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The importance of Dry docking in the Maritime Industry

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ABSTRACT

Amutenya, Malakia: The Importance of Dry Docking in the Maritime Industry
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This thesis gives guidance about the importance of dry docking and focuses on the benefits and procedures. It is targeting shipping companies and maritime future chief engineers. With the help of data collected from articles, maritime experts, and organization websites that deal or manufacture equipment, and machinery related to maritime industries in case of maintenance.

This thesis gave clear guidance or understanding to shipping companies and other vessel holders as to why they should consider taking dry docking as one of the important tasks in their company structures and considering the marine environmental structure and the life cycle prolonging of the ship and avoiding unnecessary financial damage in their prospective companies. Data was collected from sources such as organization websites, interviews, and articles based on the importance of dry docking. Information was collected to contribute to and support the thesis.

This thesis emphasizes the importance of dry docking, and it focuses on the benefits and Reasons for dry docking, Economic strategies, why ships have to be docked, different types of dry docks, environmental factors, and the performance and efficiency of vessels after dry dock and factors to consider when scheduling for dry docking and regulations based on SOLAS.

Additionally, Reasons for dry docking were the main priority in this thesis as it stipulates the main purpose of why ships in the maritime industries must adhere to the mandatory dry-docking by the cargo ship safety construction rules amended in 1974 by SOLAS.

Keywords: Dry-Docks, Budgets, IMO regulation amended by SOLAS 1974

FOREWORD

I want to give some graduates to the following people for their input toward this thesis, Kauko Kimmo the thesis supervisor, Antti Numminen marine surveyor, Mr Paulus Andela Senior Marine Superintendent Erongo Marine Enterprises (Pty) Ltd and Markus Syvanen technical superintendent at ESL Shipping.

CONTENTS

1 INTRODUCTION

Dry docking is a crucial factor in the maritime sector, especially for companies that own vessels or fleets, this process involves removing ships from the water to have excess to parts which cannot be maintained or fixed during ships operation such as the hull, rudder, propeller blades and all parts on the ship that are always fully submerge and cannot be repaired when the ship is in the water or during operation. There are factors that contribute to the importance of this task, and companies should adhere to them to keep their vessels healthy for operation. These are structures such as reasons for dry docking, economic strategies, why ships must be docked, different dry-docking methods, and environmental factors.

This thesis will mainly focus on the reasons why shipping companies need to consider dry docking and the benefits they get from this operation. Looking at major factors to prevent or avoid things that can lead to the downfall of the company asset which in this case are the vessels. Economic strategies play a huge role in a company when ships are preparing for and during dry docks. There are factors to look at to make sure the shipping company does not overspend or over budget by keeping the ship in a seaworthy manner. There are always points, regulations, and amendments to follow in the maritime sector which contributes to why ships need to visit dry docks. There are different types of dry-docking methods in the maritime world which all perform the same purpose of repairing, cleaning, and making sure the floating steel structure is in good shape. Considering the best method depends on the company's plan, financial budget, and geographical location and safety of the country where the dock is located. Environmental factors play a crucial role and there are procedures to be followed by shipping companies to keep the marine industry healthy for future reference.

With the help from industry experts, this thesis covers and gives clear feedback on why dry docking is so important in the maritime sector. Focusing on shipping companies, tackling reasons for dry docking, and looking at the importance of why ships visit dry docks. Touching on different options for dry docking by considering the best method that will benefit the company. Economic strategies need to be followed to keep the company stable and in operational standard during dry docking, and paying attention on the environmental factors.

2 REASONS FOR DRY DOCKING

Ships that are well maintained and well serviced tend to have a prolonged life cycle and for your company to achieve this, dry docking should play a crucial role. Dry docking is a well-planned strategy that involves a ship, as it is removed from the sea and placed on a dry land where its parts that cannot be excess when the ship is submerged in water are cleaned, repaired, and maintained. These are safety equipment, navigational systems, watertight equipment such as Hull, and propulsion systems such as engines, Rudders, chain lockers, stern tube seals, and propellers. According to (Sohar Shipping Transport and Trading Agencies L.L.C website, 2023) “One of the primary purposes for which ships undergo dry docking is for maintenance purposes. Over time, wear and tear can damage various components of a ship, including its hull, propellers, rudders, and engines (Sohar Shipping Transport and Trading Agencies L.L.C website, 2023).

The reason why ships go for dry dock is to comply with mandatory IMO regulation, under the cargo ship safety construction rules amended in 1974 by SOLAS (Marine insight website retrieved, 2024.). These are regulations implemented by IMO and all vessels need to be seaworthy for them to be granted permission to sail, by adhering to standard safety procedures. These kinds of regulations are monitored at shipyards by a registered classification con-

tractor, and they make sure the fleets are in good shape and prevent them experiencing problems during their operation routine.

Dry docking is essential for preventive maintenance which cannot be carried out during normal operation. Also, some of the mandatory class surveys require dry docking and there are different types of surveys done at the dry dock, such as Annual surveys, Intermediate surveys, special surveys, and Surveys outside the ship's bottom.

Figure 1: Example of a dry dock (Rak, 2023)

- Annual Surveys: An annual survey is conducted by carefully inspecting the equipment of the ship following certain classification rules. The main purpose of this inspection is to make sure the equipment inspected adheres to and performs well during the operation (Passenger Ship Surveys IMO website, 2013.)

  The goal of the survey is to confirm that the ship possesses, at the very least, and technical standard that complies with current regulations.

The intentions behind them, and that safety work and a safety culture are an integral part of daily work, enabling the crew to operate the ship safely and respond appropriately in the event of an accident. (Passenger Ship Surveys IMO website, 2013.)

There are certain criteria that ship owners or shipping companies should adhere to during the Annual survey:

- That the ship and its equipment are in good functioning order to prevent accidents as much as possible or to be able to handle them.
- In worst-case situations is the crew prepared and well equipped with knowledge.
- That the social, health, and safety circumstances of the personnel are managed.

Figure 2: Example of a surveyor doing inspection (INSPECTION | GENMARSUPPLY - Maritime Ship Supplies, 2018.)

- Intermediate surveys**:** This inspection is carried out by a well-trained surveyor who inspects mainly the ballast system and checks if it operates as required by the standard condition or regulation amended by IMO. (Mayor, 2013.). “The main idea of this kind of survey is to give a

brighter answer that the condition of the vessel is well kept to a satisfactory standard” (Shafran 2024).

- Special surveys**:** Special surveys also known as renewal surveys are designed to ascertain whether the technical state of the ship and the structural and compositional adjustments made to its components meet the criteria of the record of survey regulations., the special survey occurs mostly at dry docks where a vessel is fully inspected, by checking the conditions of the vessel and whether it complies with the classification regulation. (RATSON Ship Building, 2018.)

  There are numerous steps involved in the class renewal procedure. Both a rigorous in-water and an extensive out-of-water examination are included in the item. These procedures are required to guarantee that the primary engine, the structure, and the necessary ancillary machinery all comply with the regulations. Verification will also be required for the vessel's equipment and systems. The vessel's classification must be maintained; hence this procedure is required. Consequently, if the vessel's condition continues to fulfill the class standard, the class will need to reclassify. (RATSON Ship Building, 2018.)

- Survey outside ship bottom**:** This kind of survey can only be carried out during dry dock, where the ship is completely out of the water and its bottom can be accessed (Mayor, 2013.). During this kind of survey, a ship must be positioned on blocks tall enough and with the right staging when it is in dry dock or on a slipway to allow for the inspection of components such as the propeller, sea chests, and valves, stern frame and rudder, and shell plating, including bottom and bow plating. (Mayor, 2013.)

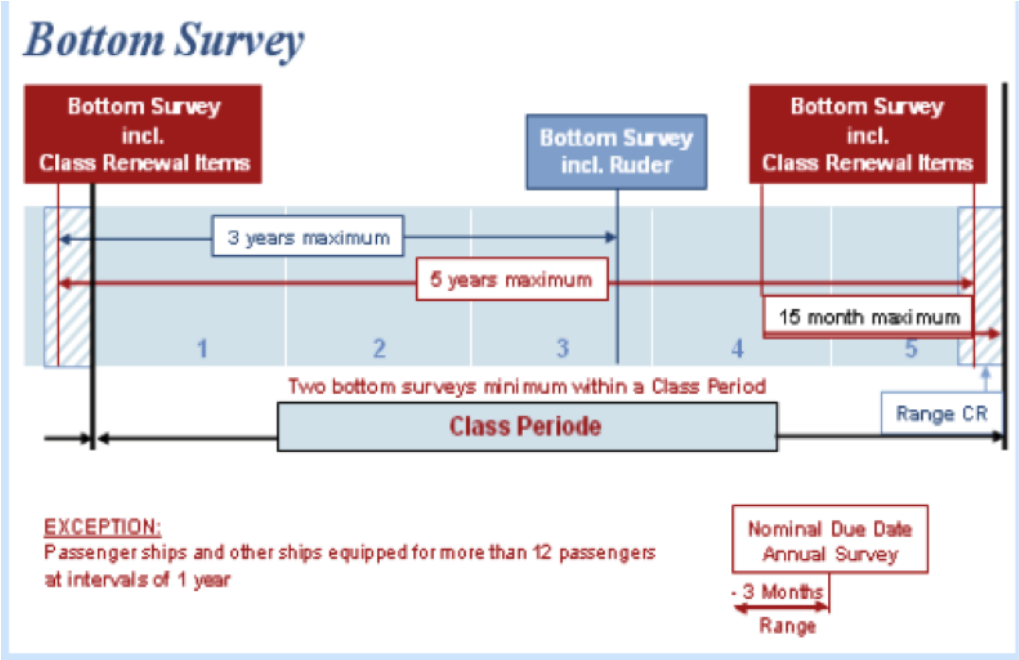

Figure 3: Example of survey diagram focusing on bottom of the ship (survey-dry-dock- SHM Blog, 2017)

3 ECONOMICAL STRATEGIES DURING DRY DOCKING

Due to the high cost of dry-docking, ship owners must carefully plan their budget for the necessary repairs. Unexpected improvements or repairs may raise the cost of the ship during maintenance at the docks, so having a back-up plan in place is crucial (Marmedsa, 2023.). Economic strategies are planned and organise by the company based on their financial budget for the ship during dry docking and monitor the factors that might affect the budget. There are financial factors for the shipping company for example, budget, Cost group, Cost parameters, and Work breakdown.

Figure 4: ship on block in dry dock (Wilhelmsen, retrieved 2024)

3.1 Financial factors for shipping companies during dry dock

Observing the financial constraints there are factors to look at, when setting up a financial budget for the ship before dry dock. The importance of setting up a budget is that dry docking is usually a comparatively expensive process, and in addition, the vessel does not make money during dry docking. Companies consider dry docking as an investment for the future. During dry docking, shipping companies spend huge sums to maintain and repair their vessels. Considering the financial factors when performing dry-docking, every ship in service must adhere to a routine maintenance procedure known as "dry-docking," which is a periodic, scheduled overhauling procedure primarily established due to the unique characteristics of the ship's underwater operational environment. Hundreds of thousands, sometimes even millions, of dollars might be spent on dry docking to keep the ship in standard operating condition. (Hendawi, 2018.)

Items(项目)	$/Year (美元/年)	$/Month (美元/月)	$/Day (美元/天)
Crew wages/st by OT(船员工资):	$8,66,800.00	$72,233.33	$2,374.79
Crew Provisions(船员伙食):	$57,500.00	$4,791.67	$157.53
Crew Medical(船员医疗):	$-	$-	$-
Crew ITF(船员ITF):	$5,000.00	$416.67	$13.70
STCW Training(STCW培训):	$25,000.00	$2,083.33	$68.49
Crew Other Manning Expenses(其他船员费用):	$70,800.00	$5,900.00	$193.97
Crew Travelling(船员差旅):	$61,800.00	$5,150.00	$169.32
Crew Total(船员费用总计):	**$10,86,900.00**	**$90,575.00**	**$2,977.81**
Stores Deck(甲板物料)	$60,000.00	$5,000.00	$164.38
Stores Engine(机舱物料)	$60,000.00	$5,000.00	$164.38
Stores Lub Oil(滑油)	$1,00,000.00	$8,333.33	$273.97
Stores Steward(事务部物料)	$20,000.00	$1,666.67	$54.79
Stores Total(物料总计):	**$2,40,000.00**	**$20,000.00**	**$657.53**
Repairs Deck(甲板维修):	$65,000.00	$5,416.67	$178.08
Repairs Engine(机舱维修):	$70,000.00	$5,833.33	$191.78
Repairs Electrical(电气维修):	$50,000.00	$4,166.67	$136.99
Repairs Nav. Eq.(航行设备维修):	$20,000.00	$1,666.67	$54.79
Surveys and Registration(检验与登记):	$20,000.00	$1,666.67	$54.79
Repairs Total(维修费用总计):	**$2,25,000.00**	**$18,750.00**	**$616.44**
Spare Parts(备件):	$2,50,000.00	$20,833.33	$684.93
Management Fees(管理费):	$1,20,000.00	$10,000.00	$328.77
General Expenses(日常开销):	$60,000.00	$5,000.00	$164.38
Total Operating Expenses(总营运费用):	**$19,81,900.00**	**$1,65,158.33**	**$5,429.86**
Owner's Expenses(船东费用):			
New Rules and regulation(新公约及规则)			
Insurance(保险)			
Dry-dock spares and stores(坞修备件和物料):	$-		
GRAND TOTAL总计:	**$19,81,900.00**	**$1,65,158.33**	**$5,429.86**

Figure 5: example of cost management on board a ship (Dsouza & Dsouza, 2022)

3.1.1 Budget

A budget is a well-structured plan that involves money and in a shipping company, it is set up by experts considering the amount of money that has been given for dry docking. Every ship has extensive repairs done while it is in dry dock. While there are multiple scheduled interim docking surveys and repairs, the principal overhaul of the ship takes place after completing an interval of a

certain period which can be five years. Dry docking is a costly procedure that calls for methodical, effective planning and cost estimation to reduce overhead and other needless expenditures (Anish et al., 2024.)

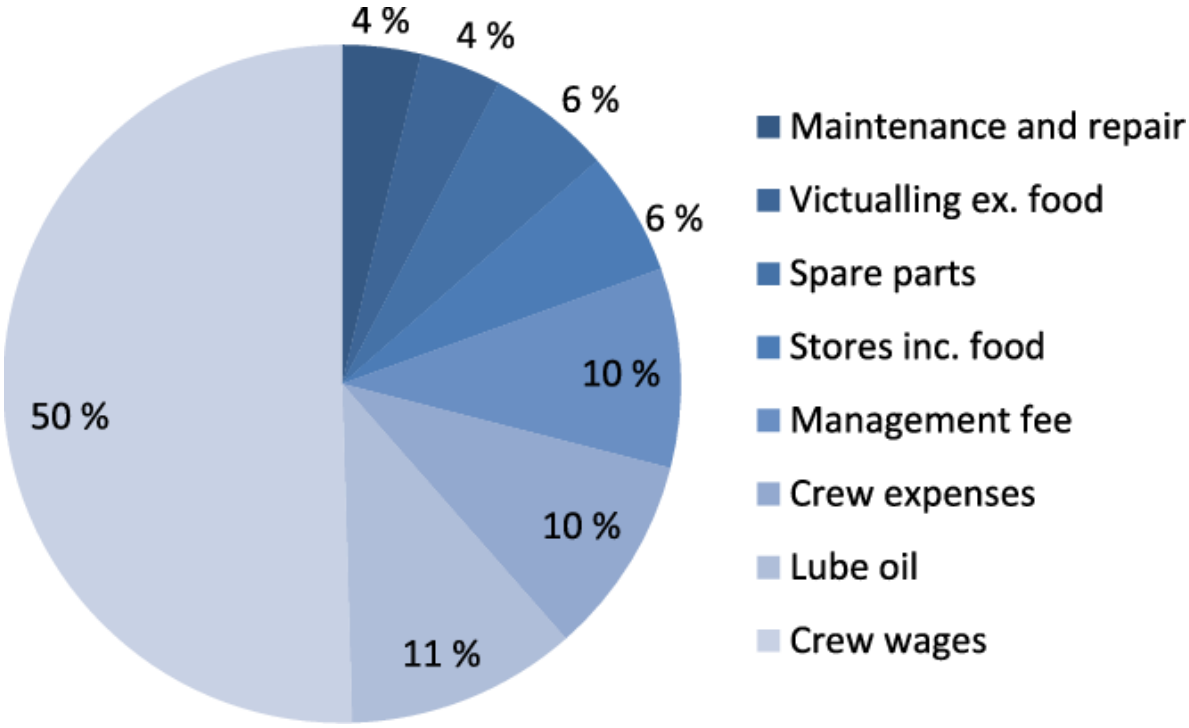

Figure 6: Example of a daily Operational Expenses (e.g., Dry Docking and Insurance, retrieved 2024)

To secure a reasonable quotation for the entire repair work and to monitor a ship's dry-docking budget, cost estimating is crucial. There are three crucial factors to look at Cost group, Cost parameters, and work breakdown structure (Anish et al., 2024.)

3.1.2 Cost Group

Cost grouping, which divides the entire repair process into sections for ease of cost quoting and timely completion of the work, is a crucial component of cost estimation. Cost groups also make the process more efficient and manageable by helping to separate and assign work to several repair yard parts and obtain unique quotations for each of them. Cost grouping is primarily carried out by the shipping department. For instance, the electrical, deck, and engine departments (Anish et al., 2024.)

3.1.3 Cost Parameters

Cost parameters are the elements that define the bounds and extent of work during dry docking repairs. They support the analysis of the work and consider every detail for the dry docking (Anish et al., 2024). Dry docking fees, repair yard costs, agency costs, classification surveyors' costs, cost of stores, Repair and Maintenance costs, Damage and Repair costs, and cost of spare parts (Anish et al., 2024.)

3.1.4 Work Break down structure.

For a significant performance during dry docking, a working plan should be created, and this plan is to be followed during the dry-docking period. The normal planned time for a vessel to be at dry dock can be estimated to be 10 – 14 days, with poor management during dry docking prices might arise and important factors will be affected. To save repair expenses, the chief engineer uses the work breakdown structure to determine which tasks can be completed by the ship's crew in the allotted time. In the end, this aids in creating the last quote that shipyards will receive (Anish et al., 2024.)

Figure 7: Example of dry-docking management plan (Al KHAIR SHIPPING MANAGEMENT, retrieved from website 2024)

4 WHY MUST SHIPS GO FOR DRY DOCKING?

Regulations and rules implemented by the IMO society and placed under cargo ship safety construction rules based on the 1974 SOLAS regulation state that all merchant ships must go through a well-monitored inspection of the hull in dry dock within five years, as well as an intermediate survey within 36 months, including the maintenance of the ship's hull, propeller, rudder, and other submerged parts that are frequently inaccessible to crew members when at sea (Tan, 2023.)

Passenger ships must have their bottoms inspected once a year. Two of these inspections must be done in a dry dock for five years, and the maximum time between them should be three years. (Tan, 2023). Ships that are well taken care of tend to produce quality performance during their scheduled op-

erations routine. “There are certain factors to look at such as improvement in the efficiency and performance of the ship, and Safety of crew on board the ship” (Ramanujan, 2021). Most importantly a vessel that is not well kept can lose its license and be considered unseaworthy or face the consequence of non-issuance of a safety construction certificate to avoid all these kinds of bad effects dry docking should be a priority in a company (Ramanujan, 2021.)

Figure 8: Example of ship in a graving dock (BSA Shipping Agencies Shipyards Over the World/ Bsaship.com, 2017)

4.1 Improvement of the efficiency and Performance of the ship

During dry docking, the ship's mechanical and propulsion problems are fixed, and marine fouling is carried out this helps by reducing operational problems, reducing unexpected mechanical failure as the ship sets sail to the designated port. Fuel consumption is also reduced as all licks are catted for during the maintenance and repair period. To restore the ship's speed and fuel consumption to its normal levels, the hull must be thoroughly cleaned, scrubbed, descaled in all rusty places, and then painted (Ramanujan, 2021.)

4.2 Safety of the crew on board the ship

A well-maintained and repaired ship tends to be one of the safe homes for seafarers as the hull thickness is measured and all hazards are eliminated from the ship during dry dock. A ship can only be securely and smoothly operated by experienced sailors with well-equipped safety equipment and technology improved. However, a conscientious ship owner who ensures that their fleet is refurbished and improved appropriately greatly benefits the crew. (Ramanujan, 2021.)

5 DIFFERENT METHODS OF DRY DOCKING

A dry dock is a built area or constructed area created for building, fixing, and maintaining boats and repairing ships/Fleets. This special design or setup makes it possible for a U shape structure to be filled with water, and a ship to be manoeuvred in freely through the well design structure. When the vessel has completely entered, the docks are locked with watertight doors, and sea water is drained out of the dock exposing the hull and other areas that have been exposed to the sea for an extended period and needs to be fixed, maintenance and repairs. Certain methods are to be considered when preparing your ship for dry docking looking at the safety of the docks, Availability of spare parts and quality of work considering the reputation of the shipyard company. In the maritime industry there are different types of dry-docking methods depending on your company budgets such as floating dock, Graving dock, syncrolift and there are procedures to be follow when preparing your vessels for dry-docking. (Dry Dock - History, Types, Advantages and Innovation website, 2019.)

Figure 9: Example of a shipyard (MiniBulk 2014)

5.1 Safety of the Shipyard

Safety is an important content when selecting a shipyard, most shipyard owners request for certain documents: safety system, verification of its implementation through auditing, Special safety requirement included in contract specifications (Safety meetings on board, Ship Ventilation, Lighting and First Aid Respond). (Antoniou, 2016, p. 20).

“Safety of the shipyard can also be affected by safety of the country and its geographical location and looking at the reputation of the shipyard and its safety standard” (Antoniou, 2016, p. 8). OCIMF (Oil Companies International Marine Forum) advises that a company should make sure shipyards of choice have an HSE policy in place before appointing them to complete any kind of work, whether it be construction or repair (Antoniou, 2016, p. 9). Implement a formal HSE Management System for every work and adhere to the (Health, Safety and Environment) Policy. This system needs to be sufficiently documented with an HSE manual and demonstrated to be successful in carrying out the goals and objectives of the Shipyard HSE Policy (Antoniou, 2016, p.

11). “Additionally, it is advised that shipowners conduct an examination of the shipyards, including their HSE Management Systems and the data on HSE performance that is already accessible, as part of the shipyard selection process” (Antoniou, 2016, p. 9.)

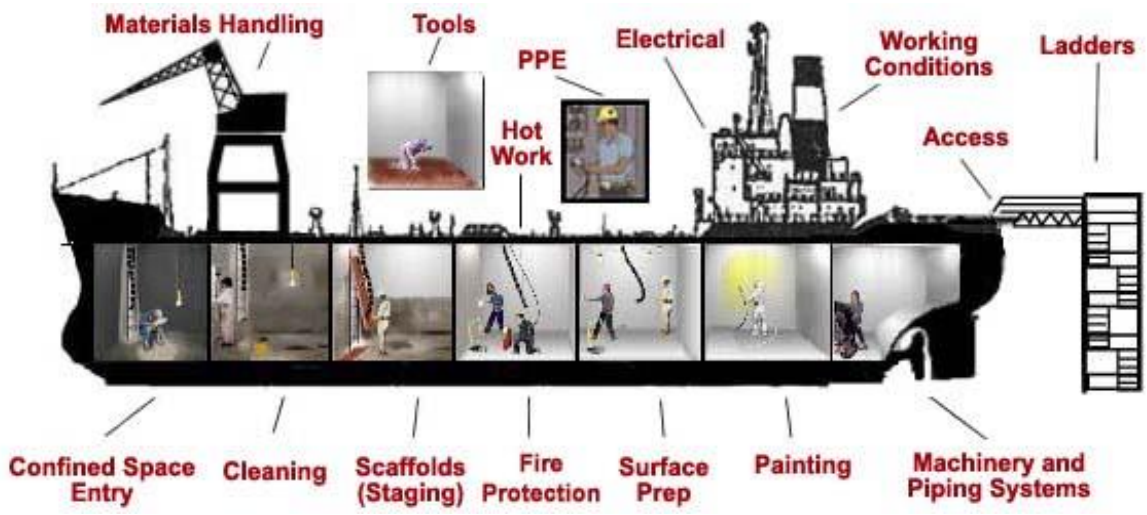

Figure 10: Etool: retrieved website Shipyard Employment - Shipbuilding / Occupational Safety and Health Administration, 2024)

5.2 Availability of spare parts

Spare parts are one of the essential equipment in the marine time industry and to provide maintenance with the appropriate spare component at the appropriate time, location, quantity, cost, and at the lowest possible overall cost to the business and how soon can they be delivered at the shipyard. When selecting a shipyard for your ships consider how fast the spare parts can get to the shipyard in case of an unplanned or unbudgeted equipment breaks down. The quality and quantity of spare parts available in the zone where the shipyard is located. Maritime shipping firms have an urgent management challenge: having the proper spare part for ship repair at the right time and location at the lowest possible cost. This is particularly difficult in bulk shipping because following port calls are determined by the dynamics of the spot market rather than fixed itineraries (Pahl, 2022, p. 10.)

5.3 Quality of Work and Prices

Most shipyards are known for the quality of work they deliver to the client's assets (Ships, boats, and Yacht) and the affordability of the maintenance and repair they provide. Shipping companies, when choosing the best shipyard for your ships, compare the prices, quality of the work and availability of items and visit the shipyard.

Figure 11: Example of Quality investigation at (HUTCO Dwyer, 2019)

5.4 Types of dry docks

There are different types of dry docks in the maritime sector which all carry out the same function and there are few that are mostly popular in the maritime sector which are Floating docks, Graving docks and Ship Lift. Dry docks are special designed and constructed structures with a function of lift and removing a vessel from water, they carry out their function by allowing water in or by partially been submerged so that it can lift a vessel from sea water to a dry surface. Maintenance, and repair of the hull, stern gear and any other under water kit are carried out when ship has been docked. With the estimated growth in maritime industry dry docking has gaining its popularity or is becoming an essential part in the maritime sector (retrieved from Marine insight website, 2024.)

. Dry docks are equipped with modern machines, tools and systems that allow them to carry out the work of fouling, cleaning, hull repair and consistent maintenance and it ensure that the vessel is safe and reliable which boost the confidence of the crew members onboard the ship. For every vessel to be considered seaworthy most of its testing and inspection by the classification society is carried out during dry docks (Retrieved from marine insight website, 2024.)

Figure 12: Picture of the (Dry-Docking Support,2021)

5.4.1 Graving Dock:

The most conventional type of dry dock is the graving dock. Graving docks are typically built with concrete and earth berms in the shape of a narrow basin, replete with blocks, walls, and gates (Learn More About Graving Dock - Articles - Ship Building Shipyard Indonesia – Ratson website, 2020.). A graving dock is constructed on land close to the coast so that a vessel can access it straight from the river or the ocean (Learn More About Graving Dock - Articles - Ship Building Shipyard Indonesia – Ratson website, 2020.)

Operation of a graving dock is a simple task based on the following steps:

- The docking plan describes how the block should be arranged based on the ships information length over all (LOA), beam and drain plugs and sea chest.
- After the complete arrangement of the blocks the locks (Gates) are open, and the graving dock is flooded with seawater or river water and the vessel is maneuverer into the dock with the assistance of tugs.
- When the vessel has completely entered the dock, the gates are closed, and the flooded water is pumped or drained out of the dock until the vessel seat perfectly on the blocks and this work is carefully monitored by a qualified Dock Master (Shipbuilding and Ship Repair - Process: Dry Docking and Launching | Occupational Safety and Health Administration website, retrieved 2024.)
- Maintenance, inspection, and repair work commences.
- After completion of all the tasks that were meant to be completed while the vessel was on the docks. Reflecting on the same protocol as for docking A tugboat will escort the vessel back into the sea once the gate is opened, following the flooding of the docks. (Shipbuilding and Ship Repair - Process: Dry Docking and Launching | Occupational Safety and Health Administration website, retrieved 2024.)

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Figure 13: Example of Graving dock, (Historic Dry-Dock Becomes Scottish Ship Recycling Facility, 2021b)

5.4.2 Floating dry dock:

Floating docks can be described in different terms such as jetty or a light-weight quay and are considered as the more valuable docks in the maritime industry due to their flexibility and manoeuvrability (Floating Docks - Shipping Wonders of the World website, Retrieved 2024.). “The world’s most famous and largest dock was produced in the 1922 in England Southampton. All that a modern floating dock is a massive raft with two hollow sides and a hollow bottom curved like a trough” (Floating Docks - Shipping Wonders of the World website, Retrieved 2024.). A ship is raised by allowing water to enter the raft's bottom and some of its sides until the keel of the ship is below the surface of the sea. The ship is then maneuverer over the raft using hawsers until the keel blocks of the raft and the ship are precisely aligned. When the water is finally drained out, the ship is carried by the raft as it rises to the surface. (Floating Docks - Shipping Wonders of the World, 2012.)

Benefits of floating docks

A floating dock, which resembles a "U" shape, is mostly used for salvage operations, where ships that have been involved in an accident and sustained damage that prevents them from sailing to a coastal dock are transported (Marine insight website retrieved, 2024). When considering choosing the right kind of dock for your vessel there is factors you look at. floating docks are gaining popularity in the maritime sector because of their admirable characteristics, The primary material of floating dry docks is steel. Unlike graving dry docks, they can be connected, and they can accommodate damaged ships because they are movable. Floating docks are one of the best options to consider when your ship have navigation problems or experiencing manoeuvring problems and are considered as one of the cheapest options when choosing the right dry dock for your vessel They are also called vessels that can carry other ships due to their technical and unique function (Marine insight website retrieved, 2024.)

Figure 14: A Floating dock In Namibia Retrieve from (Namibia Dry Dock and Ship Repair Page 2024)

Floating docks have been demonstrated to prevent critical intake pipes from collapsing due to sea growth and barnacle accumulation, in addition to lessening the deterioration of permanently submerged parts including legs, shafts, and propellers (Admin, 2019, p 4.)

Operation of a floating dry dock

“Special compartments with valves that may hold either air or water are found within the floating structures. Operators open the valves to allow water to enter the chambers when a ship arrives, causing the floating dry dock to submerge underwater” (Tangent Materials website, 2022). The dock then pumps water out of the compartments once and the dockmaster makes sure that the

ship is aligned with the arranged blocks. The ship then rises with the docked ship as it floats above the water. (Tangent Materials website, 2022.)

Figure 15: (The Largest Floating Dock in Baltic States, 2020)

5.4.3 Ship lift

Modern dry docks known as "ship lifts" also known as syncrolift system are equipped with platforms that can raise and lower a vessel straight up and down. Unlike floating docks, they are often fixed to the ground and provide movement using mechanical and electrical winches, as opposed to floating. ship lifts are known for lifting ships that have a weight of 800 – 25000 from the water to the dry land using their electrical or mechanical winches. (Tangent Materials website, 2022). This kind of system is one of the best options to consider when docking more than two vessels due to its system, the ship lift removes the vessel from the water to a packing place where they can be

painted or repaired one ship after the other, ship lift has more than one packing place, meanwhile a dry dock can only dock one ship (Tangent Materials website, 2022). To achieve this, the transfer system is made up of several cradles or trolleys that are held aloft by large steel wheels. The wheels are propelled by robust rails. One-way transportation is also an option, however two-way systems are employed to service additional parking spaces (Wikipedia contributors' website, 2023). These two-way systems use a traverser carriage, or occasionally the trolleys' wheels can be rotated 90 degrees. Hydraulic cylinders are frequently positioned above the wheels to enable ship transportation (Wikipedia contributors' website, 2023.)

Figure 16: Syncrolif – (Namibian Ports Authority Namport website 2023.)

Benefits of shiplift

Syncrolift or ship lift has been a crucial factor in the maritime sector of the shipyard market due its unique operation and as multiple ship can be lifted and packed at different slots for maintenance and hull painting, using their electrical and mechanical winches to accomplish the lifting procedures (Alobudi, 2023, p. 38.). Ship lifting is a good option for companies with smaller vessel as maintenance cost is reduced and security level is high. "Syncrolift is

highly or mostly admired because of their remarkable accuracy and adaptability, which provide the exact positioning and high-precision maintenance of ships” (Alobudi, 2023, p. 45.). Syncrolift is known for being one of the best options for its accuracy and effectiveness for smaller and medium size ships and considered as an excellent system for doing moderately time-sensitive maintenance and repair jobs, such as painting, minor repairs, and hull cleaning and they are also excellent for using to launch newly built ships (Alobudi, 2023, p. 44.)

Figure 17: (Dry-Dock - History, Types, Advantages and Innovation, 2019)

Operation of Ship/ Syncrolift:

A specialized platform with several independently controlled lifting cradles or platforms is called a syncrolift. Many boats can move vertically in unison thanks to the cradles' connection to a centralized control system, which enables their simultaneous elevation and fall (Alobudi, 2023, p. 45). To elevate

the vessels, the Syncrolift system is submerged in water and the boats are moved onto the cradles. (Alobudi, 2023, p. 45). The vessel is closely pulled or maneuverer to a submerged cradle, a set of synchronized hoists or winches lift the cradle. According to (Syncrolift - Namibian Ports Authority website retried, 2024) syncrolift is one of the major use facilities in Namibia, it carries out the function of docking and undocking mostly fishing vessels and tugs to and from the lift, in partner with private companies that carries out the maintenance and repair work at the packings. It is therefore considered as an essential facility for local based ship repair companies which bring their vessels for dry docking, maintenance, repair work and modification of hull and hull painting (Syncrolift - Namibian Ports Authority website retrieved, 2024.)

5.4.4 Preparing ship for dry docking:

There are certain procedures that companies need to look at when preparing ships for dry docking and things that the shipyard should also know when they are receiving a ship on their docks. Even if it's hard or a crucial step in the regular ship survey process, it takes times for docking to be well plan and executed as both parties need to be involved to discuss the ship details and docking preparation, with any slightly missing details related to the calculation the process can lead to a huge problem (Admin & Admin Sinotech Marine website, 2021.)

Procedures have been designed to follow when preparing a ship for dry docking.

- Pre-docking Preparation: This is a very sensitive process and requires proper planning, with experience guiding. This is the process when the dock master prepares a docking plan looking at all details of the design of the ship, for instance, hull shape, position of the drain plugs and sea chest for them not to be damaged during the ship docking (Admin & Admin Sinotech Marine website, 2021.)

- Docking Plan**:** This is a process where mathematics and design come in, under the supervision of the docking master considering the shape, size, height, and weight of the vessel. This is a plan document containing all details about how a ship should be docked and undocked considering the position of the sensitive parts and the arrangement of the blocks, reducing the risk of the ship capsizing (Admin & Admin Sinotech Marine website, 2021.)

- Stability conditions**:** The stability of the ship during docking is one of the important tasks, considering the weight of the ship as the weight will be distributed to the keel blocks, with any miss leading calculation and arrangement of the keel block it can cause mishap (Admin & Admin Sinotech Marine website, 2021.)
- Before Arrival of ship things to look at**:** Design a list containing information related to things that need to be repaired, and maintenance. Assign every experienced crew member with certain tasks listed on the list. Categorize the crew into smaller groups so that you can monitor the performance of the shipyard employees well (Admin & Admin Sinotech Marine website, 2021.)

- For all your spare components inspection should be mandatory and all the repair items must be monitored and kept at a nearby place for usage.
- It's necessary to make sure that the bilges, engine room and tank top are well cleaned.
- Crew should be informed before dry docking that the bilge line needs be well flushed.
- The oil water separator has filters and makes sure they are replaced and test the separator and see how it performs.
- Tanker vessels cargo holds should be cleaned and well ventilated.
- Before docking the vessel secures all loads that a heavy.
- Make a proper sound of the cofferdam, tanks and record the readings.
- Carry out a safety meeting related to the safety measures and fire-fighting procedures before docking the vessel.

- ❖ Inform the crew to check the firefighting tools to see if they are functioning well and make them ready to use.
- ❖ Look at the performance of the emergency lights and emergency generator before docking.
- ❖ Indication of marking should be visible on valves and sea chest.
- ❖ Cut of the access to CO2 total flooding chamber.
- ❖ Make sure the vessel reaches the dock with an even keel.

The Actual docking**:** This stage is achieved once the vessel is fully ready for docking, the ship is pushed into the docks by tugs as the main engine of the ship is not running and the propellers are not able to manoeuvre the ship. When the vessel is in the docks it is moored and positioned carefully on the keel blocks and secured. After that, the crew takes over and begins cleaning the dock, including pumping out the water and running the ballast pump and removing the drain plugs (Dry Docking – Procedure, Scope, and Advantages - SHM Blog retrieved website, 2018.)

Figure 18: A Complete Guid of Bringing a ship to Dry Dock (retrieved MySeaTime website 2016)

5.4.5 Preparation of undocking the vessels

This process involved the removal of the ship from the docks following the same procedures when it was docked, after all repair and maintenance had been completed and the vessels scheduled time on the docks had expired. Checks must be done before the ship leaves the docks, this process involves the surveyor, ship owners (Superintendent of the ships company) and vessel is inspected if it's seaworthy and if all the installed or replacement machines are in a good operation standard, and it is awarded a seaworthy license after some sea trails with experience safety officers, surveyors, and owners (KaranC & KaranC, 2024.)

There are some few things that need to be checked before the dock is flooded:

- All work done by certain departments needs to be checked and signed off as completed including testing and surveyed.
- Verify that all the rudders plug and vent and check how the anodes are fitted to the rudder.
- Verify if the anodes (ICCP) removed previously are replaced with new ones and fitted in their correct position. And check if the anodes fit well on the hull.
- Make sure to verify the bottom tank plugs if they are installed tightly and secured well.
- Verify if all the sea inlets valves and gratings are well secured.
- Verify the logs and echo sounders are secured and their protection coating is removed.
- Make sure to investigate the surroundings of the rudder and propeller if they are clear from any obstruction.
- Verify the safety of the anchor chain and ensure that it's secured.
- Let go of all external connections.
- Investigate the ship and see if all installed valves are in correct format.
- Tighten any object on board to avoid them from sliding.

- evaluate the reading of the tanks and check if they match with the previous reading by doing sounding.
- Calculate the GM of the ship and identify the stability and trim value of the ship, GM should always be positive.
- After calculating the GM and if there are any changes alert the dock master.
- The captain should give the sign for flooding the dock by signing a flooding certificate.
- When the flooding reaches the level of the overboard valve, halt it and inspect the stern tube and all valves for leaks.
- All hand on deck should be signalled to the crew during undocking.

Figure 19: (SHIP REPAIR&DRY DOCK REPRESENTATIVE/Camelot Maritime, n.d.)

6 Maritime Environmental factors

The ocean is one of the most highly valued natural resources in the world due to its richness in raw materials and it is also a home to different marine spe-

cies, there for it should also be protected from any hazards caused by marine traffic (ships) and to achieve this, vessel should be well maintained and well repaired and this can be catted for at shipyards. Due to discovered that maritime shipping global trade is one of the easiest trade routes for cargoes from continent to continent and this is made possible by ships. An unhealthy vessel can be a dangerous hazard to the maritime environment as it starts rusting, oil spillage, pollution, and growth on the hull leading to toxic chemicals which affect marine life, and habitats, this kind of hazards can be eliminated if the ship obey its mandatory procedure of visiting the dry dock after a certain period. The IMO has created and implemented some regulations related to the protection of marine life and preventing the pollution of the maritime environment and all shipping companies should adhere to the regulations or policies that falls under the IMO Pollution Prevention Treaty (MARPOL) (How Ships Are Affecting the Environment website, 2019.)

Figure 20: Unfouling a Yacht, (Yachting World website, 2019)

6.1 Rusting and wear of Hull

As the vessel sails for a certain period, it experiences fouling on the part of the hull that is completely submerged. Fouling has to do with the growth of microorganisms on the part of the ship and these microorganisms eat the hull coating surface which exposes the iron or steel part of the ship and come in contact with sea water which eats the surface slowly and rusting develops and lead to the development of toxic gaseous which affects the marine life (The Royal Australian Chemical Institute Inc webpage., 2018). The vessel should be taken to dry dock to avoid rusting which is a hazard to the marine environment as it causes leakage of tanks which might contain oil or chemicals which can kill marine life and rusting of the ship hull is a danger to the safety of seafarers as it can cause the ship to sink. Inspection of the hull and coating of the hull can be carried out at the shipyard this process also protects the ship and its crew.

Figure 21: Example of a Rusting ship, (Old Rusty Ship, retrieved Pinterest 2024)

7 DISCUSSION AND RECOMMENDATION

The author carried out an interview with industrial experts in the maritime sector and representing different companies that own fleets related to the importance of dry docking in the maritime sector. As it's been stated earlier that dry docking Is the removal of the ship from seawater to a dry surface for repairing, fix, maintain and cleaning of the hull and apply proper coating to the hull and other parts of the vessels that are always submerge in water and cannot be access during the ship's operation. The maritime field experts (Mr Paulus Andela, Mr Markus Syvanen and Mr Antti Numminen) contribution was productive and encouragement to shipping companies to consider dry docking as one of the important tasks to maintain their assets. The interview was based on the questions below, and its purpose was to find out certain information based on ships contribution toward their companies and why the companies need take their ships to dry docks. The input of the experts made it possible and interesting to execute this thesis.

Why is it important for shipping companies to send ships for dry docking?

According to the (Andela Linkin, 2024), "A vessel is just like any other machine which requires maintenance intervals for it to be fit for operation as well as for the safety of life at sea (SOLAS)". As implemented by IMO, a vessel must undergo dry docking to renew its license and other certificates for all safety equipment onboard (Andela Linkin, 2024.)

Dry docking is essential for preventing maintenance which cannot be carried out while a ship is in operation. Additionally, some of the mandatory class surveys require dry docking. For wear and tears, pull out and inspect propulsion components, check hull thickness, remove old paints, and apply new antifouling, calibrate the anchor chains, and overhaul all critical seawater valves these kinds of critical jobs can only be done in dry dock (Syvanen Email, 2024.)

What economic impact does dry docking have on companies' financial factors?

Dry docking is one of the important tasks for fleet owners and it's a comparatively expensive process in addition the vessel does not generate any capital during dry docking, and it is considered as a future investment. For instance, cargo holding blasting and painting are quite expensive but its beneficiary for carrying of various cargoes (Numminen intervened, 2024.)

How to prepare a ship for dry docking and the procedures that need to be followed.

Before going for drydocking, a comprehensive scope of work should be drafted together with ship officers or Crew by the technical superintendent. When the Scope is clear, submit to various drydocking companies to submit their price proposals. Once you receive the prices, you should then request a Capex from your management (Andela Linkin, 2024.)

Budget is crucial. You should have sufficient funds for all activities before going drydocking. If the vessel does not go for drydocking, your components will be exhausted and start to leak oil or fuel spillage due to damage to the hull which is not maintained/repaired. All necessary spare parts should be ordered well in advance before planned docking (Andela Linkin, 2024.)

How is the performance of the vessel affected if the ship does not go for dry docking?

They increased fuel consumption due to barnacles and marine growth in under water part of the hull and consequently higher emissions. Also, risk of an oil spill if for example stern tube seals are not periodically maintained. If the vessel does not go for drydocking, your components will be exhausted and start to leak oil or fuel spillage due to damage to the hull which is not maintained/repaired when the ship is in operation and can cause the ship to sink. Oil and Fuel can kill marine animals and other species. Lack of drydocking will compromise the safety of the ship, which might result in sinking and worst-case scenario might kill people onboard the vessel (Syvanen Email, 2024.)

7.1 Recommendation

This thesis contains some guidelines on why dry docking plays a crucial role in the maritime sector. Dry docking is a mandatory activity for all ship owners or companies that own vessels as it helps with prolonging the life cycle of your fleet and boosts the spirit of the crew onboard. Well-maintained vessels produce perfect results as most of the operational failures are minimise or reduce and it also attracts charters.

The purpose of this thesis is to educate and encourage shipping companies to always schedule their fleets for dry docking, With help from different sources and industrial experts it clearly shows that dry docking is very important because it helps owners or crew members to identify and repair mechanical faults, and performing antifouling on ship hull, especial the area that is always submerge and also the ship surface area, and all maintenance that can’t be done while vessel is in operation. Lastly protect the marine environment improve the safety of your ship increase performance, also prolong the life span of your vessels by taking maintenance and repair seriously for your company. To achieve all this companies should always schedule their fleet for dry docking after a period of operation and improve the safety of crew operating the ship because a well-maintained and repaired ship tends to be one of the safe homes for seafarers.

9 CONCLUSION

This thesis is mostly based on the importance of dry-docking targeting shipping companies or any other company that owns a fleet. Dry docking is the process of removing a ship or boat from water to a surface dry land where its parts that are always submerged can be easily excess for repair, maintenance, cleaning, and applying new coating to the ship's hull, anchor chain, and all other repair or maintenance that cannot be done while ship is in operation are done at dry-docks. This process helps to prolong the life cycle of a ship and improve its safety standards which boost the esteem of the crew managing the ship. Additionally, the focus was on components such as the reasons for dry docking, economic strategies, why is it so important to set up budget and how to manage your company's capital while ship is docked, why ships must go for dry docking, different methods of dry docking or types of dry docks and environmental factors.

Dry docking is the most essential and crucial part of the ship's survival and smooth operation and helps prolong your company's life span assets these are common points, and reasons for dry docking. The regulations implemented by IMO under the cargo ship safety construction rules amended in 1974 by SOLAS state that its mandatory for ships to visit a dock after a certain time interval and during this process surveyors inspect the ships and make sure that she is seaworthy and earns an operational licence. Economic strategies capital plays a magnificent role when it comes to planning for dry docking and when the ship is on the docks, and with some factors that contribute to the financial planning of the ship such as setting up a plan budge with the aim of not exceeding the plan amount during dry docking looking at the cost group, cost parameters and work breakdown. The reason for dry docking, a ship needs to go for dry docking to improve its efficiency and performance by fixing all propulsion and navigation systems making sure it is clean and smooth to operate, and improving the safety of the crew operating the fleet as a well-maintained and repaired ship tends to be one of the safe homes for seafarers. There are a lot of options to look at when choosing the proper dry dock for your fleet which is the size of your ship and geographical location of the dock.

There are a few mainly popular types existing in the world which are graving docks, Floating docks, and Ship lifts (syncroliftting). Choose the right one based on your budget. Maritime environments tend to be home of different habitat so taking care of it is mandatory. A well-coated hull reduces the risk of the ship’s hull rusting, rusting of steel or iron can lead to the development of toxic gaseous which can affect the marine life. Shipping companies have been advised to always do blasting and apply new coating layers.

Companies should make sure their fleets are well maintained and repaired and this can only be done if she is removed from the water and brought to dry land for proper investigation. IMO has made it mandatory for all vessels sailing or to be considered seaworthy when she has passed certain inspections and should go for dry docking after a certain period of operation, and surveyors should inspect her and make sure she is not a risk to the crew, and the maritime environment.

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APPENDIX:

The author created some questions and had an interview with one of the industry experts and the other experts were reached through Linkin and via email. The main objective of the interview was to get their input on why they think it is so important for shipping companies to take their ships/fleet to dry docks and their input was productive.

Question:

1. Why is it important for shipping companies to send ships for dry docking?
2. What economic impact does dry docking have in companies' financial factors?
3. How to prepare a ship for dry docking and the procedures that need to be followed.
4. How is the performance of the vessel affected if the ship does not go for dry docking?