

CARGO AMOUNT DIFFERENCES: A CARGO LOADING PROBLEM AT DURBAN SOUTH AFRICA AND SHEET HARBOUR CANADA

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Abstract

MV Ultra Cory, operated by Ultrabulk, experienced variations in the amount of woodchips loaded at two locations: Durban (South Africa) and Sheet Harbour (Canada). Although the vessel's cargo volume and type remained constant, differences in total cargo weight occurred, likely due to variations in site conditions, temperature, and weather. This study aims to identify the factors contributing to these discrepancies and propose solutions to ensure maritime safety and efficiency. Qualitative methods were employed, including observations, interviews, and documentation analysis during sea practice. The study focused on environmental factors, loading methods, and weather conditions. Validity was ensured through data triangulation, while Fishbone analysis identified potential causes, such as human, material, method, measurement, and environmental factors. The findings revealed that the hot, dry climate in Durban results in lower moisture content in woodchips, while the cold, humid conditions in Sheet Harbour lead to increased moisture absorption, raising the cargo weight without significant volume changes. This discrepancy highlights the need for improved cargo handling practices. To address the issue, strategies such as adjusting stowage factors based on moisture content, implementing faster hatch closures, conducting periodic draft surveys, and enhancing coordination with ports are recommended. These measures will minimize cargo weight differences, ensuring better operational efficiency and maintaining maritime safety standards.

Keywords: Durban, Sheet harbour, Stowage factor, Woodchips.

INTRODUCTION

The amount and type of goods transported by people around the world is constantly increasing as the population and their needs grow. Ships are not only large, but also have equipment that is constantly evolving to provide the transport. The transport of cargo on ships prioritises safety, efficiency and reduction of additional costs. So that it can be ensured that there is no loading space left in order to increase the efficiency of transportation. But in reality, sometimes the stowage factor given in the voyage instruction with the loading operation is different. Because in this research what is transported is wood cargo. Therefore, this study was carried out on board MV Ultra Cory, due to Given that wood was the property of absorbing water, the difference in temperature and weather in South Africa and in Canada can affect the DWT of the Cargo.

The factors outlined in this research are some of the problems of total load differences with the same cargo but in different places, temperatures and weather. which need to be studied and explored properly, analysed and then solved. According to that problem, it could be formulated by 2 problem formulation:

1. What factors cause differences in the ampunt of woodchips cargoes in Durban South Africa with Sheet Harbour, Nova Scotia, Canada?
2. What precaution should be made to overcome the differences in amount of woodchips cargo?

Previous research that related to the loading operation progress of cargoes was discussed about the broken stowage of the cargo from the port of loading, which is the gap with these research was there was two variable of port of loading was analysed and the external factors was also should be consider. According to Tuncel (2023), international transportation modes are developing rapidly and become an important thing for cargo import export activities bulk from various nations. The increasing volume of global trade causing a major increase in cargo handling capacity ports and, consequently, operational vulnerabilities. Therefore, if there is any broken of stowage that might be exist in the shipping operation could made a significant loss. Meanwhile, based on data obtained from the official website Canadian government regarding the price of woodchips per metric ton, it is known that in 2023, the price of this commodity will reach a value of \$114.0 per ton. This figure reflects the condition of the woodchips market in Canada.

Thus, by the focus of research is an important element in research that helps determine the direction and scope of the research, as well as limit the study to choose this data is relevent and which is not, therefore the results of this study of the practical benefits of research regarding the total difference in load with the same load but place and weather differences can make a significant contribution to optimizing transportation, developing logistics strategies, reducing costs operations, improving service quality, and developing technology.

LITERATURE REVIEW

Woodchips as an important commodity in global trade has unique properties and challenges in its production, storage and distribution. The growing demand for woodchips, especially from Japan and China, has driven the growth of the industry in countries such as South Africa and Canada, despite environmental, regulatory and operational challenges. Weather factors and air humidity play an important role in affecting the weight and quality of woodchips, as their hygroscopic nature means they easily absorb moisture from the environment. This impacts the weight of the load during transportation, especially in high humidity regions such as Canada compared to South Africa which has drier weather. Woodchips are produced from wood waste through a mechanical process, and then used for various applications such as biomass fuel, mulching and energy saving. However, storage is a concern as the degradation process can produce harmful gases and increase the risk of spontaneous fires. Different regulations in different countries, such as Canada's strict and South Africa's more varied regulations, pose additional challenges in the management of woodchips. Therefore, an in-depth understanding of environmental factors, physical properties of woodchips, and related regulations is required to ensure the operational efficiency and sustainability of this industry.



Figure 1. Woodchips

This difference is also influenced by the physical characteristics of woodchips. Chandrasekaran (2012) explains that smaller woodchips particles have a larger surface area, increasing the ability to absorb moisture from the air. In addition, the condition of the cargo is also greatly influenced by the operational system on the ship. According to Lesmini (2019), the success of ship operations is highly dependent on the captain and crew who are responsible for ensuring the loading of cargo in accordance with the safe capacity of the ship. Non-optimization in the loading system can lead to safety risks and economic losses (Pambudi, 2003).

In addition to environmental and physical load factors, the issue of broken stowage or non-optimally filled empty space in the cargo hold is also an important factor in the difference in load weight. Broken stowage occurs due to the shape of the cargo hold and variations in cargo properties, such as the size and distribution of wood particles. According to Stevens (1859) and Taylor (1920), broken stowage can be minimized through a well-structured stowage plan and the implementation of strict operational standards, such as proper calculation of the stowage factor for each type of cargo.

Ship operational efficiency is also related to stowage factor planning. Stopford (2009) explains that the stowage factor is a value that indicates the volume of loading space required to load one ton of cargo. This factor is very important in determining the efficient use of the ship's loading space. On the MV Ultra Cory, the difference in cargo weight indicates the need for periodic draft surveys and more careful cargo planning to adapt to environmental conditions in different ports. Broken stowage is one of the main challenges in ship cargo hold optimization, especially in the transportation of bulk cargo such as woodchips. Broken stowage can be caused by various factors, such as the shape of the cargo hold, cargo characteristics, type of cargo, worker skills, and suboptimal application of dunnage. In the case of MV Ultra Cory, broken stowage occurred at C/H no. 1 even though the cargo hold capacity should have been filled to 100% based on the calculation of stowage factor and cargo hold capacity, as well as draft restrictions at loading and unloading ports. In order for a ship to be fully and economically loaded, it is necessary to pay attention to aspects of cargo volume, ship carrying capacity, and the permitted draft limit at the port. With proper management, broken stowage can be minimized, thereby improving transport efficiency and optimizing the use of loading space.

Efficiency and safety in ship loading operations require the application of structured basic principles and strict watch service procedures. The speed and smoothness of loading is influenced by the organization of the loading space, equipment readiness, labor skills, and the adjustment of cargo according to the stowage plan. According to Sumardi (2023), the main objectives of this process are to protect cargo, maximize loading space, organize cargo systematically, and ensure

the safety of the crew and workers. In this case, the implementation of the guard service at the port plays an important role in maintaining the safety of the ship, cargo, and crew, according to STCW guidelines which include observation of the surroundings, monitoring ship stability, weather conditions, and protection against the risk of environmental pollution. The duty officer is responsible for the security of the vessel from risks such as fire, theft, or other hazards, as well as recording important events in the log book. Careful planning through safety meetings, preparation of checklists, and supervision of cargo data, ship stability, and berthing equipment are important steps to maintain safety and smooth operations. In addition, communication and crew cooperation are required to coordinate activities, prevent the risk of cargo damage, and ensure hazard control is in place. With systematic procedures and in accordance with regulations, loading operations can take place effectively, efficiently and safely, thus supporting the success of the ship's journey.

In conclusion, this study shows that the weight difference of woodchips cargo is caused by a combination of environmental factors, physical characteristics of the cargo, and broken stowage. By implementing measures such as improved coordination between the port and ship's crew, periodic draft surveys, and adjustments to stowage factors, the load weight discrepancy can be minimized. The results of this study contribute significantly to efforts to improve efficiency and safety in commercial shipping operations, especially in the transportation of bulk cargo (Maskur, 2021; Stopford, 2009).

RESEARCH METHOD

Qualitative methods were used in this study to understand the phenomenon of different loading weights in two different locations. The research was conducted on board the MV Ultra Cory for 12 months and 5 days, focusing on loading operations in Durban, South Africa, from December 1, 2022 to January 15, 2023, and in Sheet Harbour, Canada, from February 24, 2023 to March 11, 2023. The data collected included text, photographs, logbooks and other relevant documents to support the analysis.

The data in this study consisted of complementary primary and secondary sources. Primary data is obtained directly, such as the final stowage plan and documentation, while secondary data is in the form of supporting documents such as MSDS (Material Safety Data Sheet), voyage instruction, and weather information. Data collection techniques were conducted through direct observation, interviews with the Chief Officer, 2nd Officer, and 3rd Officer, as well as documentation and literature studies to enrich understanding related to cargo characteristics and the influence of weather on cargo weight.

Data processing was conducted systematically to ensure the validity of the research findings. Data analysis was conducted using an inductive approach that included data simplification, interpretation, and conceptualization, with the help of a fishbone diagram to identify the root of the problem. Human, material, method, measurement, and environmental factors were analyzed as causes of load weight differences. Research instruments such as observation and interview guides were carefully constructed to ensure all relevant aspects were covered.

Data validity was guaranteed through the use of triangulation as the main method. Credibility, transferability, dependability, and confirmability tests were conducted to ensure the data generated could be accounted for. With this approach, the research was able to provide an in-depth analysis of the operational and environmental factors that influence the difference in load weight between the Durban and Sheet Harbour locations.

RESULTS AND DISCUSSION

On November 29, 2022, MV Ultra Cory received a Voyage Instruction from Ultrabulk for the transportation of woodchips from Durban, South Africa, to Marin (Pontavedra), Spain. Based on this instruction, the vessel was required to load a full cargo of woodchips with a Stowage Factor (SF) of 100 Cuft/MT, which was stated in the Voyage Instruction document. This SF information is an important reference in the calculation of cargo capacity and operational preparation during loading at the port. After receiving the instruction, the Skipper directed the Chief Officer to prepare a pre-stowage plan that considered the SF of 100 Cuft/MT and the principles contained in the cargo MSDS for handling woodchips. The loading process was carried out using one loader and conveyor unit to move the cargo into the five holds of the vessel, where a bulldozer was deployed to level and organize the cargo, especially during the trimming process. During the loading process, no special treatment was required based on the cargo MSDS, and the cargo was considered safe in any weather conditions.



Figure 2. Weather information Port of Durban, South Africa

Recorded weather data showed that during the loading period between December 15 and 19, 2022, clear and calm weather was very favorable for the smooth loading operation. This ensured that the loading process could be completed on time according to the set schedule. The reliability of the weather also improved work safety and accelerated the loading and unloading process at the port. Upon completion, the vessel loaded woodchips to 100% capacity in all holds, in accordance with the verified final stowage plan. This optimal loading result demonstrates the effectiveness of careful operational planning and execution, which has ensured the smooth loading process and the success of the woodchips transportation mission.



Figure 3. Full loaded cargo from Port of Durban South Africa

On February 16, 2023, MV Ultra Cory received a Voyage Instruction from Ultrabulk to load 30,000 MT of woodchips at Sheet Harbour, Nova Scotia, Canada, for delivery to Easport, Maine, USA. Based on previous experience with the same cargo, Ultrabulk instructed the vessel to load the full cargo to that capacity. Upon receiving the instruction, the Master gave directions to the Chief Officer to develop a pre-stowage plan, which should take into account the Stowage Factor (SF) listed in the cargo's Material Safety Data Sheet (MSDS). This MSDS provides important guidance regarding the handling and storage of woodchips, given the physical and chemical properties of the cargo that need to be managed with care. During the loading process, special attention is paid to proper load arrangement and adherence to the safety instructions listed in the MSDS to ensure safe and efficient cargo handling.

February 2023 Weather in Sheet Harbour — Graph

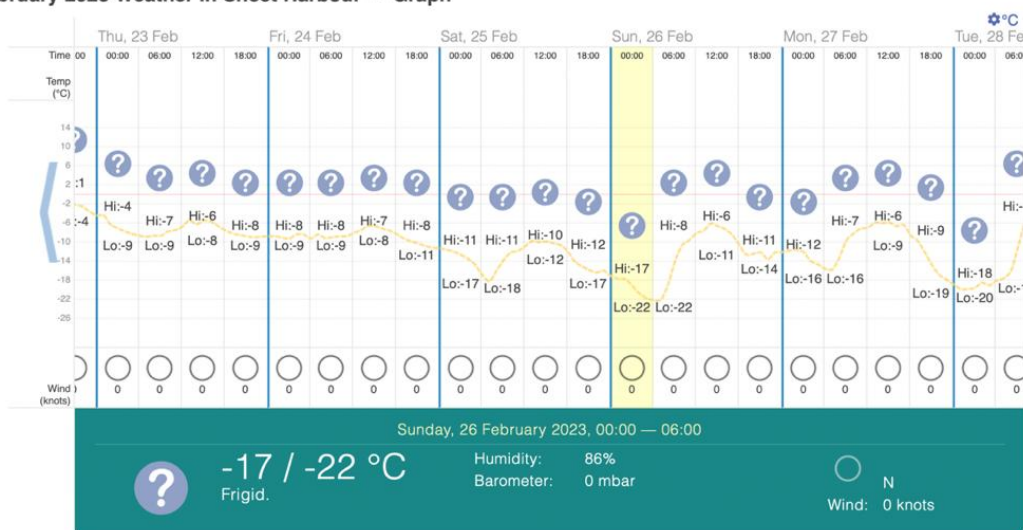


Figure 4. Weather Information Port of Sheet Harbour, Canada

The weather in Halifax, Nova Scotia, in March 2023, exhibited typical springtime cold conditions with average temperatures around 4°C during the day and -3°C at night, and heavy

rainfall, reaching 118-127 mm over 13 days. Although the MSDS states that woodchips are not affected by moisture, humidity levels can reach up to 46% during the voyage, potentially affecting the quality and safety of the cargo. Therefore, extra care is needed to ensure that changes in humidity due to extreme temperatures and severe weather do not damage the cargo. Although severe weather such as snow and temperatures that can reach -16°C threaten smooth loading, operations continue without delay, in contrast to South African practice which is more flexible regarding weather conditions. In the field, hatches were often left open even when loading and unloading was temporarily suspended, demonstrating the challenges associated with managing cargo in extreme weather conditions.



Figure 5. Complete load C/H no 1 Port of Sheer Harbour, Canada

Upon completion of the loading process, broken stowage was found in hatch number 1, despite the load meeting Ultrabulk's instructions. Ultimately, 31,571 MT of cargo was transported, more than expected. This discrepancy shows how environmental factors and load management can affect the total load that can be transported despite the load conditions being in line with the original plan. The success of this operation shows that despite weather challenges, careful management and monitoring can ensure optimal results in the woodchips loading process.

The woodchip loading process carried out by MV Ultra Cory at two different ports shows how weather factors, stowage factor calculations, and cargo management play a significant role in determining the cargo capacity that can be carried. During the sea practice, the vessel often docks at ports with various international routes, transporting various commodities including coal, gypsum, corn, and woodchips. In December 2022, the vessel loaded woodchips in Durban, South Africa, with dry and hot weather conditions that were very conducive to efficient loading. Although the port agent gave a stowage factor of 100 Cuft/MT, after conducting a draft survey, the vessel was able to load 30,847 MT, exceeding the initial calculation of 819 MT. This was due to the weather reducing the potential for moisture contamination of the cargo, allowing the vessel to accommodate more cargo safely.

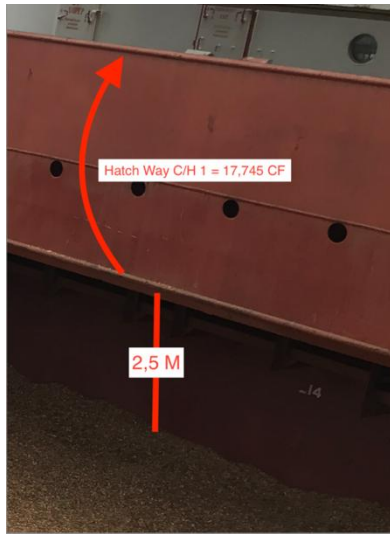


Figure 6. Broken stowage calculation Port of Sheet Harbour, Canada

$$broken\ stowage = \left(\frac{2,5}{16} \times 481,237 \right) + 17,745$$

$$broken\ stowage = 75,193.28 + 17,745$$

$$broken\ stowage = 92,938.28\ Ft^3$$

$$broken\ stowage\ percentage = \frac{92,938.28\ Ft^3}{SUM\ CH\ 1}$$

$$broken\ stowage\ \% = \frac{92,938.28\ Ft^3}{498,982\ Ft^3} \%$$

$$broken\ stowage\ CH\ no.\ 1 = 18,62\ \%$$

On the other hand, in February 2023 in Sheet Harbour, Nova Scotia, Canada, load calculations show differences due to more humid weather factors. Although the port agent stated that the vessel was capable of loading up to 30,000 MT with a stowage factor of 84.76 Cuft/MT, the cold weather conditions and high humidity (up to 46%) affected the cargo weight, which ultimately caused the vessel to carry 31,571 MT. Although the MSDS stated that the cargo was not affected by humidity, these conditions still affected the amount of cargo carried, as well as the occurrence of broken stowage in hold number 1, which reduced the efficiency of space utilization.

The calculation of broken stowage showed that hold 1 had empty space that could have been filled up to 1,086.86 MT more, which could have increased the efficiency of space utilization and maintained the stability of the vessel. Weather factors and careful cargo management are essential in ensuring that cargo can be transported safely and optimally, despite the differences in environmental conditions in the two ports. With the right approach to cargo planning and management, the vessel can maximize its capacity and reduce the potential for broken stowage, which in turn supports smooth transportation operations.

The differences in the amount of woodchips loaded by MV Ultra Cory in Durban, South Africa, and Sheet Harbour, Nova Scotia, Canada, were caused by various factors involving people, methods, measurements, environment, and materials. In Durban, dry and stable weather conditions allowed the woodchips to remain dry, with a higher Stowage Factor (SF) of 100 Cuft/MT. In contrast, in Sheet Harbour, low temperatures and high snowfall caused the woodchips to absorb moisture, reducing the SF to 85 Cuft/MT and increasing the weight of the load without increasing the volume. Human factors, such as more efficient coordination in Durban compared to the extreme weather challenges in Canada, also affected the speed and efficiency of loading. In addition, environmental influences, including cold temperatures and high humidity in Sheet Harbour, caused a decrease in the quality of the load measurements, while the sunny weather conditions in Durban supported smooth transportation.

To overcome these differences, a number of efforts need to be made, including adjusting the SF calculation more accurately based on the weather conditions of each port, as well as tighter hatch closure arrangements in Sheet Harbour to reduce the risk of moisture absorption. More frequent use of draft surveys at both ports is also essential to monitor changes in cargo weight in real time,

ensuring that load differences can be detected early and allow adjustments to loading plans. Better coordination between ships and ports is also needed to reduce broken stowage and improve loading efficiency in extreme weather conditions. A more flexible approach to preparing loading plans according to local environmental conditions can help optimize cargo capacity and maintain vessel stability during the voyage.

CONCLUSION

The conclusion of this study shows that the differences in the amount of woodchip cargo carried by MV Ultra Cory in Durban, South Africa, and Sheet Harbour, Nova Scotia, Canada, are influenced by several main factors. Weather and humidity are significant factors, where the dry and warm weather in South Africa allows the woodchips to remain dry, thus optimizing the cargo capacity. In contrast, the cold and snowy weather in Canada causes the woodchips to absorb moisture, which increases the weight of the cargo without significantly increasing its volume. In addition, the difference in Stowage Factor (SF) in both ports affects the amount of cargo that can be carried, with SF being more stable in South Africa and decreasing in Canada due to moisture absorption.

To overcome these differences, several efforts need to be made, including adjusting the calculation of SF more accurately based on the weather and humidity conditions in each port. Tighter hatch closure arrangements in cold weather ports, such as Sheet Harbour, are also important to reduce moisture absorption by woodchips during loading. In addition, more optimal draft survey implementation and improved coordination between the ship and port during ship shore meetings are needed to ensure that loading plans are adjusted to local weather conditions and technical needs. With these steps, it is hoped that the difference in the amount of woodchips cargo between Durban and Sheet Harbour can be minimized, which in turn increases efficiency and safety in the transportation process.

REFERENCES

- Burhani, A. (2018, March 17). Penanganan muatan kapal. <https://alvinburhani.wordpress.com/2018/03/17/penanganan-muatan-kapal/>. Retrieved July 28, 2024.
- Bolgov, O. (2023). Planning the cargo operations of a bulk carrier with continuous maintaining its seaworthiness. *Розвиток методів управління та господарювання на транспорті*, 2(83), 61-67.
- Chandrasekaran, S. R., Hopke, P. K., Rector, L., Allen, G., & Lin, L. (2012). Chemical composition of wood chips and wood pellets. *Energy & Fuels*, 26(8), 4932-4937.
- Chriscolf, Z. (2019). Upaya meningkatkan pengapalan batu bara oleh PT. Berau Coal melalui pengendalian broken stowage di Muara Pantai, Berau (Doctoral dissertation, Sekolah Tinggi Ilmu Pelayaran Jakarta).
- Stopford, M. (2009). *Maritime economics* (3rd ed.). Routledge.
- Dikin, A. (2014). Standar teknis perlakuan karantina dengan alfa sipermetrin terhadap wood chips. *Pusat Karantina Tumbuhan dan Keamanan Hayati Nabati, Badan Karantina Pertanian, Kementerian Pertanian*.
- Elyzarti, N. (2018). *Analisis Tari Lungun Koba di Sanggar Rumah Seni Balai Proco Kabupaten Rokan Hulu Provinsi Riau* (Doctoral dissertation, Universitas Islam Riau).

- Febryan, H. (2019). Identifikasi upaya full and down untuk mengatasi ketidaksesuaian pemuatan curah batu bara di Kapal MV Sri Wandari Indah (Doctoral dissertation, Politeknik Ilmu Pelayaran Semarang).
- Isbester, J. (2015). *Bulk carrier practice*. The Nautical Institute.
- Khasanah, U. (2020). *Pengantar mikroteaching*. CV Budi Utama.
- Lesmini, L., Anggraini, A., & Rifni, M. (2019). Perencanaan dan penyusunan muatan pada kapal landing craft tank (LCT). *Jurnal Logistik Indonesia*, 3(1), 10-28.
- Maskur, Z., & Nugroho, A. (2021, March). Analisa karakteristik biomasa untuk cofiring pada pembangkit batubara di Indonesia. *Prosiding SENASTITAN: Seminar Nasional Teknologi Industri Berkelanjutan*, 1(1), 394-402.
- Nurudin, F., & Hasanudin, H. (2020). Desain kapal bulk carrier guna pemenuhan kebutuhan batubara PLTU Sudimoro Pacitan. *Jurnal Teknik ITS*, 9(1), G1-G8.
- Pambudi, C. S. (2003). Strategi mengurangi timbulnya broken stowage di KM Caraka Jaya Niaga III-15. Politeknik Ilmu Pelayaran Semarang.
- Prakoso, D. (2018). Analisis pengaruh tekanan udara, kelembaban udara, dan suhu udara terhadap tingkat curah hujan di Kota Semarang. *Universitas Negeri Semarang*.
- Pratiwi, A. C., & Putri, I. A. J. (2024). Analisis strategi bersaing dalam meningkatkan market share curah cair di Terminal Nilam. *Innovative: Journal of Social Science Research*, 4(4), 11216-11233.
- Pustiulha, S., Samchuk, V., Prydiuk, V., Pasichnyk, O., & Shymchuk, O. (2024). Improving safety criteria for transporting hazardous goods by road through optimizing the geometric parameters of their stowage. *Eastern-European Journal of Enterprise Technologies*, (3).
- Tjatji, M. P. (2007). *Woodchips as carbon and energy source for denitrification* (Doctoral dissertation, Tshwane University of Technology).
- Rachmawati, I. N. (2017). Pengumpulan data dalam penelitian kualitatif: Wawancara. *Jurnal Keperawatan Indonesia*, 11(1), 35-40.
- Rahardjo, M. (2010). Triangulasi dalam penelitian kualitatif. *Universitas Islam Negeri Malang*.
- Rahmawati, A. K. (2024). Pengaruh pengawasan personel apron movement control terhadap kedisiplinan petugas ground support equipment di apron Charlie Bandara Internasional Juanda Surabaya (Doctoral dissertation, Politeknik Penerbangan Palembang).
- Rikardo, D., Saleh, S., & Bulqiest, C. (2021). Optimalisasi pengawasan crew terhadap proses bongkar muat pada kapal tanker MT Gamkonora. *Journal Marine Inside*, 38-43.
- Riyanto, N. S., Yudo, H., & Trimulyono, A. (2020). Analisa kekuatan deck akibat perubahan muatan pada tongkang TK Nelly-34. *Jurnal Teknik Perkapalan*, 8(3), 454-460.
- Slameto. (2016). The application of fishbone diagram analysis to improve school quality. *Dinamika Ilmu*, 16(1), 63.
- Stekom. (n.d.). Bagaimana mengatasi cuaca panas yang mencekam. Retrieved from <https://stekom.ac.id/artikel/bagaimana-mengatasi-cuaca-panas-yang-mencekam>. Retrieved July 28, 2024.
- Sugiyono. (2018). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Alfabeta.
- Sumardi. (2023). Operational performance model of container cranes in stevedoring process at the new container terminal Makassar 2. *Journal of Law and Sustainable Development*.

- Suranto, Y. (2012). Penerapan formulasi skedul suhu dan kelembaban menurut Terazawa pada pengeringan kayu meranti merah bersortimen raamhaut. *Seminar Nasional Mapeki XV*, 171-179.
- Tunçel, A. L., Erdem, P., & Turan, O. (2023). Estimation of human errors during cargo unloading operations on bulk carriers using SLIM and interval type 2 fuzzy sets. *Journal of ETA Maritime Science*, 11(3), 198-208.
- Waruwu, M. (2023). Pendekatan penelitian pendidikan: Metode penelitian kualitatif, metode penelitian kuantitatif dan metode penelitian kombinasi (Mixed Method). *Jurnal Pendidikan Tambusai*, 7(1), 2896-2910.
- Widyaningsih, U., & Lestari, J. N. (2019). Pelaksanaan dinas jaga pada saat operasi bongkar muatan di Kapal MT. Transko Arafura pada Pelabuhan Gunung Sitoli. *Jurnal 7 Samudra*, 4(1).