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Analysis of The Log Loading Process for the Optimization of Ship Operations on the MV. Cosmo Gloria

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Abstract

The loading of logs is an essential activity in ship operations that requires proper planning, stowage, cargo securing, and stability control. On MV. Cosmo Gloria, log-loading operations are particularly complex because cargo is stowed both inside the cargo holds (under deck) and on the weather deck (on deck), while being influenced by weather conditions, crew competency, equipment readiness, and cargo-securing arrangements. This study aims to analyze the log-loading process, identify factors that hinder loading operations, and determine optimization measures to improve the operational efficiency of MV. Cosmo Gloria. The study employs a qualitative approach using field research. Data were collected through observations, interviews with the Master, Chief Officer, Bosun, Able Seamen, and Ordinary Seamen, documentation, and literature review, and were subsequently analyzed descriptively. The results indicate that log loading involves planning, cargo-hold preparation, under-deck and on-deck loading, center lashing, and over lashing. The main obstacles include adverse weather conditions, limited crew competency, insufficient understanding of lashing equipment, and changes in ship stability during loading. The study concludes that well-planned and integrated loading operations can reduce delays and improve operational efficiency. It is recommended that crew training, stability monitoring, equipment maintenance, coordination among involved parties, and consistent implementation of the Cargo

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Securing Manual be strengthened.

Keywords: **Log Loading, Optimization, Operational Efficiency, Cargo Securing, Ship Stability.**

INTRODUCTION

Transportation is one of the service sectors that has a strategic role in supporting the mobility of people and goods and supporting a country's economic activities. In trade activities, transportation functions as a link between production, distribution, and market locations, both domestically and internationally. In the context of maritime logistics, sea transportation is an important part of the trade system and supply chain because it connects shipping, ports, distribution, and trade activities between countries (Song & Panayides, 2021). Among various modes of transportation, sea transportation has an important role because it is able to transport commodities in large volumes and support the movement of goods in international trade. UNCTAD (2024) states that sea transportation is the backbone of international trade and the global economy, with more than 80% of the volume of international trade in goods transported by sea. Therefore, ships and ports are an important component in maintaining a smooth global supply chain. However, the effectiveness of sea transportation is not only determined by the ship's ability to transport cargo, but also by the port's performance and the smooth handling of cargo handling activities, as disruptions to such activities can increase waiting times and turnaround times, ultimately affecting the ship's operational efficiency.

One type of ship used in transporting commodities by sea is a log carrier, which is a ship that is specifically designed to carry a cargo of wood, either in the form of logs, boards, and other wood products. This research was conducted on MV. Cosmo Gloria operates transporting logs, mainly from a number of ports in New Zealand such as Tauranga, Wellington, Gisborne, and Marsden Point to unloading ports in China. The load is mostly in the form of pine wood which has the characteristics of non-uniform size, relatively large weight, and requires special handling during the loading process. These characteristics cause the log loading process to have a high level of complexity because it involves stowage, lashing, loading space planning, equipment readiness, and coordination between crews, loading and unloading equipment operators, port workers, and terminal parties. This condition is in line with the research of Putro et al. (2021) regarding the optimization of wood loading and unloading (log) to support the smooth loading process and the research of Lestari et al. (2022) which emphasizes the importance of loading space readiness in supporting the success of the loading process.

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Log loading processes that are not planned and executed properly have the potential to cause various operational bottlenecks. Internal factors can come from a lack of crew readiness, inconsistencies in work procedures, suboptimal loading room preparation, limited understanding of cargo tying methods, and inadequate conditions of loading and unloading equipment (Wahyudi, 2025). Meanwhile, external factors can be in the form of weather conditions, delays in port equipment, queues of transport vehicles, and weak coordination and communication between parties involved in ship and port operational activities (Muhamad & Salleh, 2024). These various obstacles can extend loading times, increase port stay and idle time, disrupt departure schedules, and increase ship operational costs. The problem of delays in maritime activities is also a concern for Muhamad and Salleh (2024) through the research Identifying Delay Factors in Maritime Operations: A Case Study of Ship Owner Perspective, while Heda (2021) identified the existence of log loading constraints and the need to optimize loading and unloading activities on MV. K. Pluto.

In addition to the time factor, the success of the log loading process is closely related to the utilization of cargo space capacity, one of which is through the calculation of the stowage factor. The stowage factor is a parameter that shows the relationship between the volume of space occupied by the cargo and the weight of the cargo, so that it can be used to estimate space requirements and optimize the utilization of ship cargo space capacity (Setyohadi et al., 2024). In loading planning, the value of the stowage factor also affects whether the ship's capacity will be limited first by the volume of cargo space or by the ship's ability to transport the weight of the cargo (Law et al., 2022). In log loads, the value of the stowage factor can be different because it is influenced by the type and density of wood, diameter, length, moisture content, and the empty space formed between the wood arrays (broken stowage). High-density wood tends to require less space for the same weight, while low-density wood requires larger volume. Inaccuracies in estimating the stowage factor can result in cargo space not being used optimally, uneven load distribution, increased loading times, disturbances to ship stability, and potential deadfreight. Therefore, proper stowage planning is an important part in achieving time efficiency, productivity, safety, and optimization of ship operations.

In MV. Cosmo Gloria, the complexity of loading is even higher because the logs are not only placed in the hatch (under deck), but can also be loaded on deck (on deck cargo). This condition requires cargo planning to pay attention to weight distribution, ship stability, structuring methods, and cargo security systems so that logs do not shift during shipping. The International Maritime Organization (IMO) through the Code of Safe Practice for Ships Carrying Timber Deck Cargoes,

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2011 or TDC Code emphasizes that the arrangement (stowage) and securing (cargo securing) of wooden cargo must be carried out appropriately to ensure the safety of ships, crews, and cargo during shipping. This principle is also related to the implementation of the Code of Safe Practice for Cargo Stowage and Securing (CSS Code), SOLAS, and the ISM Code which are safety standards in the implementation of loading activities. Thus, log loading optimization is not solely geared towards accelerating loading times, but must still consider the balance between operational efficiency, load space utilization, ship stability, and shipping safety.

These problems are empirically also found in operational activities MV. Cosmo Gloria. On December 20, 2023, the ship carried out log loading in Auckland, New Zealand and was scheduled to depart on December 22, 2023 at 12:00 local time, but the departure was delayed due to the process of setting up the stanchion and the implementation of the lashing center taking longer than planned. A similar problem occurred again in February 2024 when the ship was loading in Napier. The loading process could not be completed as scheduled because the lashing wire that will be used for the lashing center was crushed by the log load so that part of the log had to be disassembled again to free the lashing wire. The study's operational data also shows several indications of other problems in 2024, namely crane breakdowns, irregular logging, and lashing processes that last more than 12 hours. These conditions show that the aspects of equipment, loading methods, human resources, and cargo security have a direct relationship with the effectiveness of the loading process and the accuracy of ship operations.

Based on this description, it can be understood that the log loading process is an important part that determines whether or not operations are optimal MV. Cosmo Gloria. The smooth loading does not only depend on the speed of loading but is the result of the relationship between the readiness of human resources (man), equipment (machine), work method (method), load characteristics (material), and environmental conditions (environment). The management of these five aspects in an integrated manner is needed to reduce delays, shorten port stays, optimize the use of cargo space, maintain ship stability and safety, and increase operational productivity. Therefore, a comprehensive analysis of the implementation of log loading in the hatch and on deck is needed, the factors that are inhibiting, its impact on the ship's performance, and the optimization measures that can be applied.

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Table 1 Ship Operational Delays

Month	Causes	Variable Category	Problem Indications
February 2024	Damaged ship crane	Loading equipment *(Input)*	Decreased loading process effectiveness
March 2024	Irregular log organization	Loading process	Load time utilization is not optimal
April 2024	Lashing process exceeds 12 hours	HR and operations *(Process)*	Delays in ship operations

Source : Author Data Processing (2026)

LITERATURE REVIEW

Transportation Management

Sea transportation management is a process of managing transportation and shipping activities in a planned manner that includes the functions of planning, organizing, implementing, controlling, and supervising various resources involved in operational activities. The management includes the use of ships, cargo handling, the use of port facilities, human resource management, and other supporting facilities so that transportation activities can take place effectively, efficiently, safely, and according to the set schedule. From a maritime logistics perspective, sea transportation activities do not stand alone, but rather become part of the logistics system and supply chain that connects shipping, ports, trade, and distribution of goods. Therefore, sea transportation management is directed not only to ensure the smooth movement of goods, but also to optimize the use of ships and port facilities, control operational costs, improve shipping safety, and maintain the timeliness of services (Song & Panayides, 2021). The Maritime Logistics literature also places shipping and ports as important components of global trade and supply chains.

In the context of this study, the application of sea transportation management is directly related to the management of the log loading process on the MV. Cosmo Gloria. The loading process needs to be planned and controlled systematically by considering the readiness of the loading space, loading equipment, crew competence, load characteristics, stowage and lashing methods, operational environmental conditions, and coordination between the ship and the terminal. Proper management of these elements is expected to facilitate the loading process, reduce waiting time and port stay, prevent departure delays, increase ship capacity utilization, and still ensure operational safety. Thus, the management of sea transportation in this study is

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the basis for analyzing how the process of loading logs on MV. Cosmo Gloria can be optimally managed so that it is able to support the increase in effectiveness, efficiency, safety, and operational productivity of ships. This focus is consistent with the thesis manuscript that connects marine transportation management with the optimization of the log loading process on the MV. Cosmo Gloria.

Ship Cargo

Ship cargo is the main object in sea transportation activities in the form of goods or commodities transported by ships from the port of origin to the destination port. In commercial shipping activities, cargo transportation has an important economic value because it is a source of income for shipping companies through the receipt of mining money (freight) which is used to support the sustainability of ship operational activities and activities at the port. Sudjatmiko (1995) explained that ship cargo includes various types of goods and merchandise that are handed over to the carrier to be carried by ship and then handed over at the destination port. In line with this understanding, Girvin (2022) views ship cargo as all goods that are objects of sea transportation based on transportation agreements, both in the form of bulk cargo, general cargo, containerized cargo, and other types of cargo.

In its implementation, every cargo transported by sea requires a handling method that is adapted to the physical characteristics, nature of the cargo, the level of danger, as well as its storage and security requirements. Based on the guidelines of the International Maritime Organization (IMO), ship cargo can generally be grouped into general cargo, bulk cargo, containerized cargo, dangerous goods, project cargo, and timber cargo. The difference in the characteristics of each type of cargo causes the handling, arrangement (stowage), and security (cargo securing) procedures applied to be also different. Specifically for timber loads placed on decks, the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 2011 stipulates that the loading process must be based on the cargo loading plan by considering the load distribution, ship stability, deck structure strength, and adequate lashing system (IMO, 2011). The arrangement of wooden cargo must also be carried out in a tight and stable manner to minimize the possibility of shifting during the voyage and maintain the safety of the ship, crew, cargo, and the environment.

In the context of wood load, there are several terms used to distinguish the form and level of wood processing, namely timber, log, and lumber. Timber in the manuscript is described as logs that come from trees that have been cut down and have not been processed into lumber, while log is a large or long piece of wood that has not been further shaped or processed. Meanwhile,

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lumber is a log or timber that has undergone a processing process so that it is ready to be used, for example in the form of boards or pieces of wood. The IMO's Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 2011 uses the term timber broadly to encompass various forms of wood products, including lumber, cants, logs, polishes, and pulpwood. Therefore, an understanding of the type and characteristics of the timber load is important in determining the appropriate loading, structuring, and securing methods on log carriers such as MV. Cosmo Gloria (IMO, 2011).

Log Carrier

Log carriers or timber carriers are ships designed or modified to transport wooden cargoes, either in the form of logs, sawn timber, or various other forms of wood products. Ships that transport wood on deck require appropriate construction and security systems so that the cargo can be safely laid and lashed during the voyage. The International Maritime Organization (IMO) through the Code of Safe Practice for Ships Carrying Timber Deck Cargoes, 2011 provides guidelines on the practice of arranging and securing timber cargo on deck to maintain the safety of ships, crew, and cargo (IMO, 2011). In addition, the International Convention on Load Lines, 1966 regulates specific requirements for ships using timber load lines, including ship construction requirements and timber load arrangement conditions. The convention also explains that timber deck cargo can provide additional buoyancy and protection against the sea so that ships that meet the requirements can obtain a certain freeboard reduction (IMO, 1966). Thus, the characteristics of a log carrier are not only related to the ship's ability to transport large quantities of timber, but also to the suitability of construction, cargo arrangement, stability, and the security systems necessary to guarantee the safety and effectiveness of log transport as is done on the MV. Cosmo Gloria

RESEARCH METHODOLOGY

This study uses a qualitative approach with a type of field research that aims to gain an in-depth understanding of the log loading process and the factors that cause delays in loading activities on the MV. Cosmo Gloria. A qualitative approach allows researchers to explore a phenomenon in depth through engagement with the research context and the use of various data collection procedures (Creswell & Poth, 2024). In this study, direct observation of the operational condition of the ship was used to understand various aspects that affect the loading process, including technical factors, human resources, equipment readiness, environmental conditions,

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and coordination between the parties involved. Field observations are relevant in qualitative research because they can provide an understanding of the activities and behaviors that take place in the natural environment of the study (Dado et al., 2023). The object of the research is focused on the log loading process and its optimization efforts to improve the effectiveness and operational efficiency of the ship. Meanwhile, the research subjects were determined using purposive sampling techniques based on the experience, knowledge, and direct involvement of informants in the loading process. The research informants consisted of Captain (Master), Chief Officer, Bosun, Able Seaman (AB), and Ordinary Seaman (OS), who had different duties and responsibilities in planning, supervision, loading implementation, equipment use, and lashing activities.

Data collection was carried out through observation, interviews, documentation, and literature studies. Observation is used to directly observe the implementation of log loading so that the actual conditions and causes of delays can be objectively identified, while interviews are conducted with informants who have competence and direct involvement in these activities to obtain more in-depth information. Sugiyono (2022) explained that observation allows researchers to obtain data through direct observation of the research object, while interviews can be used to explore information about informants' experiences, views, and perceptions more comprehensively. Field data is then completed through documentation and literature studies in the form of documents, notes, photos, and relevant national and international journals. The study of previous research is also used to understand the development of research, compare approaches and results of previous research, avoid duplication, and clarify research contributions. All of this data is then analyzed descriptively to obtain a comprehensive picture of the factors causing the delay and become the basis for formulating efforts to optimize the log loading process on the MV. Cosmo Gloria.

RESULTS AND DISCUSSION

Log Loading Process on top of MV. Cosmo Gloria

Based on the results of observations during sea practice, interviews with the Captain, Chief Officer, and Crew (ABK), as well as a study of the Loading Plan, Cargo Manifest, Cargo Securing Manual (CSM), Statement of Facts (SOF), and Timber Deck Cargo Code (TDC Code), the process of loading logs on the MV. Cosmo Gloria is carried out through systematic and interrelated stages. This arrangement is necessary because log loads have non-uniform sizes, diameters, lengths, and weights, so they require more careful planning than other types of loads. The cargo is placed in

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two main areas, namely in the hatch (under deck) and on deck (on deck). Therefore, the loading process must consider the weight distribution, loading space capacity, ship stability, work safety, as well as cargo safety during shipping.

The initial stage begins before the ship arrives at the port of loading through coordination between shipping companies, ship agents, terminal operators, shippers, surveyors, stevedores, and port authorities. Estimated Time of Arrival (ETA) information is used to prepare docking facilities, loading and unloading equipment, and labor. The Captain and Chief Officer then held a Pre-Loading Meeting to discuss loading plans, division of tasks, communication systems, and emergency handling procedures. In preparing the Loading Plan, the Chief Officer considers the number, volume, weight, length, diameter, type and moisture level of the log, stowage factor, loading space capacity, deadweight, draft limit, deck strength, weather conditions, and the order of the unloading port. This planning is needed to prevent overloading, unbalanced load distribution, as well as bending moment values and shearing force that exceed safe limits.

Before loading, the loading chamber and all supporting equipment must be ensured to be ready for use. The preparation of the loading room includes the disposal of the previous remaining load, the removal of dirt and dust, the cleaning of the hatch manhole, washing with fresh water, draining the water, and the operation of ventilation until the loading room is dry. The Chief Officer then conducts an inspection before further inspection by the cargo surveyor and crane surveyor. Lashing equipment such as turnbuckle, shackle, chain, hook, center lashing wire, snatch block, fabricated web lashing, and top overlashing wire are also inspected, maintained, and placed in locations that are not at risk of being buried in cargo. Inspections of the loading bay, exhaust system, ventilation, hatch cover, safety system, crane, and wire crane are important parts to ensure that the ship is ready to receive cargo.

After all preparations and inspections meet the requirements, an initial draught survey is carried out to find out the actual condition of the ship before loading. Draft data on the forward, midship, and aft sections is used to determine displacement and verify the amount of cargo that is still acceptable by considering deadweight, ballast, fuel, fresh water, lubricants, and other ship needs. The results were then used in the Loading Computer calculation to evaluate draft, trim, heel, metacentric height (GM), shearing force, and bending moment. If there are parameters that exceed the safe limit, the distribution of the load or ballast must be adjusted first. Loading on the MV. Cosmo Gloria then always starts from inside the hatch before moving to the on deck, with the aim of keeping the ship's weight point low so that the ship's stability during the loading process can be maintained.

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At the loading stage in the hatch, the preparation of logs is carried out based on the Loading Plan by taking into account the size, diameter, length, weight, capacity of each hatch, and the order of the unloading port. Large and heavier logs are placed at the bottom of the hatch as the bottom tier, while logs with a smaller diameter are used to fill the empty space so that compact stowage is created and the use of loading space becomes more optimal. Loading can be done using a ship crane or shore crane equipped with a log lifting sling, wire rope sling, or log grapple. During the activity, the Chief Officer, Officer on Duty, Bosun, and stevedore foreman supervise the placement of logs so as not to damage the internal structure of the hatch and ensure that the load distribution remains even. The condition of the ship's draft, ballast, and stability is also monitored continuously so that changes in cargo distribution can be corrected immediately.

After loading in the hatch is complete, a draught survey is conducted again to determine the amount of cargo that has been loaded and obtain the final GM value before determining the load capacity that can be placed on the deck. Before the on-deck loading begins, the collapsible stanchion is erected as a buffer as well as a barrier to the loading space so that the logs do not fall into the sea. The logs are then lifted using a crane and placed on top of the hatch cover and deck area, then arranged with the help of excavator operators on the left and right sides of the ship. Log placement must be done appropriately to prevent shifting when the ship is sailing or facing bad weather. At this stage, the position of the railing, wire lashing, and chain lashing must also be considered so as not to be overwritten or damaged that can cause delays in the loading process.

After the arrangement of logs on the deck is formed, the securing of the cargo is carried out through the center lashing method. In MV. Cosmo Gloria, this system uses a combination of wire rope, stanchion, chain lashing, and turnbuckle to maintain the position of the load during the voyage. The wire rope is installed through the binding points and stanchions on the port and starboard sides in a zig-zag pattern so that the binding force can be evenly distributed. Installation is done with sufficient pre-tension and can produce a self-tightening effect when the next layer of log exerts pressure on the fastening system. All components must be inspected by the Chief Officer to ensure that they are in accordance with the Cargo Securing Manual and are suitable for use. During shipping, the lashing tension also needs to be checked and retightened in case of compaction or shifting of the load arrangement.

The final stage of securing the on-deck cargo is carried out through over lashing, which is the installation of an additional fastening system at the top of the log array to improve the ship's ability to withstand the dynamic force of the load. This system uses wire rope, lashing chain, foot wire, turnbuckle, bow shackle, snatch block, wire clip, and tensioning tools, among others.

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Fastening is installed between the port and starboard sides with a pattern that is able to distribute the force evenly, then tensioning and final inspection are carried out by the Chief Officer with Bosun. During the voyage, the condition of the binding is checked periodically and re-tightened if there is any loosening due to cargo settlement, vibration, or bad weather. Thus, the entire process of loading logs on the MV. Cosmo Gloria—starting from planning, preparation, under-deck loading, on-deck loading, to center lashing and over lashing—is carried out with an emphasis on loading space efficiency, cargo stability, ship stability, and shipping safety in accordance with the Loading Plan, CSM, SOLAS Chapter VI, CSS Code, and TDC Code 2011.

Factors Inhibiting the Implementation of Log Loading on MV.Cosmo Gloria

There are several main factors that hinder the execution of log loading on MV. Cosmo Gloria, namely weather conditions, limited knowledge and experience of the crew, lack of understanding of the use of cargo securing or lashing equipment, and obstacles in maintaining ship stability during the loading process. These four factors are interrelated because the log loading process requires coordination between human aspects, equipment, environmental conditions, and ship stability control. If one of the factors cannot be controlled properly, loading times can increase and have an impact on delays in ship operations.

The first factor is weather conditions that directly affect lifting, stowage, and cargo securing activities. Log loads have a non-uniform shape and vary in weight so they require great care when lifting using a crane. High wind speeds can cause pendulum movement on logs and increase the risk of impact on hatch coaming, ship structures, loading and unloading equipment, and workers.

Table 2 Wind Speed in Log Loading

Wind Speed	Log Loading Operation Conditions
0–20 knot (0–10 m/s)	Normal conditions. The crane operation and log loading can run with regular supervision.
20–30 knot (10–15 m/s)	Surgery can still be performed with special attention. The crane speed is usually reduced and the operator must pay attention to the load swing.
30–40 knot (15–20 m/s)	High-risk conditions. Log loading began to be restricted, especially for large logs because they had a large surface area exposed to wind. Risk assessment is required.

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>40 knot (>20 m/s)	Generally, log lifting operations are suspended because the risk of losing control of the load increases significantly

Source : Author Data Processing (2026)

In addition, heavy rain can make the log surface slippery, hindering the arrangement and installation of lashing. This condition causes loading activities to be slowed down or temporarily stopped if the risk level exceeds the safe limit. In addition to wind and rain, waves, swells, and limited visibility are also operational obstacles. The movement of the ship due to waves can change the relative position between the ship and the dock, making it difficult for the crane operator to place the load precisely. Fog or heavy rain can also reduce visual communication between the crane operator, signalman, and stevedore. In these conditions, loading activities need to be reduced in speed or stopped until the situation is safe again. Cessation of operations due to weather reduces effective working hours, decreases loading productivity, extends port stays, and increases the likelihood of delayed ship departures.

The next factor comes from human resources, especially the limited experience and understanding of some crew members in handling log cargo. Operations on wooden transport vessels require special competence because the crew must understand the characteristics of the cargo, stowage procedures, and cargo securing systems. At the loading at the Port of Gisborne on January 14, 2024, it was found that the over lashing activity took place later than planned because some crew members did not have experience in securing log cargo. The planned activity was completed in 10 hours in the end it took about 12 hours, so the fumigation stage and the ship's departure schedule also underwent adjustments.

The delay was also influenced by the crew's lack of understanding of the difference between center lashing and over lashing. In its implementation, some crew members consider the two methods to have the same procedure so that the configuration of wire rope, snatch block, and turnbuckle is not installed in accordance with the Cargo Securing Manual and lashing plan. As a result of these method errors, the work has to be repeated and requires additional time. This condition shows that the technical competence of the crew has a direct relationship with operational productivity, since the lack of understanding of procedures not only slows down the work, but also increases the risk of cargo shifting during the voyage.

Another obstacle arises from a lack of understanding of the function and use of lashing equipment. In the installation of the stanchion, some crew members have difficulty determining the equipment that must be used, such as wire rope, chain, shackle, turnbuckle, and snatch block.

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Work that can normally be completed in about 20 minutes ends up taking up to an hour. The same thing happened in the installation of center lashing, when the crew did not understand the difference between a 23 mm diameter center lashing wire and a 27 mm diameter over lashing wire. As a result, center lashing work that normally requires 15–20 minutes has increased to about 40 minutes.

In the implementation of over lashing, competency problems became increasingly visible because some crew members had difficulty determining the type of wire rope, installing snatch blocks, connecting wire ropes with turnbuckles, and tightening the lashing system. In addition, some security equipment was found to be not functioning optimally due to poor maintenance. The combination of limited competence and suboptimal equipment conditions causes the over lashing process to take longer and contributes to delayed ship departures. Thus, the readiness of equipment and the ability of the crew are two aspects that are interrelated in determining the smooth running of cargo securing activities.

The results of the study also show that the problem of human resources is related to the existence of a competency gap and the lack of optimal practical familiarization programs. Some crew members have not adequately understood the contents of the Cargo Securing Manual, the functions of the equipment, and the order of installation of lashing and over lashing centers. The familiarization provided is still more theoretical and not sufficiently equipped with demonstrations and direct practice. As a result, the adaptation process takes longer and the crew only understands the procedure when loading activities are in progress. Therefore, practical training, lashing installation simulations, and competency evaluation before loading are important parts in reducing human error and improving work efficiency.

The next inhibiting factor has to do with changes in the stability of the vessel during the loading process. The characteristics of logs that have different lengths, diameters, weights, shapes, and stowage factors cause the distribution of loads in each hatch and on-deck area to be more complex. The addition of cargo on deck can increase the vertical centre of gravity (KG) and decrease the metacentric height (GM) if the load distribution is not well controlled. Therefore, the Chief Officer must continuously monitor GM, trim, heel, draft, shearing force, and bending moment using the Loading Computer. If any of the parameters are close to or exceeding operational limits, loading activities must be temporarily stopped and corrected through load redistribution, cargo restow, or ballast adjustments.

This condition once occurred when MV. Cosmo Gloria unloading at the Port of Tauranga, New Zealand. Evaluation using the Loading Computer shows that the value of the shearing force

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in the center of the ship is close to the operational limit, while the bending moment has the potential to exceed the limit if the loading sequence is continued. The Chief Officer then stopped loading for about 1–2 hours to make ballast adjustments and change the loading order to another hatch. After the re-simulation showed that the GM, trim, shearing force, and bending moment were back within safe limits, loading resumed. Thus, weather factors, crew competence, understanding and readiness of lashing equipment, and ship stability are the main obstacles in loading logs in MV. Cosmo Gloria. While corrective action may extend loading times, it is still necessary to maintain the safety of the vessel, crew, cargo, and compliance with SOLAS, ISM Code, STCW Convention, CSS Code, TDC Code, and Cargo Securing Manual.

The Smoothness of the Log Loading Process Enhances the Operational Efficiency of the MV Cosmo Gloria

The smooth execution of the log loading process is directly linked to the operational efficiency of the MV Cosmo Gloria. The characteristics of logs that vary in size, length, diameter, weight, and shape cause loading activities to require more careful planning, handling, load distribution, and stability monitoring. Every stage, starting from hatch preparation, stowage arrangement, cargo securing, to evaluating ship stability, must be carried out according to procedures so as not to cause operational obstacles. The smooth running of the process depends not only on the readiness of the ship and equipment, but also on weather conditions, human resource capabilities, understanding of lashing equipment, and the ability to maintain ship stability during loading.

Weather conditions are one of the factors that affect the efficiency of loading activities because the process of moving logs with cranes is greatly influenced by wind, waves, and rain. Strong winds can increase load swings and pose a risk of impact to ship structures, equipment, and workers, while adverse weather conditions may require a reduction in work speed or a temporary halt to loading activities. The termination has an impact on increasing port stay time and reduced operational time efficiency. However, these actions are still necessary as an application of the safety first principle to ensure that the achievement of productivity targets does not compromise the safety of crews, port workers, ships, and cargo.

The efficiency of loading is also highly determined by the competence of human resources. Lack of experience or knowledge of crew and labor regarding the characteristics of log loads can lead to misplacement, inconsistency with the loading plan, and the need for re-correction of the load arrangement. This condition extends loading time as the Chief Officer must conduct

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additional checks to ensure the distribution of the load remains within safety limits. Therefore, improving competence through training on log handling, safety procedures, and understanding of manual cargo operations is important to reduce work errors and increase productivity. In accordance with the principles of the ISM Code, personnel involved in ship operations must have adequate competence and training in order for activities to take place safely and effectively.

Another aspect that affects the smooth loading is the crew's understanding of cargo sewing equipment. The use of wire rope, chain lashing, turnbuckle, tensioner, stopper, and other safety devices requires an understanding of the function, installation method, and limits of the capabilities of each equipment. Errors in lashing installation can increase the risk of cargo shifting, damage to safety devices, and ship safety disruptions. In addition, inappropriate installation also requires re-inspection and repair before the ship is allowed to sail, increasing operational time. Thus, competence in the implementation of cargo securing in accordance with the CSS Code, TDC Code, and ship procedures plays an important role in accelerating the completion of loading while maintaining cargo safety during shipping.

The smooth loading process is ultimately also determined by the ability to maintain the stability of the ship as long as the weight of the load increases gradually. Variations in log characteristics can change the position of the center of gravity, KG value, GM, trim, heel, draft, shear force, and bending moment, so all of these parameters must be monitored continuously using the Loading Computer and verified through manual calculations. If conditions are found to be close to the operational limit, the loading process can be temporarily stopped to make ballast adjustments, change the loading sequence, or redistribute the load. While these corrective actions can increase loading times, proper control supports overall operational efficiency by preventing greater disruptions, maintaining ship readiness before sailing, and minimizing the risk of delayed departures. Thus, a planned, systematic, safe, and procedurally compliant loading process is able to speed up the completion of activities, reduce port stay time, and increase operational efficiency MV. Cosmo Gloria.

Log Loading Process Can Optimize Ship Operations on MV.Cosmo Gloria

The operational optimization of MV Cosmo Gloria is significantly influenced by the effectiveness and efficiency of the log loading process. Loading activities are not only directed to achieve the amount of cargo according to the capacity of the ship, but must also consider safety, ship stability, time efficiency, and the readiness of human resources. The non-uniform characteristics of logs in terms of size, length, diameter, weight, and shape make the loading

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process more complex than other types of loads. Based on the results of the research, optimization can be achieved through the implementation of the right loading plan, continuous stability monitoring, improving personnel competence, using cargo securing equipment according to standards, and the ability to adapt activities to changing environmental conditions. Its implementation refers to the safety principles contained in SOLAS 1974, the ISM Code, the CSS Code, and the IMO Timber Deck Cargo Code.

Weather conditions are one of the important aspects in optimizing loading because lifting activities using cranes are greatly influenced by wind, rain, waves, and visibility. Strong winds can increase load swings, while rain causes log surfaces to become slippery and reduced visibility can hinder communication between signalmen, crane operators, and officers in the loading room. Therefore, optimization is carried out from the pre-loading planning stage through the use of weather forecasts in the preparation of loading schedules, then continued with real-time weather monitoring during the activity. In safe conditions, operations can be continued with mitigation in the form of reducing crane speed, using taglines, improving communication, and adding signalmen. Conversely, if the weather exceeds operational limits, loading must be temporarily stopped as part of the Safety Management System. Proper weather management can reduce disruption to port turnaround time while maintaining operational safety and productivity.

The next optimization is carried out through improving the competence of human resources because the success of loading is highly dependent on the ability of personnel to operate equipment, understand the loading plan, make decisions, and implement work procedures correctly. The results of the study still found several obstacles, such as lack of experience handling logs, delays in understanding changes in loading plans, cargo positioning errors, and suboptimal coordination between crew and stevedore. These conditions can increase loading times and increase risks to ship stability. Therefore, continuous training and familiarization is required which includes log characteristics, cargo stowage arrangements, the use of loading computers, ballast operations, lashing techniques, crane communication, and safety procedures. The implementation of toolbox meetings, pre-loading safety briefings, improved coordination through BRM and TRM, and periodic competency evaluations are also needed to reduce human error and accelerate operational decision-making.

Another important aspect is the optimization of the lashing system through increasing the crew's understanding of cargo securing equipment. The shape of the logs is cylindrical, non-uniform, and relatively slippery, causing cargo to be at risk of cargo shifting or rolling due to dynamic forces during shipping. Therefore, equipment such as wire rope, chain lashing,

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turnbuckle, shackle, wire clip, stopper, and tensioning devices must be used according to the function, capacity, and Safe Working Load listed in the Cargo Securing Manual. Optimization is carried out through lashing configuration planning according to the characteristics of the cargo and shipping route, checking the condition of the equipment, training in installation and tensioning techniques, and pre-departure cargo securing inspection. Checks should also be carried out during the voyage, especially after facing bad weather, and re-tensioning should be carried out if loosening ties are found. These efforts can reduce the correction time before departure while minimizing the risk of load shifts, structural damage, and work accidents.

Operational optimization also relies heavily on controlling the stability of the vessel during the loading process. The gradual addition of logs in the hatch and on deck causes changes in displacement, draft, trim, heel, KG, GM, shear force, and bending moment. To control these changes, the Chief Officer uses a Loading Computer to simulate various scenarios and determine a safe and efficient loading sequence. However, computer results must still be verified through manual calculations to anticipate input errors and system interference. Control is also carried out through ballast adjustment, load redistribution, and change of loading order if the load distribution is uneven or the stability parameters are close to the permissible limit. Any significant change in the amount of payload needs to be followed by data updates and re-evaluation so that corrective action can be taken before the condition of the vessel reaches critical limits.

Thus, optimizing the log loading process on the MV. Cosmo Gloria is the result of integrated management between loading planning, weather conditions, human resource competence, cargo securing system, and ship stability control. The use of loading computers accompanied by manual verification, ballast management, continuous monitoring of stability parameters, crew training, and lashing inspections allows the loading process to take place more safely, systematically, and efficiently. This approach can minimize cargo shifting, load planning errors, ship instability, excessive structural stress, and delays due to corrective actions that should have been prevented. Ultimately, an optimal loading process can enhance the productivity and operational reliability of the MV Cosmo Gloria while ensuring compliance with SOLAS 1974, the ISM Code, STCW 1978 (including the 2010 Manila Amendments), the CSS Code, the Timber Deck Cargo Code, and other maritime safety standards applied in this study.

CONCLUSION

The results of the study regarding the optimization of the log loading process in MV. Cosmo Gloria, it can be concluded that the loading process, both in the hatch (under deck) and on deck

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(on deck), must be carried out in a planned, integrated manner, and in accordance with international maritime safety standards. The loading stages include planning, preparation, implementation, supervision, and cargo security based on the Loading Plan, checking the readiness of loading spaces and equipment, controlling ship stability, and implementing a cargo securing system. Loading in the hatch must pay attention to weight distribution, space efficiency, shearing force, bending moment, draft, trim, and metacentric height (GM), while on-deck loading requires attention to deck capacity, stanchion installation, center lashing, and over lashing. The entire process is carried out with reference to SOLAS 1974, ISM Code, CSS Code, 2011 TDC Code, International Convention on Load Lines, and Cargo Securing Ship Manual.

Execution of log loading on MV. Cosmo Gloria still faces a number of inhibiting factors that come from internal and external factors. External factors are mainly in the form of weather conditions such as strong winds, rain, waves, and limited visibility that can cause restrictions or temporary suspension of loading activities. Meanwhile, internal factors include limited competence and experience of the crew, lack of understanding of the use of cargo securing equipment, and changes in stability due to the gradual distribution of cargo. These changes affect GM values, trim, heel, draft, shearing force, and bending moment, so they must be monitored using a Loading Computer and verified through manual calculations. Therefore, controlling these factors through the implementation of SMS and compliance with international regulations is important to maintain the safety and smooth operation of the ship.

The smooth execution of the log loading process has proven to have a significant impact on enhancing the operational efficiency of the MV Cosmo Gloria. Loading that is carried out systematically and according to procedures can speed up the completion of activities, reduce port stay time, minimize the risk of late departure, and increase ship readiness before shipping. This efficiency is greatly influenced by weather conditions, human resource competence, the ability of the crew to use cargo securing equipment, and the accuracy of stability control. With good management of human aspects, methods, equipment, material characteristics, and environment, the loading process can take place more effectively, safely, and support the sustainability of ship operations optimally.

Overall, operational optimization of the MV. Cosmo Gloria can be achieved through the implementation of integrated loading management, encompassing the preparation of an accurate loading plan, sequencing of loading operations, use of a loading computer, enhancement of crew competence, application of cargo securing systems in accordance with the Cargo Securing Manual (CSM), weather monitoring, and stability control through the evaluation of GM, trim, draft, shear

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force, and bending moment. This step is able to reduce the risk of delays, operational errors, lashing system mismatches, and stability disturbances due to uneven load distribution. Thus, a safe, effective, and controlled log loading process not only supports operational time efficiency, but also ensures that ships are ready to sail according to SOLAS 1974, ISM Code, CSS Code, TDC Code, and STCW 1978 standards.

RECOMMENDATION

The company and the parties associated with MV. Cosmo Gloria are advised to maintain and enhance oversight of the entire log loading process to ensure strict adherence to the Loading Plan, Cargo Securing Manual (CSM), and Safety Management System (SMS). Continuous monitoring of the vessel's stability is required—through the evaluation of GM, trim, heel, draft, shearing force, and bending moment—complemented by inspections of cargo securing conditions before, during, and after loading. The Captain and Chief Officer also need to improve the implementation of toolbox meetings, safety briefings, pre-loading meetings, and practical familiarization before work begins. In addition, companies need to strengthen pre-joining training programs, practice-based training on timber cargo operation, the use of lashing equipment, and cargo securing procedures, while ensuring that all security equipment is inspected and maintained through the Planned Maintenance System. Coordination between ships, terminals, and loading and unloading personnel also needs to be strengthened so that operational risks can be controlled and the loading process takes place more safely, effectively, and efficiently.

For further research development, the study can be directed to a more in-depth quantitative analysis of the effect of log load distribution on ship stability, especially changes in GM, trim, shearing force, and bending moment by using various variations of loading conditions on the Loading Computer. The next research can also develop loading sequence optimization methods by considering load distribution, ballast use, operational time, and ship safety limits, as well as examining human factors through evaluation of crew competencies and training effectiveness. On the operational side, the crew still needs to improve their understanding of log characteristics, cargo securing, the use of Loading Computers, and stability analysis through regular training and familiarization. Supervision of loading sequences, lashing conditions, load distribution, and changes in stability parameters must be carried out on an ongoing basis, accompanied by regular inspections of cargo securing equipment so that all equipment remains in a suitable condition and supports the safety and operational efficiency of the ship.

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