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Optimization of Hoisting and Luffing Wire Crane Maintenance as a Main Support For The Loading and Discharging Process of MV. PAN DAISY

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***Abstract*—The purpose of this study is to determine and analyze how the ship's crew maintains the hoisting and luffing wire to obtain optimal maintenance in ensuring the loading and Discharging process on the MV.PAN DAISY operates optimally when using the ship's crane. The author uses a qualitative descriptive method to create a cause and effect approach used to describe the case that occur on the ship. On the MV. PAN DAISY the author takes a case related to the title of the study. 6 broken wires were found on the hoisting crane number 2, so the ship's party was asked to replace the wire crane immediately so that the loading and discharging process could begin, this hampered the loading and Discharging process on the MV.PAN DAISY. To ensure that the ship's crane can operate optimally, it is necessary for the crew to carry out maintenance in accordance with the PMS and carry out supervision by creating a crane running hours checklist to find out for sure the schedule for renewing the wire crane. As long as these efforts are carried out correctly, the ship's crane is always ready to be used to loading and discharging process..**

Keywords—Hoisting and luffing wire, maintenance, loading and Discharging process, supervision.

I. INTRODUCTION

The maritime transport fleet is generally used as a means to distribute goods from one place to another. Problems often arise in the loading and Discharging process, which frequently become an issue related to the type and form of the cargo. This is addressed by the creation of specialized ships that can only transport certain commodities, such as bulk carriers.

A bulk carrier, also known as a bulk ship, is the type of vessel with the largest population. A total of 16,892 units recorded worldwide. As its name suggests, this ship is intended for carrying bulk cargo (such as coal, grains, sugar in bags, rice in bags, steel coils, etc.). Unlike general cargo ships that can carry various types of cargo. Bulk carriers typically transport one type of (homogeneous) cargo. Bulk carriers include single decker types and cannot carry containers. This ship has a cargo hold (the section for placing the cargo) and is equipped with hatches to protect the cargo.

MV. PAN DAISY from Panama Ocean Shipping Management is a bulk carrier built in 2009. This bulk carrier transports cargo such as steel, fertilizers, sulfur, rice in bags, and can also carry wood and other cargo. MV. PAN DAISY has a crane deck as the main facility in the loading and Discharging process. Many of the loading and Discharging activities of MV. PAN DAISY are carried out using the crane located on the ship. Having a crane on board is one of the supporting factors for the efficiency of the loading and Discharging process. Behind those advantages, cranes also require inspection and maintenance of the hoisting and luffing wires to ensure safety and security during the loading and Discharging process.

The maintenance of the hoisting and luffing wires is still not optimal and does not align with the maintenance plan system that is in place on the ship. The ship, which is now 14 years old, can already be considered an old ship in 2023. It is a heavy responsibility for the Chief Officer to maintain all parts of the ship on deck, as many areas require intensive care and attention. Therefore, the Chief Officer focuses on the parts of the ship that have the highest priority for maintenance. For example, there are the hatch covers, the windlass, the rusted deck, the leaking hydraulic pipes of the hatch covers, and many others. The maintenance of the deck crane is not only aimed at hoisting and luffing, but also at the cargo block, crane hook, and sheave. The consequences of this have an impact during the loading and Discharging process of granite stones in Mumbai, India, at the time of Discharging the cargo. The crane surveyor found 6 wires on the hoisting wire rope of crane number 2 in a broken condition. The crane surveyor reported to the Chief Officer to immediately replace the broken hoisting wire. With the crew having different understandings of how to replace the wire, the process of replacing the wire took quite a long time to assemble the entire team to plan the replacement of the wire rope. Ultimately, the crane surveyor decided to postpone the loading and Discharging process. This has resulted in losses in terms of material and time that are certainly beyond expectations, due to the condition of the ship not being ready to facilitate loading and Discharging activities.

The supervision of officers during the loading and Discharging process in the field is still lacking, resulting in crane operators from the port often working unprofessionally, disregarding the safety of the maximum lifting weight of the crane when not under the officers' watch. On the other hand, there is a need for skilled crane operators who can handle various types of loads during loading and Discharging activities. Monitoring in the form of hoisting and luffing running hours wire recordings, as well as consistent records of wire replacement dates, is not applied to determine the maximum usage age of the wire. In addition to data recording monitoring, having certified hoisting and luffing wire is very important and it is the Chief Officer's responsibility to ensure that all wires used have passed the tests indicated by the certification. Furthermore, the preparation of spare wire is crucial; as a Chief Officer, it is essential to understand the importance of providing sufficient spare wire to avoid unavailability in emergencies when a wire replacement is needed. A checklist from the plan maintenance system is necessary to be applied as a standard guideline for maintenance and structured supervision, as well as a reference for the company related to recording the maintenance history on board the ship.

The primary objectives of this research are:

- To determine how to ensure that the maintenance of wire cranes is carried out according to the maintenance plan system.
- To find out how to enhance the supervision of the duty officer regarding the lifting capacity of the safety working load of the crane during loading and Discharging activities.

This research is expected to broaden the knowledge of prospective officers or cadets who wish to work and serve as officers on vessels equipped with deck cranes, to understand the forms of supervision, maintenance, and also problem-solving related to hoisting and luffing wire deck cranes, and to serve as reading material in the STIP library. The results of this research are expected to serve as a reference for sailors who will work on similar ships and can be used as input for the companies operating such vessels.

II. Literature Review

A. Loading and Discharging Process

As mentioned by Istopo (1999) in the book "Ships and Their Cargoes", loading and Discharging refers to the placement or transfer of cargo from land onto a ship or vice versa, moving cargo from the ship to the destination port. As mentioned by Dirk Koleangan (2008:241) in the book titled "Container System", the definition of loading and Discharging activities is as follows: Loading and Discharging activities refer to the process of transferring goods from land transport vehicles, and to carry out this transfer of cargo, adequate facilities or equipment are required in a certain manner or shipping procedure. From the above definition, it can be concluded that loading and Discharging is the activity of transferring goods from inside or outside the ship using preparations that are arranged before the loading and Discharging activities are carried out. The loading and Discharging services at the port are carried out by the Stevedoring Company. According to the regulation of the General Manager of PT. Pelabuhan Indonesia III (PERSERO) Branch Tanjung Emas Semarang No: PER. 35/05.0102/TMS 2011 regarding the service procedures for ships and goods, the Stevedoring Company is a legal entity in Indonesia specifically established to organize and manage the loading and Discharging activities of goods to and from ships. Meanwhile, the Loading and Discharging Labor refers to all workers registered at the local port who perform loading and Discharging work at the port.

B. Maintenance

Maintenance as mentioned by Kurniawan (2013:2) is an activity carried out in an industry to maintain or enhance the capacity of machines during the production process. A production machine that is used continuously will experience a decline, which is why maintenance needs to be carried out. Optimal maintenance should be carried out continuously and periodically so that the machine can function at its best. According to the National Skills Occupation Standards (NSOS) (2004:110) in the book "Maintenance and Repair Management", maintaining a ship involves continuous management to ensure that the facilities or maintenance of the ship can be utilized for the smooth operation of shipping business processes.

Types of maintenance process:

1) Preventive Maintenance : Preventive maintenance is the activity of care and maintenance aimed at preventing unexpected damage and detecting conditions that, if used in the production process, could result in damage to manufacturing equipment.

2) Corrective Maintenance : Corrective maintenance is the maintenance performed to restore a machine to its normal condition through repairs or adjustments. Unlike preventive maintenance, which is carried out routinely without waiting for damage to occur, corrective maintenance is performed only after components show signs of damage or are completely broken.

Corrective maintenance is divided into 2 types, namely:

1) Repair and Adjustment : Repair and adjustment refer to maintenance that fixes damage that is not yet severe or cannot be repaired. For example, if the charging system is not functioning properly (no charging), one way to fix it is by making adjustments.

*2) Brakedown Maintenance :*Breakdown maintenance is the maintenance carried out after something can no longer be used. This is largely due to ongoing damage that has been continuously ignored and cannot be repaired.

C. Wire Rope

Wire rope is an essential element in withstanding tensile forces in lifting and moving loads. The assumption of wire rope as a machine is acceptable because wire rope has several moving parts that bear the load and dynamically distribute it to perform work. One advantage of wire rope is its ability to withstand heavy loads while remaining flexible at the same time.

Inside the MV. PAN DAISY ship, there is a deck crane that operates using two types of wire ropes, namely hoisting wire and luffing wire, which have the following differences:

1) Hoisting Wire : Hoisting wire is a lifting medium widely used in environments where heavy lifting occurs, such as heavy metal casting, factories, and manufacturing plants. It is similar to a conventional standard electric hoist, which instead uses a steel chain to lift loads of varying weights.

2) Luffing Wire : Luffing wire rope is most suitable when there is enough space on the deck. This crane offers a cost-effective alternative to knuckle boom or telescopic boom. The luffing jib crane with a Box Boom or Lattice Boom is a reliable and effective crane for handling general cargo offshore on ships and offshore units. Derek is designed for efficient and accurate handling of general loads at variable radii, depending on the angle of the luffing boom.

D. Supervision Concept

Supervision is one of the organic functions of management, which is the process of leadership activities to ensure and guarantee that the goals and objectives, as well as the tasks of the organization, are and have been carried out properly in accordance with the established plans, policies, instructions, and regulations that are in effect. (LAN RI, 1997:159). A broader understanding of supervision is presented by Victor and Jusuf (1993:17) as follows: among experts or scholars, the concept of controlling has been equated with supervision. So, supervision is included in control. Control means directing, correcting activities that are off course, and steering them towards the right direction.

The monitoring techniques according to Prof. Dr. Sondang P. Siagian, in the Philosophy of Administration (1994:139), are as follows:

1) Direct control which is : when the leader of the organization personally oversees the activities being carried out.

2) Indirect control which is remote monitoring, which is conducted through reports submitted by subordinates.

Based on the theories presented in the literature review, it is evident that care is very important and that proper maintenance and supervision are necessary to achieve good and optimal results. Maintenance is needed to prevent damage due to aging and the wear and tear of equipment, which results in a decrease in the capability of loading and Discharging tools. Although the maintenance of loading and Discharging equipment has been carried out properly according to the regulations, if the supervision of the operation of the loading and Discharging equipment is not conducted with greater responsibility, it can lead to the improper use of the equipment, resulting in damage to the loading and Discharging equipment. This means that the maintenance should be carried out in accordance with the regulations, and the supervisory function must be conducted with greater responsibility, both for the ratings and the ship's officers.

The delay in the loading and Discharging process on the ship caused by equipment malfunction is the responsibility of the ship's party. Therefore, in the preparation of this thesis, the author starts from what causes this issue, namely the malfunction of the crane loading and Discharging equipment. This damage has been attempted to be repaired, but there are times when these repair efforts have not been effective because the maintenance procedures have not adhered to the existing protocols. This issue has become the basis for the author's thoughts in the preparation of this thesis.

According to Usman Effendi (2014:138), supervision is the most essential management function; no matter how well the work activities are carried out, without supervision, those activities cannot be deemed successful. Meanwhile, Irham Fahmi (2014:138) states that supervision can generally be defined as a way for an organization to achieve effective and efficient performance, further supporting the realization of the organization's vision and mission.

III. METHODHOLOGY

Research methods are the ways to discover, develop, and test the truths of the principles of a natural phenomenon, society, or humanity based on the relevant scientific discipline in a scientific manner. Essentially, research methods are scientific approaches used to find data in research for specific purposes and uses with the methods that will be employed.

Based on the explanation above, the important role of research methodology can be understood as providing an overview of the results from all studies and research obtained during the researcher’s practical experience at sea on the ship, by explaining what and how the research was conducted in the preparation of this thesis. The author will also explain in detail about the time and place during the research, as well as the methods used in the research that has been conducted. Thus, in this chapter, the author aims to provide a better understanding of the research process conducted by the author, with the hope that reaunders can comprehend the research results obtained very well.

A. Time and Place of Research

1) Time of Research : In obtaining detailed data and information, the writer acquired it during the research conducted while on board the MV. PAN DAISY, specifically from the sign-on date of December 18, 2021, to the sign-off date of October 30, 2022.

*2) Place of Research :*Tempat penulis melaksanakan penelitian dan pengamatan adalah di atas kapal MV. PAN DAISY, milik perusahaan pelayaran asal Korea yaitu PANAMA OCEAN COMPANY LTD. Dengan kerjasama cabang Indonesia PT. JASINDO DUTA SEGARA sebagai crewing supplier yang berkebangsaan Indonesia.

B. Research Design

The qualitative descriptive research method aims to understand and describe social or cultural phenomena within a broader and more complex context through exposition methods by analyzing data in the form of findings obtained in the field, using measurement tools in the form of theories that are relevant to the issues being studied, thus uncovering the causes and effects of a particular problem. According to Mukhtar (2013:10), "Qualitative descriptive research method is a method used by researchers to discover knowledge or theory regarding research at a specific point in time." The cause and effect of the lack of maintenance and supervision on wire cranes leads to problems that hinder loading and Discharging activities.

C. Data Collecting Methods

Complete, objective, and accountable data and information must be researched and presented as a depiction and understanding that can assist in the preparation of this thesis. This writing requires assistance in the form of data analysis to formulate the material issues in order to achieve good writing results.In this regard, the author collected data using the following techniques:

1) Observation : What is meant by observation is the research conducted by directly visiting the location being studied and seeing firsthand what is present in the field. In other words, data collection through direct observation involves gathering data using one's own eyes, which can be assisted by a camera as additional evidence for the research, all of which has been systematically planned and is intended *for research purposes.*

2) Literature Study : Collecting data and information from various literatures or other sources that are closely related to the understanding of wire cranes, as well as how to practice it on board a ship with the theories found in books related to the issues to be discussed, so that the extent of its application on the ship can be determined.

3) Documentation : Documentation is a data collection technique that involves gathering and recording all data or information related to the issues connected to the discussion in qualitative research. According to Sugiyono (2016:240), he defines documentation studies as follows: "Documents are records of past events. Documents can take the form of writings, images, or monumental works by an individual. Written documents, for example, include diaries, life histories, biographies, and policy regulations".

D. Data Analysis

To analyze the main issues that arose during the research, the author employs descriptive data analysis techniques, which involve detailing the events that occurred in the field and then presenting them in written form or narrative, starting from the origin of the problem, the causes of its emergence, analyzing the issues, and ultimately finding solutions to the problems investigated in this thesis. By using descriptive analysis techniques, the author can gain a deeper understanding of the phenomenon or issue being studied. This is because the author can collect more comprehensive data. The technique of qualitative descriptive analysis allows the writer to perform a deeper interpretation of the data obtained. The writer can analyze the meaning or significance of the data collected, thus enabling a more profound understanding. This allows the writer to discover new data that was not previously found. This is because the writer can conduct direct observations with the subjects involved in the research, enabling them to uncover information that has not been revealed before.

With the issues related to the crane on the MV. PAN DAISY ship, several solutions have been identified, including conducting regular maintenance on the crane wire and implementing coordinated supervision by officers. It is hoped that this will make it easier for readers to understand the content of the research presented by the author.

IV. Findings And Discussion

A. Findings

1) Data Description

One of the factors that support the smoothness of the loading and Discharging process on ships is the availability of equipment, such as loading and Discharging tools, which must be in ready-to-use condition. An example of this is the crane, which must always be operational during the loading and Discharging process. Based on the author's experience, the author found several incidents during the loading and Discharging process on the MV. PAN DAISY that underlie the preparation of this thesis, including:

a) The maintenance of the hoisting and luffing wire has not been in accordance with the maintenance plan.

In February 2022, the MV. PAN DAISY was docked to carry out Discharging activities at the port of Mumbai, India. At that time, the loading process was requested to use a ship's crane, because the port did not have crane facilities to carry out the loading process. The cargo to be loaded is granite stones. During the loading preparation process, a problem occurred when the wire on crane number 2 broke during the crane inspection by the Crane Surveyor, causing the loading and Discharging activities to come to a halt. The duty officer who was aware of the incident immediately reported it to the Chief Officer and the Master. The Chief Officer, along with the bosun and the able-bodied seaman on duty, promptly inspected the condition of the crane and the broken wire. After the inspection, the Chief Officer stated that the wire broke because it was not in good condition before being used, or in other words, maintenance on the wire had not been carried out. The Chief Officer reported the condition of crane no. 2 to the Master, and at that moment, the Crane Surveyor decided to request the Master to replace the wire of crane no. 2 as soon as possible. The data regarding the MV. PAN DAISY is that it is a bulk cargo ship equipped with Discharging equipment, specifically 4 cranes at each separator between the holds (Cross Deck) that connect one to another, and it has 5 holds in total.

b) The suboptimal supervision of the duty officer regarding the lifting capacity of the crane's safety working load during loading and Discharging activities.

While the MV. PAN DAISY was conducting loading and Discharging operations at the port, the chartering party requested the use of the ship's crane in the loading and Discharging process, with the cargo to be unloaded at that time being granite stones. During the preparation for the Discharging process, the duty officer and the crew did not pay attention to how the crane was being operated by the crane operator at the port. It was evident that during the loading and Discharging process, the duty officer and the crew were overwhelmed trying to monitor each crane operator, who did not adhere to the maximum load that the crane could lift. The Safety Working Load (SWL) for the crane is 25 tons, but the operator was lifting a load exceeding the recommended safe limit of 25 tons, approximately 30 tons, which caused the wire on crane number 2 to break. This incident was noticed by the crane surveyor before anything undesirable occurred, preventing any losses or incidents that could harm the duty officer. This was immediately reported to the Chief Officer and the Master. The Chief Officer and bosun promptly

inspected the condition of the crane. After the inspection, the Chief Officer reported that the cause of the rope breaking was not only due to the poor condition of the wire but also because the officer on duty was not paying enough attention to the lifting process, which exceeded its load capacity beyond the Safe Working Load (SWL) of 25 tons, as they were overwhelmed in monitoring during the loading and Discharging process.

2) Data Analysis

Based on the data description above, an analysis is conducted to identify the root causes of each issue present, as follows:

a) The maintenance of the hoisting and luffing wire has not been in accordance with the maintenance plan system: Based on the description of the data provided, it can be analyzed that there are several factors causing the maintenance of the hoisting and luffing wire to not align with the maintenance plan system. These factors are:

- Intensive maintenance on the MV. PAN DAISY ship. With the numerous equipment and parts requiring maintenance on the ship as well as repairs, this leads the Chief Officer to prioritize urgent tasks first, such as fixing the rubber on the hatch cover and replacing the brake pads on the winch and windlass, resulting in the maintenance of the hoisting and luffing wire not being carried out according to the routine schedule of the maintenance plan system.
- Difficulties in performing maintenance due to field conditions. Maintenance on the hoisting and luffing wire crane, which involves lubricating the wire with grease, requires the crew to climb up to the crane wire at height. This lubrication maintenance can only be performed while the ship is sailing or anchored, as when docked, the crew cannot conduct maintenance on the wire because the crane is in operation. Additionally, during sailing conditions, lubricating the wire requires calm sea conditions, which are rarely encountered, leading to delays in maintenance.

b) The suboptimal supervision by the watch officers: regarding the safety working load capacity of the crane during loading and Discharging activities is influenced by several factors. These factors include:

- The fatigue experienced by the watch officers due to overtime and watch hours. One of the duties of the Second Officer and Third Officer is to assist the Chief Officer in cargo operations during their watch. The officers on duty on the MV. PAN DAISY perform a 6-hour watch each, but sometimes after completing their watch, the Second and Third Officers work overtime. This is what causes the lack of rest hours to do. Monitoring of loading and Discharging activities, and this reduces the rest time for the crew, which will lead to fatigue during the next watch.
- The lack of knowledge about the risks that may occur Often, when the duty officer supervises loading and Discharging, they do not focus on the load being lifted by the crane itself, but rather on the amount of cargo that has been loaded or unloaded, the ship's draft, and the loading and Discharging activity reports. This is due to the absence of understanding or a strong emphasis on supervision regarding the lifting capacity of the crane, unlike the Chief Officer who is well-versed in the supervision and maintenance of all components on deck.

B. Discussion

The findings from this research will provide insights into the key factors that contribute to effective collaboration between maritime institutions and industry stakeholders. These insights will be used to develop a model of best practices for transforming seafarer training through innovation.

C. Evaluation for Problem Solving

Based on the alternatives offered by the author to solve the problem, the author first conducts an analysis of the problem-solving alternatives by considering the previous advantages and disadvantages, which will later be used as the appropriate solution to address the issues at hand. Here is the problem-solving analysis that the author presents:

1) The maintenance of the hoisting and luffing wire has not been in accordance with the maintenance plan system.

a) Taking overtime to carry out urgent repairs: By taking overtime for the crew in carrying out urgent maintenance and repairs on the ship, this prevents the maintenance schedule that has been planned for 1 month, 6 months, and annually from needing to be rescheduled. The crew's break time is reduced.

Determining the priority scale: The ship maintenance planning schedule that has been prepared for a period of 1 month, 6 months, and annually is not rescheduled. There are no negative aspects.

The suboptimal supervision by the watch officer regarding the lifting capacity of the crane's safety working load. Implementing working hours in accordance with MLC 2006 (Marine Labour Convention) : This can enhance the quality of work from the watch officer and crew in supervising during loading and Discharging. The disadvantages is daily targets for maintenance and supervision are not met due to regular overtime on usual days, and now, according to the schedule, it allows for many tasks to pile up and remain unfinished.

Providing understanding or education meeting: Enhances the crew's sense of responsibility in supervising the crane's lifting capacity, thereby reducing the risk of workplace accidents. The disadvantages is that it takes time and disrupts other schedules to hold an education meeting.

D. Solutions for the Problem

After evaluating each alternative solution, the author attempts to provide the most appropriate alternative to be chosen as the solution to the problem. The author will describe the problem-solving approach to the issues raised as follows:

1) The maintenance of hoisting and luffing wires has not been in accordance with the maintenance plan system: In finding a solution, the author chooses from various alternatives to address the issue of maintenance on hoisting and luffing wires not aligning with the maintenance plan system, so that officers and crew on board are aware of the

correct implementation of the maintenance plan system procedures regarding the maintenance of loading and Discharging equipment on the ship, as well as the planning of periodic or regular maintenance by determining priority scales and organizing the planning.

2) The lack of optimal supervision by the on-duty officer regarding the lifting capacity of the crane's safety working load during loading and Discharging activities: Regarding this issue, the author determines the solution by implementing break times in accordance with the regulations in the MLC 2006 (Marine Labour Convention), which states that the maximum working hours for seafarers is 14 hours per day or 72 hours per week, with a rest period of 10 hours per day. Furthermore, the rest time should not be divided into more than 2 periods, with at least 6 hours of rest being provided consecutively in one of the two periods.

V. CONCLUSION

Based on the presentation of various issues along with their solutions in the previous chapter regarding the maintenance of hoisting and luffing and the supervision of crane operations on the MV. PAN DAISY, the best alternative solutions have been identified as follows:

- The maintenance of the hoisting and luffing wire on the MV. PAN DAISY is still not in accordance with the maintenance plan system, resulting in premature damage to the crane wire and disrupting the loading and Discharging process of the ship. This lack of maintenance is due to the numerous equipment and parts that require maintenance or repair on board, as well as the difficulties encountered during maintenance due to field conditions that depend on sea and weather conditions.
- The suboptimal supervision by the duty officer regarding the lifting capacity of the crane's safety working load during loading and Discharging activities leads to premature damage to the crane wire. This lack of supervision is caused by the fatigue of the duty officer and crew due to overtime work, as well as a lack of understanding of the dangers posed by not adequately monitoring the SWL lifting capacity. To improve the performance of the duty officer in supervision due to fatigue, it is necessary to implement working hours in accordance with MLC 2006 (Marine Labour Convention) and ensure that the physical condition of the personnel is fit so that supervision during loading and Discharging becomes optimal.

The ship's crew must pay more attention to the maintenance and supervision procedures for the crane, so that the loading and Discharging process is not hindered.

1) The maintenance of the hoisting and luffing wire has not been in accordance with the maintenance plan system: The crew should create a periodic or regular maintenance plan by determining the scale of priorities and organizing the planning. The company can recommend to the ship's master to call in technicians from the shore or additional workers from the shore to assist in completing heavy tasks, so that the planned work can proceed in an orderly manner.

2) The suboptimal supervision of the duty officer regarding the lifting capacity of the crane's safety working load during loading and Discharging activities: To improve the performance of the duty officer in supervision due to fatigue, working hours in accordance with the MLC 2006 (Marine Labour Convention) should be implemented. The company can remind and provide understanding and education to the ship's crew to be more attentive to maintenance on board, especially emphasizing to the officers that the other crew members should be more concerned.

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