil, which can either be hired -a third party barge or own their own. The barge then delivers the bunker fuel to the vessel.

In Figure 1 a simplified overview of a bunker purchase and the parties involved can be seen. In this picture the bunker department lies under ship-owner. As can be seen in the schematic overview different stakeholders are involved in different areas of the running of the vessel.

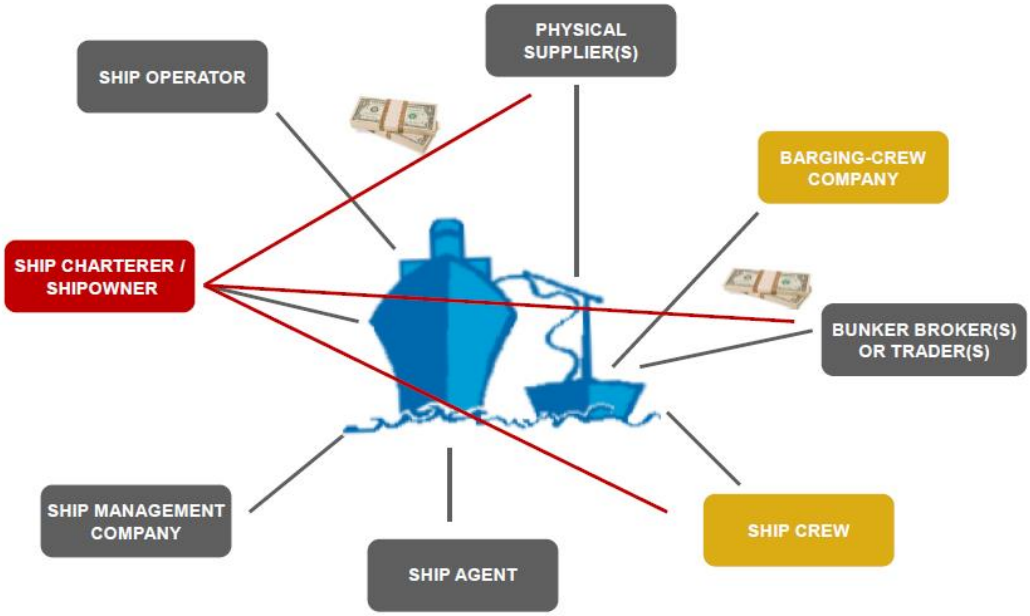

Figure 1. Parties involved in a vessels bunkering (Kamminga, E.)

2.4.2 Pricing of bunker fuel

When discussing the pricing of fuel in Singapore a reference is often made to Platt's Bunkerwire (Platt's). Platt's is a global newsletter that focuses on marine fuel prices. Everyday a newsletter is sent out with an average pricing from the day before (see Appendix 1) as a comparison for buyers worldwide. Platt's also provides a monthly overview. The service is charged for and not available for the public (Platts McGraw Hill Financial, 2013).

The price comparisons are made by Platt's Bunkerwire plus or minus what the buyer bought the bunker fuel for. For example, if a buyer bought HSFO in Singapore for USD590 per metric ton and Platt's Bunkerwire for that day was USD595 per metric ton, the buyer would refer the price as Platt's minus 5. In many bunkering ports the prices are close to Platt's with only small fluctuations but in Singapore the standard is Platt's minus 10-15 (*Authors observation on the Singaporean price difference reached as low as Platt's minus 43.)*, sometimes even higher (Malmbratt, 2013). Pricing in Singapore is also special since sometimes the price offered for bunker fuel delivered by barge is lower than the price that the bunker fuel is being sold from ex-wharf (Malmbratt, 2013). Which results in a loss for whomever trading that oil.

The prices for bunker fuel are constantly changing during the day but s general branch standard when discussing pricing for HSFO in Singapore is using an average of USD600 per metric ton (Malmbratt, 2013). In this thesis the branch standard will be applied and USD 600 per metric ton will be used in any calculation.

2.4.3 The Bunker Delivery Receipt (BDR)

When the bunker is delivered and the barge is measured the bunker delivery receipt (also called bunker delivery notice BDN) should be signed by both parties. The document is the record of how much bunker is delivered and how much the buyer should pay. It is one of the most important documents in the bunker purchasing process and the information it should contain at a minimum is date and time, details regarding the barge, the suppliers name, fuel type, temperature, density, viscosity, quantity, sampling information, vessel details and metric tons (Bracken, 2000). The density is only estimation since the temperature and viscosity cannot be measured exactly. Both the chief engineer and the barge master should sign this document. In Singapore, the bunker barge cannot leave the vessel if the BDR is not signed (Malmbratt, 2013).

3. Method

3.1 Choice of method

The method used is a qualitative case study with semi-structured interviews. It was estimated that that would be the appropriate way to investigate the stated problem. The method provides the possibility to use multiple ways to collect information and to look at different angles and entities. Since there has not been many studies made on the specific studies, a case study is also good as the boundaries and the final result are not evident in the beginning of the process (Benbasat, Goldstein, & Mead, 1987).

It was decided that the first step would be to collect secondary information about similar and surrounding problems by finding published scientific articles and books. Also attending to trade events, in this case ARACON2013 was beneficial to be able to get the general and official opinion of the trade.

Then to identify the different ways to short-deliver a vessel an open (unstructured) phone interview was performed with Mr Ewoud Kamminga of Inspectorate in Rotterdam. Mr Kamminga actively works with bunkering disputes worldwide and was able to freely speak about troubles with short-deliveries. The phone interview was followed up by a personal interview after the collected information was analysed and cross checked with secondary data (this method will be discussed further in chapter 5.4 Method discussion on page 25). Due to the small amount of previous research on the subject there is not a lot of available material to control collected information with. Therefore several short meetings were held with Mr Lars Malmbratt, the general manager of Stena Bulk Bunker Division, to discuss the collected information. Mr Malmbratt has a long experience of the oil and bunker trade as buyer, seller and supplier. He had good inputs and assisted with cross checking the information from the first interviews with reliable resources from the trade. This information was then compiled and became the foundation for the subsequent interviews that was carried out in Singapore.

Together with the secondary data from books and articles the different strategies and options could then be found, based on the problem. Information regarding the precautionary strategies was also gathered from the ARACON2013 conference which focus was on bunkering disputes.

To be able to get a clear overview of the costs involved in using a coriolis mass flow meter a quantitative method was used to complement the qualitative method. Thus provide a better foundation for the discussion if the identified strategy by using a mass flow meter was functioning in a satisfactory manner. Two programs were created in computer program designed for analysing large amounts of data (MatLab) to visualize the additional costs that emerges when using a barge with an installed meter. The MatLab program was created by using a randomization for the expected loss of one to five percent. The randomization was used to show how much the expected loss varied. Five percent is the worst case scenario of bunker loss but due to the randomization it was decided to be included so the estimated maximum loss could be seen. This was plotted against the linear expression of the growing cost of using a barge installed with the coriolis mass flow meter so a comparison between the economic losses can be done. The randomized values are changing for every time the program is run. The next program written shows a mean value of the randomization run 1000 times. This gives an estimated mean value and is a linear growing function. The two graphs were used to provide a visual overlook over cost comparison due to bunker lost or the increase in price because of the flow meter.

To develop and investigate the collected information further and to collect primary data on how the identified strategies adapt to reality, semi-structured interviews were planned and performed. The qualitative focus was chosen because the intention is not to compare the respondents' answers but to create an overall picture of the case. With the semi-structured setup it is also easier to compare similarities and differences between the respondents' answers.

The structure of the interview was made up by a mix of open questions and key words. The open question were intended to let the interviewee to elaborate his or her point of view of the stated problem without being held back, this is a better way to discovery new information in complex question setting (Denscombe, 1998).

3.1.1 Preparation for Interviews

While preparing the interviews the questions and key words that were chosen is based on the previous work and already collected information. The question to open a discussion was "What do you think a buyer can do to protect him or herself from shortage in deliveries?" and the key words to steer the conversation were:

- Precautionary actions
- Bunker surveyors –surveillance methods
- Bunker trader
- Coriolis mass flow meter
- The Marine and Port Authority of Singapore
- Other techniques

The choice of using key words instead of full questions gives the respondent an option to open up and elaborate (Denscombe, 1998).

3.1.2 Selection of Respondents

The selection of respondents was chosen from different parts of the trade. The idea is to get a spread and to be able to see the problem from different point of views and to fully understand the extent of the problem.

The selection consists of a mix of one bunker traders, one bunker buyer, one bunker surveyor and two government officials. Further reasons are that the respondents well-reputed in the trade and also thought as successful in their business by the market. They are also from different companies and do neither work together nor know each other. This to establish a spread on answers and insights. A consideration to the cultural background was also made, having all Singaporean respondents or all non-Singaporean could possibly inflict the attitude of the respondent so a mix of Singaporeans and ex-pats was chosen.

It was decided due to the sensitive matter of the problem that the interviews were to be presented as confidential in this thesis, which applies to both name and occupation. The respondents will be referred to as Respondents number 1-4

3.1.3 Performing interviews

There were personal interviews made at the respondents' office and recorded by two electronic devices, in case one would fail. The interviews were approximately one hour long.

When performing the second part of interviews, it was found that the respondents were positive to talk to about the subject. The interviews went from semi-structured to open. This

was a general observation that applied to all interviews except with MPA, which will be discussed at a later point in the thesis. A choice was made to let the respondent speak freely and to only observe and listen. The benefit of not directing the questions had the effect that the information that was not previously touched on or considered was collected.

The analyse of the recorded interviews was divided in two parts. The first part consisted of finding the previous stated keyword and the thoughts of the respondent on the matter. A summary of each respondent's answers was put in a table (see Table 1 on page 20) detailing each respondents answer. This will provide an overview and simplify the process of comparing the answers (Denscombe, 1998).

The second part was to find new information on the subject that needed further research that could give additional information and input to the research. This was crosschecked with previous read articles and new material was added.

The primary data that was collected is the foundation for the results of this thesis.

4. Results

4.1 Identified procedures of short-delivery

The problem with discrepancies in bunker delivery caused by the bunker barge was identified to several different ways; which are discussed in more detail below. The bunkering problem is not only depending on issues between bunker buyers and suppliers. The fact that the bunker is delivered in volume but paid for in weight is a cause of contention. This means that a recalculation of volume in to mass has to be made. For an exact recalculation from volume to mass, the exact temperature has to be known since the volume of a liquid is depends on temperature and density (Kamminga, 2013b).

However during the last few years the customer (represented by the captain, not the buyer) has been getting increasingly more involved. Often the Captain has some undeclared bunker hidden in a tank (sleeve oil), which he then "sells" to the bunker barge by signing a BDR with a higher volume than he has received. The bunker barge captain pays off the Captain in cash for his "services". This is very easy to do and very hard to avoid as everybody involved in the process have common interests and thus no dispute is reported (Malmbratt, 2013).

When further strategies are discussed it is implied that the oil is transferred/pumped between tanks on the bunker barge.

4.1.1 The Cappuccino effect

A problem that is specific for Singapore is aerated fuel, also known as the Cappuccino effect. It is formed when air is pushed in to the fuel and forms bubbles that increases the volume.

The air can be mixed in the barges tanks before the bunker is being delivered to the vessel or during the actual transfer. The air can be added via the pump or the pipeline, either with help from the compressed air equipment that normally blows through the pipelines after finishing deliver or a separate system (www.westpandi.com, 2012).

The first and easiest way of spotting the Cappuccino effect is to look down the tanks of the vessel. If it is receiving aerated fuel it is easy to see since the surface of the oil in the barge tanks should be clear as a mirror. If there are bubbles in there the surface is disrupted and frothy, see Figure 2. Normally the surface of the oil should be black and shiny like a mirror.

Figure 2. Aerated fuel in tank (Malmbratt, L)

Also observe the measuring tape while sounding the tanks, if the air is already added to the bunker this will show by the oil not being smooth on the tape ((Kamminga, 2013a). Not all vessels have visual access to the bunker tanks but a majority do, these needs to be screened as well, the sighting will be discovered in the same way as on the barge (Malmbratt, 2013).

If there is no visual access to the vessels bunker tanks, the aerated fuel will be discovered a few days later as the aeration dissolves and the volume in the tanks decreases quicker than the vessel is burning fuel (Malmbratt, 2013).

The bunker fuel in Singapore is not heated during delivery which means that the viscosity of the bunker in Singapore is higher than most other bunkering ports. This is a possible cause for the cappuccino effect as the higher viscosity can hold the imposed air bubbles better than warmer oil.

4.1.2 Tampered measuring tapes

Tampering with measuring tapes will give the impression that it is more in a tank on the barge than it is in reality. In Figure 3 it clearly shows on how this is done (Kamminga, 2013a). This has a big impact on the delivered amount

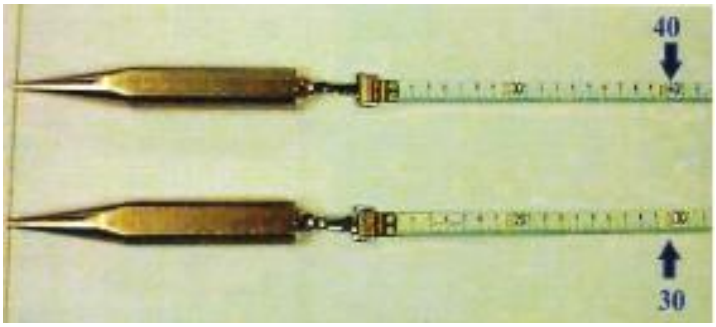

Figure 3. Tampered measuring lines (Kamminga, E)

4.1.3 Pre-signing of BDR

A technical chief might do two or three bunkerings a year, often this is performed in different countries. Every country has its own document that needs to be signed, often in the local language of the country of port that the vessel is situated. When the bunkering is prepared the technical chief normally receives a large amount of documents that needs to be signed straight away. If the supplier "hides" the bunker delivery receipt (BDR) in the pile, it can be accidentally signed even before the delivery has started. It is not easy knowing what all the documents are for and knowing the difference between the different ports and customs. If the BDR is signed, the receiving vessel has nothing to say or complain about if they do not receive the full amount of bunker (Kamminga, 2013b).

4.1.4 Line content - maintain vacuum in lines

When bunker is being delivered it is pumped through pipeline from the barge through to the vessel. To finish the delivery there normally is a line blow, this is a gush of compressed air to clean the lines and put the entire bunker in the receiving vessel. If a vacuum is kept instead, the oil in the lines is not transferred from the barge but stays in the pipes. The amount of oil

that stays in the lines is estimated to 30 metric tons and can later be transferred back into the barge (Kamminga, 2013b). For a buyer, 30 metric tons transfer to a loss of USD18 000, calculating with an average bunker price of USD600.

4.1.5 Not measuring barge tanks at all

In some cases the tanks of the barge is just not measured at all, due to various reasons (Kamminga, 2013a).

4.1.6 Only measuring nominated tanks

A full barge can deliver bunker to several vessels. A nomination of which tank is for which vessel is made before hand. The barge crew can refuse to sound the tanks that are not nominated to the receiving vessel and by not doing that bunker can be pumped from one of the nominated tanks to another tank without the receiving vessel being able to control if this is being done. When the final sounding is made the decreased volume in the nominated tank is the number that will be on the BDR even though the vessel has not received the full amount of stemmed bunker (Kamminga, 2013b).

4.1.7 Density shortage and temperature

As previously mentioned the bunker is delivered in volume and then recalculated into mass. This is done by multiplying density with volume and mass is given (density=mass/volume). Density is dependent on temperature, so if the temperature is higher or lower, the density will increase or decrease accordingly to the volumetric change of the fluid. Viscosity is also affected by temperature, oil flows easier at a higher temperature (Spitzer, 2013). A higher temperature on the bunker than stated on the BDR will result in the recalculation being incorrect and the delivered mass being lower than stated (Malmbratt, 2013). This is not a common problem in Singapore since oil is not normally heated here.

A density shortage may also be a sign of aeration of the fuel.

4.2 Identified strategies for minimizing discrepancies in bunker deliveries

A handful of options were identified as possible strategies to support to the bunker buyer. The different options are using a bunker surveyor, a bunker trader, a coriolis mass flow meter and utilizing the support that MPA contributes with. Some of the options involve a cost and this has to be put in perspective to what they bring to the transaction. Since the assistant director of the MPA recently made a statement where the MPA wishes to make the mass flow meters mandatory for bunkering in Singapore (Chew, 2013).

4.2.1 Bunker surveyor

A bunker surveyor is an independent third party that is hired to control the bunker delivery. When it comes to quantity the surveyor confirms the level and amount of bunker in the tanks of the barge and in the tanks of the vessel before and after the bunkering (Cockett, 1997). He or she should also take a drip sample of the bunker and analyse the water content of this since it affects the volume and the quality of the delivered bunker. High water content entails a lower volume of actual bunker. To ensure that the controlled volume is correct and the recalculation can be properly done, the surveyor should ensure that the barge provide the updated barge tank calibration tables (Cockett, 1997).

Using a bunker surveyor as an independent third party to overlook the bunkering process is a common way to try to minimize the risk of discrepancies. On the MPA website there is a list of 351 registered surveyors (Maritime and Port Authority of Singapore, 2013). The price that a bunker surveyor is charging is very different between different surveyors. Some charge 400-USD500 as a lump sum but the majority lies within USD1000-1500 for the first 8-12 hours and then an hourly cost if the surveying would go over that time (Sidhu, 2013).

A Singaporean surveyor should also be knowledgeable on how to see the signs of the cappuccino effect and other ways of withholding bunker. A bunker surveyor also controls the quality of the bunker but that part is not applicable for this thesis.

4.2.2 Trader

A bunker trader acts as a middle man between the physical supplier of bunker fuel and the buyer. The trader buys bunker from the supplier and sell it on to a buyer. It is beneficial for a buyer to use a trader in several ways. A buyer cannot go out with an enquiry to every supplier in the current port. By using a trader that is specialised in that port is channelizing the buying power by letting the trader contact the supplier and find the best price. The trader normally works in several ports and it is easier for a buyer to get a good relationship with a trader and work with them instead of several suppliers in different countries. A third benefit of using a trader is that if and when a problem occur the buyer has bought the oil from the trader. This means that the buyer will only have to deal with the trader, in which an existing good relationship stands and the trader deals directly with the supplier. The buyer also gets the terms of condition of the trader, which in some cases are better than the terms and conditions they would have gotten from the supplier (Malmbratt, 2013).

A trader sits as a buffer between the supplier and the buyer. This induces an additional cost on the bunker price, the amount depending on the trader. Normally the cost is a couple of dollars per metric ton with leeway both up and down (Malmbratt, 2013).

4.2.3 Coriolis mass flow meter

A coriolis mass flow meter measures the bunker by measuring the force from the acceleration by the liquid flowing towards or away from centre of rotation (www.flowmeters.com, 2013). The meter can work in both single- and two-phase flow operations. A single-phase operation is purely the bunker going through the system and two-phase is when the bunker is mixed with air and run through the system (Gregory, o.a., 2008). The fluid flow, the density of the bunker and the temperature of the line/outside wall of the meter is measured by most coriolis meters, while some can even measure the bunkers viscosity (www.flowmeters.com, 2013). By providing this information the recalculation from volume to mass should be able to be performed correctly. Also detecting on when air is within the bunker and to disregard the volume of the air should provide accurate volume of bunker at all time.

The mass flow meter can be installed on the bunker barge and/or on the vessel.

Only a few bunker barge companies in Singapore have a coriolis mass flow meter installed today. OW Bunker is one of them. By utilizing the service with the meter a buyer has to pay a higher price per metric ton. According to Per Funch Nielsen, the general manager of OW Bunkers physical division, the price is at Platt's Bunkerwire plus 5 per metric ton. The total increase in price for the buyer is then about USD20 per metric ton.

The cost of installing a meter on your own vessel is high. The meter itself cost around USD75 000. Then installations are about USD15 000. On top of that you need to get the meter calibrated, there must be wiring done from the meter to the bridge, pipelines, insulations et cetera (Malmbratt, 2013). The shipping company might not be able to work the vessel during installations so a loss of income must be taken in consideration.

An estimated cost was given during the ARACON2013 by Steve Jones from Emerson Process Management (producer of coriolis mass flow meters), he said that a installation of a meter with survey, equipment and all would cost USD125 000 and that he expected that those who chose to invest that money could get it back in 1-3 bunkerings if disputes occurred.

Figure 4 shows a schematic view (made in MatLab, the code can be reviewd in Appendix 3) over the development of expected bunker loss which normally is between 1-3 percent and in worst case scenario 5 percent. For the figure below, randomized value between one and five percent was taken and then the value of that loss in USD was calculated. This is plotted against the linear function of the increasing cost of using a flow meter (additional USD 20 per metric ton). The values used are the average price per metric ton of USD 600 (as mentioned in chapter 2.4.2, Pricing of bunker).

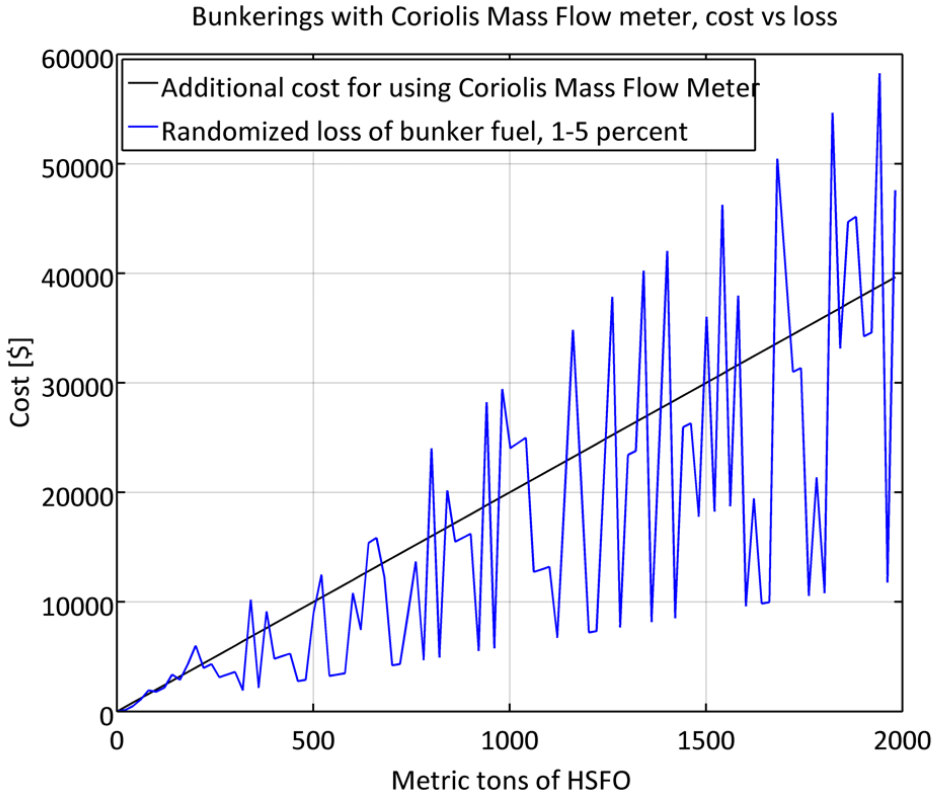

Figure 4. Comparison of expected loss of bunker versus additional cost of using flow meters

With the randomized values it proved to be hard to estimate if the usage of the mass flow meter pays off or if it is an additional loss of money. To get a clearer picture of cost situation, the randomized value between one and five percent was run 1000 times and then a mean

value was calculated. The results are shown in Figure 5. The mean value has stabilized to a straight linear function and according to the graph, if no intended discrepancy occurs the buyer will be losing money if he decides to use a barge with an installed mass flow meter.

When using a mean value of the expected loss the relation between expected loss and additional cost is clearer and as shown in figure 5, it is not paying off if no intended short-deliveries are performed.

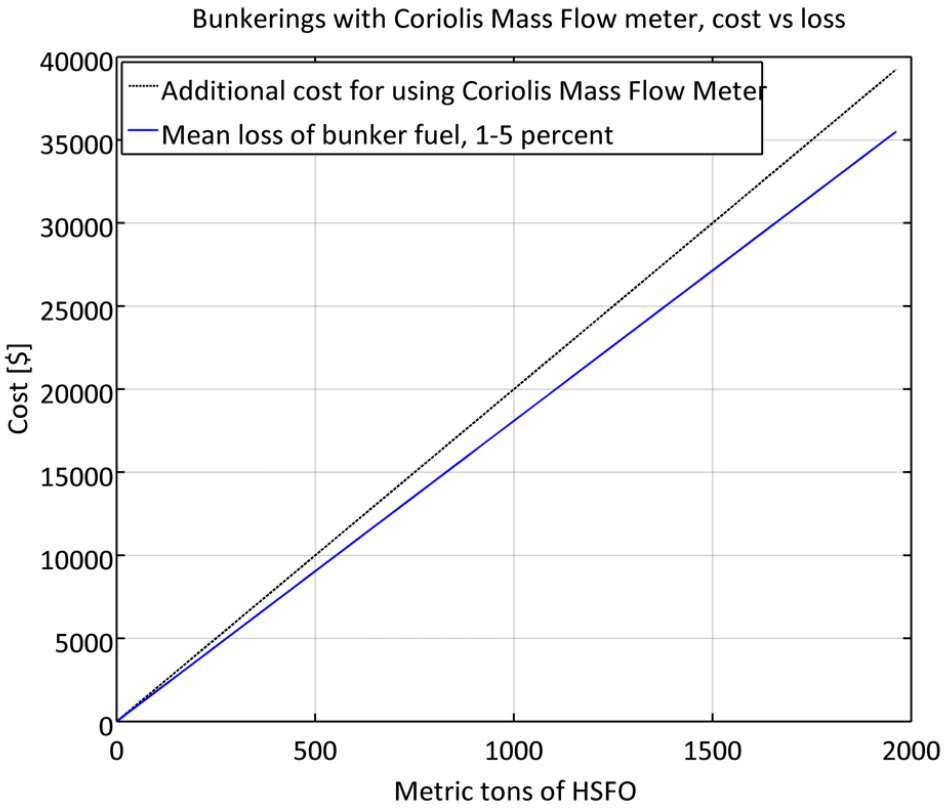

Figure 5. Mean value of the expected bunker loss versus the additional cost of using a coriolis mass flow meter

4.2.4 The Maritime and Port Authority of Singapore (MPA)

The Maritime and Port Authority is the government institution handling all the matters of shipping in Singapore. They are working for a better way to handle the bunkering problems in the port of Singapore by licensing the bunker suppliers and barge companies. This is ruled by a demerit system where all companies get evaluated and get points. If there have been any complaints or claims they will lose points and if the y lose enough points they will lose the license and no longer be able to operate (Maritime and Port Authority of Singapore, 2013).

If a buyer has a problem with a barge or supplier they can call the bunker helpline on 1800-Bunker. On the website the buyer can also find lists of licensed suppliers and barges, statistics for different suppliers and guides to handling enquiries and problems (Maritime and Port Authority of Singapore, 2013).

On the MPA website a buyer can control if a supplier and barge is licensed. There is also information about how much each supplier sells, total sale volume per year and the average tested value of different kinds of bunker fuel (Maritime and Port Authority of Singapore, 2013).

To get licensed or accredited (new or renewing) as a bunker supplier you have to meet three qualifications; a minimum capital of 200 000 Singaporean dollars, a quality management system so that the buyer is assured that they follow procedure during the supply chain of bunker sales and delivery. The last qualification to be met its reach the set Key Performance Indicators (KPI) to show that the supplier is holding a high standard. The components of the KPI can be seen in Appendix 4 (Maritime and Port Authority of Singapore, 2013).

MPA is also using a merit/demerit scheme. When a supplier receives or renews the license an allotment of 100 points for each KPI is given by the MPA. If the supplier is handling his business correctly and get no complaints or have no problems, the full allotment of points will be remaining by the end of the year. A clean period could also result in additional merit points to the supplier. However if the supplier has registered complaints points will be taken, if the average points is lower than 75 by the end of the year it will be difficult for the supplier to remain in the accreditation scheme. The claims and complaints are differently valued; this can be seen in Appendix 5. (Maritime and Port Authority of Singapore, 2013)

The terms and condition to make a claim to the MPA is different than the terms and condition to the trader/supplier. If a shortage is discovered you have 14 days to put in a claim to the MPA and Singapore Shipping Association and 30 days if the quality is not as agreed, then they will take action (Ostenfeldt, 2013).

4.3 Results from interviews –The functionality of identified strategies

The results from the interviews will be accounted for as short summaries in the matrix below (see Table 1.) then a comparison of said summaries from each respondent will be made. The respondents consist of a bunker buyer, a bunker surveyor, a government official and a bunker trader. They are only shown as respondents 1-4, partly to keep the confidentiality. The other part is to keep focus of the background of the respondent and put the focus on the answers. This is believed to give the reader a greater insight in the existing problem without a pre-conceived opinion based on the respondents' occupation.

	Bunker surveyor	Trader	Mass flow meter	MPA
Respondent no. 1	Good tool if you find the right one. Many registered surveyors, you tend to get what you pay for.	Good to use as a buffer and also to reach a wider market utilized in the right way.	Good technique and great asset if handled correctly it will most likely minimize disputes in Singapore	Slow, to scared to lose business to ports in near vicinity to make a bigger statement
Respondent no. 2	More crooks than honest surveyors, but still very important.	Not a necessity, would be better for the buyer to establish a direct contact with the market.	Not 100% foolproof and it is still depending on the barge crew to handle it appropriately.	To governed to make a real change and is too slow
Respondent no. 3	Good way forward but need to find an honest. It is only a temporarily solution for a bigger problem	Not a necessity but simplifies the process and could lead to reaching a wider market.	Good technique if correctly calibrated and maintained but easy to tamper with.	Working slowly, good with only one centralized governing body
Respondent no. 4	Necessary, but not always easy to find honest surveyors, you get what you pay for.	Easier way, good as a buffer but not a necessity, reaching a wider market.	Could work but is it worth the money	To slow to make an impact, hesitation to contact MPA since all processes freeze when investigated.

Table 1. Overview over respondents answers

4.3.1Evaluation of interview matrix

When respondents were asked about utilizing the services of a bunker surveyor they all agreed that it is a good strategy. They also agree on that there are difficulties finding an honest surveyor that would be unbribable.

As the interviewed bunker surveyor said *"...don't trust anyone, I don't even trust my own employees. That is how bad the situation in Singapore has become."*

A slight disagreement between the respondents started showing while the answers regarding bunker traders was analysed. No one of them considers it a necessity but it is established that it is a good and useful resource for the buyer. Neither one of them consider the trader as more than a buffer during a dispute. The trader will not significantly minimize the risk of discrepancy but it will simplify the process when dispute occurs.

The mass flow meter is a current subject to discuss and everyone have their own opinion regarding the functionality of it. The respondents all agree that the technique is good if monitored and calibrated accordingly but it does require a trust between buyer and supplier that does not exist today. Respondent number 1 has the most positive approach to the relatively new technique and presumes that it in the future will make a difference when the procedure is governed properly.

Covering the answers regarding the MPA the respondent's answers were again very similar. A common concern is regarding the approach the MPA have to handle disputes and the elongated process once a claim is reported. It is also implied in two of the interviews that the work with disputes are moving forward so slowly is because it is afflicted by the fear of losing business to other port.

Another opinion that was conclusive for all respondents is that the problem can not only be blames on suppliers and barge operators. It is equally the fault of the crew of the receiving vessels. The problem could not exist to the current spread if some vessels did not agree on accepting a short delivery in exchange for payment. According to the bunker trader *"...this can be clearly noticed when two vessels are arriving to Singapore on the same day, wanting the same amount of HSFO but get quoted different prices. The vessel getting the lower quote have previously proven to be more receptive for direct "agreements" with suppliers and barge operators"*

5. Discussion

5.1 Identified ways to short-deliver a vessel

The identified ways of short-deliveries can be divided in to three different groups; bunker fuel delivered with and increased volume, withholding bunker fuel on the barge and document fraud. The first group are the ways where the problem is density like Cappuccino bunker. This is a specific problem to Singapore and can be hard to manage for crew onboard vessel that only transits Singapore a few times each year. The cappuccino bunker can be detected by inspecting the tanks of the receiving vessel if that is possible. However the legislation in Singapore obstructs the receiving vessels potential to win a claim.

The second group is where bunker is intentionally not being delivered to the receiving vessel by keeping fuel in the lines or not measuring tanks the right way (e.g. vacuum in lines, tampered measuring tapes etc). This is partly due to not updated equipment and the lack of education of the vessels crew members. If a crew member is not aware of the potential procedures for short-delivery he or she can not actively work to prevent it. Another cause that was touched upon by all the respondents is that some crew members could be involved.

The signing of the BDR before the bunker fuel is delivered is fraud, as the amount is already filled in the form without the barges master knowing how much was actually transferred to the receiving vessel. But due to the standards of Singapore, the SS600:2008, if the BDR is signed then the vessels master has approved the deliver and the barge is free to go.

5.2 Identified strategies for precautionary actions against short-deliveries

In theory the short-deliveries could be corrected by using the identified strategies that are widely available for a bunker buyer. For example a correctly installed and calibrated coriolis mass flow meter on the barge should detect all density and temperature issues, it should also show if there is a shortage. If installed on the receiving vessel the buyer would know if a short-delivery was performed but still not be able to make a claim if the numbers from the barge differs due to the legislation. Based on the results from the interviews and the graph, the cost of installing a mass flow meter exceeds the gain and function. It would be more economically viable to use a bunker surveyor. The additional cost charged for using the meter surpasses the cost of using a surveyor. It is also an issue of trust, a mass flow meter installed on the barge could be tampered with. It is no different from trusting the soundings would be an exact measure.

The use of a surveyor is the most hands on way of overlooking the delivery. Having a third party independent representative present should ensure the accuracy of the delivered bunker fuel by controlling tanks, equipment and the oil. This could be assumed to be the best option. A well educated surveyor knows the different ways a supplier might try to withhold bunker fuel from a vessel and can save a shipping company money. But according to the interviews there is a problem finding a bunker surveyor that is honest. With recent developments in the market with prices are being negotiated some surveyors might turn to unscrupulous activities.

Based on the results from the interviews it seems as if the usage of a bunker trader is to simplify buying process and facilitate if a dispute should occur. A trader implies an additional cost to all bunker purchases. For the buyer the result is to reach a larger part of the market

through a channel that is better informed on the daily state of the market. The trader is most likely having better contacts with suppliers and the latest updates. The trader can then inform the buyer if there are any ongoing claims and disputes regarding certain suppliers and try to make the deal with a supplier that has a good reputation.

However when money is involved and buyers are using traders to push the prices down further, the trader cannot always guarantee that the best reputed supplier will be used. Even though the trader buys the oil from the supplier and sell it to the buyer, they have no influence over the delivery of the bunker to the vessel so no control of identified short-delivery procedures can be done. But a good relationship between buyer and trader that ensures future business for the trader could potentially lead to better prices and easier handling of the disputes. What has to be considered is if the simplification of the buying and delivery process is compensating the additional cost on the bunker price.

The interviews revealed that the confidence in MPA is low even though they are making a slow progress on handling the disputes. MPA can be used as precautionary action by using the information regarding suppliers and barges that is available on the website. They can also be contacted via the bunker help-line if a dispute arises. The general consensus of the respondents answers is that when MPA has been contacted the situation freezes, both on the supplier and trader side. This makes many buyers and traders reluctant to utilize the services provided by MPA. A result of that is also that not all claims are being reported and the real extent of the problem is not realised.

5.3 Are the strategies working in a satisfactory manner?

The source of the problem is a mutual trust issue between buyer and supplier and distrust for the governmental institution created to govern these disputes.

Installing a mass flow meter on a barge and believe that the problem is solved is not a plausible assumption. From a bunker buyer's point of view it should be as easy to tamper with the mass flow meter as it is to tamper with measuring equipment or pumping air into the bunker fuel. If a meter is installed on the receiving vessel the numbers can be compared but the buyer can still not base a claim on the figure received from the vessel due to the legislation.

However being able to compare figures from the barge with "your own" meter can provide estimation on how much bunker is disappearing and see how big the economical loss is an advantage. A bunker buyer can then compare different suppliers and buy where the losses are the smallest. What needs to be taken into consideration is the education of the crew members so they know how to use the meter properly. The regular exchange of crew aggravates the continuous training and information will be lost. The decision if the investment is economical feasible must be made, considering that the equipment is not taken full advantage of and the figures provided will not strengthen the ability to make a claim.

Finding a good independent third party is a trial and error procedure. The competition is high between surveyors as well as suppliers and unscrupulous activity exists amongst surveyors too. A good bunker surveyor compensates the cost fairly quickly. Assuming the buyer pays USD1200 per the first 8 hours and then USD100 for the following six hours gives a total sum of USD1800. That is the average cost of three metric tons. If a surveyor prevents any of the identified ways of short-delivery the bunker buyer is going plus. A surveyor also controls the

sounding of the tanks and theoretically should “find” enough bunker fuel to “pay” for his visit.

Good surveyors can be recommended by other shipping companies or by seeing when bunker prices increase. Some supplier will not work with certain surveyors or charge more per metric ton, the author assumes that this is due to the thoroughness of the surveyor. Bunker traders might be of assistance in the buyer’s choice of surveyor in a specific market. The trader works closely with many suppliers and must have an extensive knowledge of the market to be successful. Creating a good relationship with a trader might not prevent discrepancy directly but lead to positive side effect such as better pricing and terms and conditions. A relationship based on recurring business might result in easier claim handling. It is more beneficial for a trader to have a happy, returning customer than a dissatisfied customer and find themselves in a middle of a dispute.

If the trader cannot solve the issue the bunker buyer can turn to the MPA. The recent statement regarding the potential mandatory mass flow meters make is met with scepticism according to the respondents. To ensure all 214 licensed bunker barges are equipped with the meter will take time and money. A consideration regarding the barge operators that cannot afford a new investment, what side effects might that cause on the ability to bunker in Singapore. One might also want to consider who is going to provide all the mass flow meters and if that supply can keep up with the demand. A possible effect could be that the bunker buyer might see an increase the bunker price or not being able to take bunker without waiting times. This might result in a movement in bunkering vessels to ports close by.

Previous many buyers were given a discount when purchasing fuel in Singapore. The divergence from Platt’s might be considered as a replacement since the buyer can see that the price provided is under market value. By using several traders for one stem, buyer push the bunker price down and can sometimes buy bunker delivered by a barge for less than supplier/ trader can buy ex-wharf. Sometimes the difference is covered by traders accepting a loss to maintain a long-term relationship with a buyer. If the supplier is not delivering the stemmed quantity the buyer has to consider if the loss is compensated by the “discount” given.
For bigger shipping companies that have a separate bunker department, the bunker buyers are normally well informed about the existing issues and are working actively to prevent them. The operator that has contact with the vessel is not informed and can then not inform the vessel about the situations and the issues in the current port. A chief engineer that have never bunkered in Singapore before, cannot be aware of all the “tricks of the trade” and how to be able to spot the signs of potential short-deliveries. The knowledge about the current state of the bunkering situation in Singapore must be established through all ranks. If the crew members are updated it will be easier to spot the tell-tales of short-deliveries and together with the established strategies could potentially lead to a more stable market.

A good combination of legislation, equipment and people can make the market in Singapore more transparent. A surveyor controlling the usage and accuracy of the mass flow meter can provide a more exact way of measure the quantity that is transferred. But it still needs to be governed and not as a perfect solution. Where money is involved there is always a risk of corruptness.

The authors own reflections from working as a bunker buyer is that buyers are a part of the problem. There is prestige in getting a price far below market value and Platt’s. And during the 20 years this issue has existed very little has been done to prevent it. A perception from

writing the thesis is that most people in the business are more than happy to talk about the problem but they don't want to see any changes that might increase the price. The problem must be looked at from both sides, it is not only the supplier side that needs a change. An idea that might be worth looking at in the future is if bunkers can be delivered in mass and paid for in mass. That would rectify the majority of the stated procedures for short-delivery.

5.4 Method discussion

5.4.1 Evaluation of references

Evaluating the references and sources in thesis is based on three key words; Reliability, validity and objectivity (Lunds tekniska högskola, 2013).

As previously mentioned the selection of respondents was based on successful and recommended people with extensive experience in the trade. With the combination of similarities in the interviews and their experience they are believed to be reliable sources for the information. The information was also comparable to the secondary data that was collected which further confirms the respondents' reliability.

A possible contradiction to the reliability is that it could be problematic to re-create the results and answers from the interviews. The author continuous contact with the respondents over a couple of months and had previously worked with some. This was favourable for building up a rapport with them and to make them feel comfortable during the interview process.

If another selection of respondents was chosen would the outcome and the result been different? An assumption can be made on the similarities of the respondent's answers and the dissimilarities of the respondents that the result would have been alike. Consideration was made when selecting the respondents to not use people from the same area of expertise or the same area of business. It was also established that the respondents have little or no contact in between each other.

As the stated problem is both complex and sensitive it is important to look at the validity of the collected information. Both the primary and secondary data needed to be filtered to reach the core values and this was done by triangulate the data. This is a method where contrasting sources are used (Denscombe, 1998), hence the array of respondents and the articles. But the choice of method is also supporting this due to that a qualitative research is to an extent permissive with ambiguous results and contradictions (Denscombe, 1998).

If the thesis had a longer allowance for time the validity could be tested by field studies (Denscombe, 1998).

Objectivity is the hardest part to evaluate. Can the respondent gain anything by not telling the truth or angling their answers? The information collected was compared to the articles and what the other respondents said in their interviews and by that a selection of information was discarded that were deemed to be too misrepresenting of an impartial case.

Although while analysing the results from the interview the answers from the respondents were very similar, one has to ask themselves if the selection of respondents was based on a variety of people within the business or is the situation is quite one sided.

The objectivity of the author also has to be controlled. In this case the author works as a bunker purchaser for a larger shipping company. This can lead to a certain tendency to angle the information due to the previous knowledge about the subject is based on loosing large sums of money. This has been taken into consideration, since the thesis is also supposed to be a tool for a buyer on how to evaluate the available techniques and services on the market. There are also advantages for the author the be slightly partial, while working with bunker purchasing, a bigger insight in the previous stated problem is developed and the understanding will help to look at different options from more than one side.

The author had a work relationship with the respondents before the thesis. This influences how the author analyses the data received from interviews. The respondents were chosen due to the good reputability and also because the author felt confident in their experience. This could lead to that the author put more trust in the result from the interviews than if there were no existing relationship. However the replies from the separate respondents were so alike so it could be assumed that they were good representatives of the trade and that their answers were valid.

5.4.2 Evaluation of method and outcome

The chosen method is still believed to be the appropriate method of evaluation. A quantitative thesis could have been prepared by only comparing costs and volume. But to reach the core of the problem and to look at possible, functioning techniques the qualitative approach is more thorough and beneficial.

The method used when performing the first interviews with Mr Kamminga was not structured. To do a telephone interview with a person that has a significant experience and knowledge about the subject the decision was made to let it be unstructured. Letting the respondent talk freely about the business, the market, problems, strategy and processes gave a much wider knowledge and understanding about the subject and elucidated problems. When the opportunity arose to perform a second and personal interview, it was also allowed to be of an unstructured format. The interview was more of a discussion of previously touched upon subjects where the author was given the opportunity to deepen the previously collected and analysed information. This primary data is the foundation for the thesis; it is also the base for the information and the secondary data in the theory part. It is both unconventional and not according to guidelines for the chosen method but an assessment was made that this would bring better and more in-depth information.

The disadvantage of not controlling the interview as planned is that the amount of information given is more wide spread topically, which takes longer to analyse. All respondents did not touch on all the main point during the interview. This led to follow up questions via email. All the collected information was critically and objectively processed, with the emailed information even more so. There is always a difference on how information is provided face to face and through electronic means and also depending on the relationship between interviewer and the interviewee (Denscombe, 1998).

The location where the interviews were performed was well deliberated. It might have been favourable to take the respondent out of the work environment to create an openness and feeling of ease. Due to the short amount of time in Singapore they were performed in the office. But considered the already existing rapport with the interviewer, this was compensated.

One big setback while performing the interviews was the meeting with the MPA. Instead of a personal interview they held a presentation about their port system. An email was given to a government official to contact regarding the bunker problem and attempts were made to contact him, but unfortunately they were not interested in participating further.

6. Conclusions

The conclusion of the thesis is that there is no foolproof way to protect a vessel from quantity discrepancies. Attempts can be made by hiring third parties but the real solution lies in market transparency and knowledge.

The long-term goal to improve the market in Singapore could be done by improving the overall knowledge of the situation. The crew on board should be informed on the expected issues to be able to assist the potentially hired bunker surveyor. With the knowledge some of the more simple ways of quantity discrepancies can be redressed, like pre signing the BDR or not checking the tanks. This could put pressure on the suppliers; a well informed technical chief and crew are harder to fool. Maybe different kinds of incentives will minimize the desire for extra money on the side. This is a different matter that should be further invested.

The transparency of the industry and market is also important. This is can be helped with knowledge and education about the problem and future research to find new technical devices that could assist. Also to help MPA to develop and be able to control the market better, for the buyers to report the issues they are having, both with barge companies, suppliers, surveyors and traders. A more firm control of these could potentially lead to a stricter policy in delivery and to make this information easily accessible for the buyer. The consequence is a possible increase in price but to pay more and get what is stemmed should be a positive outcome and a break even.

The short term goal attempting to minimize the potential losses for a shipping company that originates in paying for bunker that is not delivered is to find a good, honest surveyor. Use the contacts available through traders and other shipping companies. The direct effect will most likely be an increase in cost for bunkers and the process. A better surveyor will cost more, a trader that knows the market should stop when less accountable suppliers is the only ones providing prices, report to the MPA and use the information available on websites.

To sum up, the issue is a part of the solution. It is a question of trust and relationships and has existed since the market was opened in 1985. There will not be a simple solution or a foolproof way to stop this. There is still no solution to the problem through procedures or technical development, even though 20 years have passed since the problems started to occur. So the question has to be made; does the market really want a solution?

6.1 Future research

Future research should be focused on how to manage the relationship with the crew on the vessel and how the potential deception is performed from that side. Also researching how the amount of stakeholders involved in the running of a vessel is affecting the ratio of short deliveries would provide an interesting angle on the problem. Managing the internal issues is the first step of disentangle quantity problems within Singapore and other ports. An opinion is that the quantity issues in Singapore are not as much a technology issue as it is based on mistrust and future research should reflect that.

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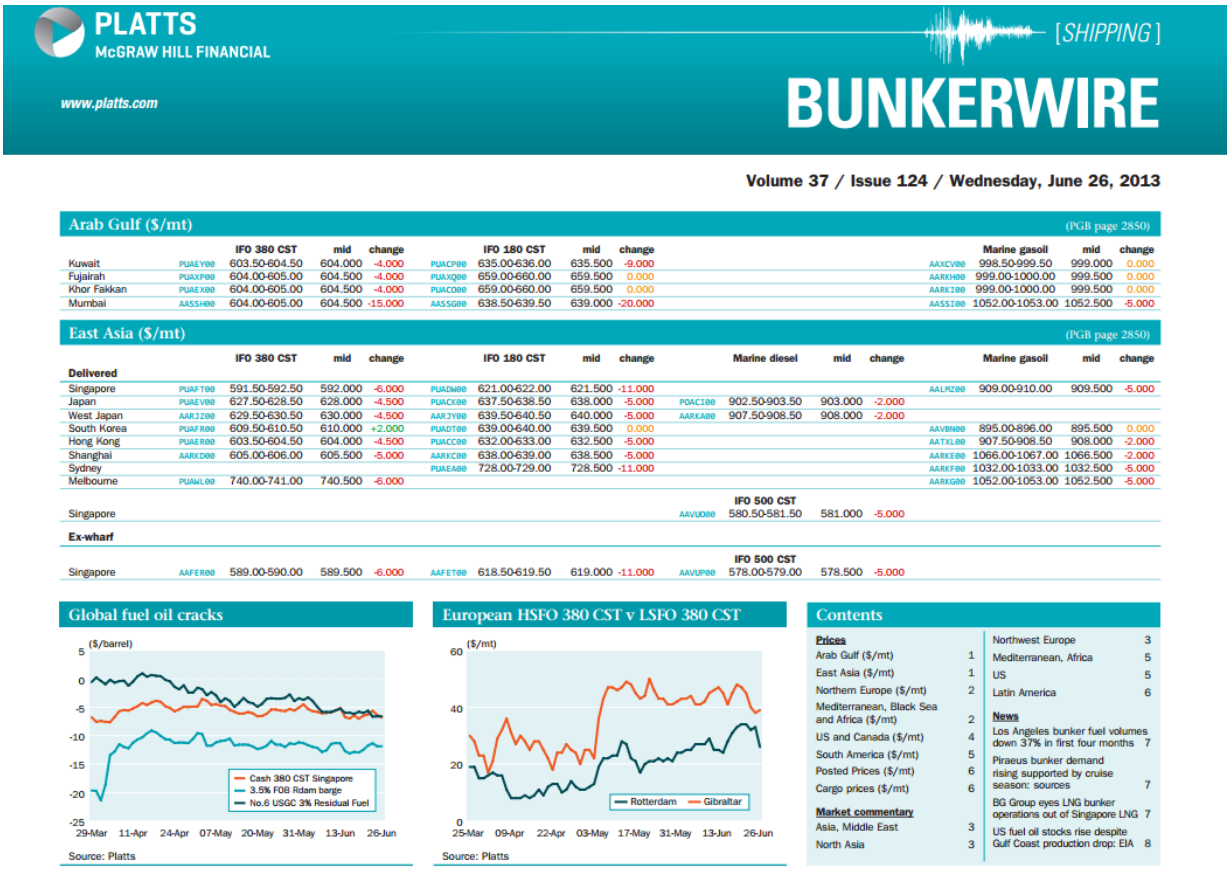
Appendix 1.



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Arab Gulf ($/mt) (PGB page 2850)

		IFO 380 CST	mid	change		IFO 180 CST	mid	change			Marine gasoil	mid	change
Kuwait	PUAEY00	603.50-604.50	604.000	-4.000	PUACP00	635.00-636.00	635.500	-9.000		AAXCV00	998.50-999.50	999.000	0.000
Fujairah	PUAXP00	604.00-605.00	604.500	-4.000	PUAXQ00	659.00-660.00	659.500	0.000		AARKH00	999.00-1000.00	999.500	0.000
Khor Fakkan	PUAEX00	604.00-605.00	604.500	-4.000	PUACO00	659.00-660.00	659.500	0.000		AARKI00	999.00-1000.00	999.500	0.000
Mumbai	AASSH00	604.00-605.00	604.500	-15.000	AASSG00	638.50-639.50	639.000	-20.000		AASSI00	1052.00-1053.00	1052.500	-5.000

East Asia ($/mt) (PGB page 2850)

		IFO 380 CST	mid	change		IFO 180 CST	mid	change		Marine diesel	mid	change		Marine gasoil	mid	change
Delivered																
Singapore	PUAFT00	591.50-592.50	592.000	-6.000	PUADM00	621.00-622.00	621.500	-11.000					AALMZ00	909.00-910.00	909.500	-5.000
Japan	PUAEV00	627.50-628.50	628.000	-4.500	PUACK00	637.50-638.50	638.000	-5.000	POACI00	902.50-903.50	903.000	-2.000				
West Japan	AARJZ00	629.50-630.50	630.000	-4.500	AARJY00	639.50-640.50	640.000	-5.000	AARKA00	907.50-908.50	908.000	-2.000				
South Korea	PUAFR00	609.50-610.50	610.000	+2.000	PUADT00	639.00-640.00	639.500	0.000					AAVBN00	895.00-896.00	895.500	0.000
Hong Kong	PUAER00	603.50-604.50	604.000	-4.500	PUACC00	632.00-633.00	632.500	-5.000					AATXL00	907.50-908.50	908.000	-2.000
Shanghai	AARKD00	605.00-606.00	605.500	-5.000	AARKC00	638.00-639.00	638.500	-5.000					AARKE00	1066.00-1067.00	1066.500	-2.000
Sydney					PUAEA00	728.00-729.00	728.500	-11.000					AARKF00	1032.00-1033.00	1032.500	-5.000
Melbourne	PUAWL00	740.00-741.00	740.500	-6.000									AARKG00	1052.00-1053.00	1052.500	-5.000
										IFO 500 CST						
Singapore									AAVUO00	580.50-581.50	581.000	-5.000				
Ex-wharf																
										IFO 500 CST						
Singapore	AAFER00	589.00-590.00	589.500	-6.000	AAFET00	618.50-619.50	619.000	-11.000	AAVUP00	578.00-579.00	578.500	-5.000				

Global fuel oil cracks

Source: Platts

European HSFO 380 CST v LSFO 380 CST

Source: Platts

Contents

Source: http://www.platts.com/IM.Platts.Content/ProductsServices/Products/bunkerwire.pdf

Appendix 2.

Extract from SS600 code

"1.14.1 The delivered quantity shall be based on the bunker tanker's tank gauging and calculations as witnessed by both the cargo officer and the chief engineer. Where flow meters are used instead of tank gauging, the flow meter readings as witnessed by both the cargo officer and the chief engineer shall be used for the quantity delivered

1.14.2 The chief engineer shall verify the delivered quantity as stated in the bunker delivery note. The chief engineer is strongly advised to witness the tank gauging of all the cargo tanks on the bunker tanker after completion of the bunker delivery. The calculations shall be based on the opening and closing gauges of the bunker tanker's tanks and the cargo temperatures as witnessed by both the cargo officers and the chief engineer. The bunker tanker's certified tank calibration tables and ASTM D1250 Petroleum measurements Table 54B and Table 56 shall be made available by the cargo officer

1.14.3 The bunker tanker shall only carry its latest certified tank calibration tables, an identical copy of which has been deposited with the implementing authority of this standard. The cargo officer shall allow the chief engineer to make photocopies if the relevant pages if the chief engineer so requests."

Appendix 3

```
clear all
close all
clc

x=linspace(0,2000,1000); % Antal bunkringar

S=randi([1 5],1000,1)./100; % Slumpm‰ssigt svinn av br‰nsle mellan 10-50 ton

P=600; % Br‰nslekostnad per ton
E=20; % Extrakostnad vid anv‰ndning av flˆdesm‰tare

A=x*E;
B=x'.*S*P;
Mean_S=mean(S);
Mean_B=x'.*Mean_S*P;

C=x*(E/P);

figure(1)
plot(x(1:10:1000),A(1:10:1000),'k',x(1:10:1000),B(1:10:1000),'LineWidth',4)
set(gca,'FontSize',16)
set(gca, 'YTickLabel', num2str(get(gca,'YTick')','%d'))
legend('Additional cost for using Coriolis Mass Flow Meter','Randomized loss of
bunker fuel, 1-5 percent','location','NorthWest')
title('Bunkerings with Coriolis Mass Flow meter, cost vs loss')
xlabel('Metric tons of HSFO')
ylabel('Cost [$]')
grid on


figure(2)
plot(x(1:20:1000),A(1:20:1000),'k--',x(1:20:1000),Mean_B(1:20:1000),'LineWidth',8)
set(gca,'FontSize',16)
set(gca, 'YTickLabel', num2str(get(gca,'YTick')','%d'))
legend('Additional cost for using Coriolis Mass Flow Meter','Mean loss of bunker
fuel, 1-5 percent','location','NorthWest')
title('Bunkerings with Coriolis Mass Flow meter, cost vs loss')
xlabel('Metric tons of HSFO')
ylabel('Cost [$]')
grid on
```

Appendix 4.

KPI	Components	Weightage
Craft Operations Records(COR)	• Collision / Crew injury • Pollution to sea • Compliance with bunker tanker standards • Others	15%
Bunker Supply Records (BSR)	• Compliance with SS 600	70%
Customer Feedback Records (CFR)	• Customer feedback on every bunkering operation	15%
Total		100%

Appendix 5.

Merit and Demerit Points of KPI		
KPI	**Demerit Points**	**Merit Points**
Craft Operations Records (COR) (a) Collision / Crew Injury (b) Pollution to Sea (c) Non-compliance with bunker tanker standards (d) Others	With adverse records Max. 20 Max. 20 10 10	With no adverse records • With no adverse records for COR : 10 • Additional (non-mandatory) Training conducted : 10
Bunker Supply Records*1(BSR) Compliance with SS 600: (a) Serious Non-compliance (b) Moderate Non-compliance (c) Minor Non-compliance	40 20 5	)) 10)
Customer Feedback Records (CFR) Annual average rating by customers*2: (a) Below 2.0 (b) 2.0 – 2.9 (c) 3.0 – 3.9 (d) 4.0 and Above	 50 30 - -	 - - - 10

Notes:

*1: For BSR,

- Minor Non-Compliance (NC)
  1. 1st NC (Letter of Advice – No demerit point),
  2. 2nd NC (Letter of Caution – No demerit point),
  3. 3rd & subsequent NC (Letter of Warning with 5 demerit points)
- Moderate NC – Letter of Warning with 20 demerit points
- Serious NC – Letter of Warning with 40 demerit points for each NC.

*2: Bunker suppliers shall obtain from the master or chief engineer of the vessel receiving bunkers their satisfaction level of the bunkering operations. Customer's satisfaction level on the bunker deliveries will be assessed on a scale of 1 to 5. The rating 5 denotes 'Very Satisfied' and the rating 1 denotes 'Very Dissatisfied'. Suppliers should key in the customer feedback for every bunkering operation into the MPA system when declaring their bunker operations through Marinet to MPA.
The standard format of the feedback questionnaire is as follows: