Procurement of Ship Materials Through the Shipmate Application using the Material Requirement Planning Method

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ABSTRACT

The shipyard industry in Indonesia plays a central role in the national economic structure. However, it faces various challenges, one of which is inefficient material management. This research explores the material management system at PT Merpati Marine Service with the aim of enhancing operational efficiency. The research method employed is a field study combining observation techniques, interviews, and literature analysis. Data collected are presented through flowcharts and qualitative analysis. The findings indicate that the material management system at PT Merpati Marine Service is still bound by conventional methods, leading to dependence on manual and computer processes, resulting in delays in material procurement and increased costs. To address this issue, the research proposes the implementation of an Application-based Material Requirement Planning (MRP) system. It is expected that this system will minimize dependence on manual and computer processes, expedite material procurement processes, enhance data accuracy, facilitate interdepartmental communication, and reduce material wastage.The implementation of the application-based MRP system is anticipated to enhance material management efficiency at PT Merpati Marine Service, ultimately positively impacting product quality, cost control, and profitability.

Keywords*: Shipyard Industry, Material Management, Material Requirement Planning, Operational Efficiency.*

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ABSTRAK

Industri galangan kapal di Indonesia memegang peranan sentral dalam struktur perekonomian nasional. Namun menghadapi berbagai tantangan, salah satunya adalah pengelolaan material yang tidak efisien. Penelitian ini mengeksplorasi sistem manajemen material di PT Merpati Marine Service dengan tujuan untuk meningkatkan efisiensi operasional. Metode penelitian yang digunakan adalah studi lapangan yang memadukan teknik observasi, wawancara, dan analisis literatur. Data yang dikumpulkan disajikan melalui diagram alur dan analisis kualitatif. Temuan penelitian menunjukkan bahwa sistem pengelolaan material di PT Merpati Marine Service masih terikat dengan cara konvensional sehingga menyebabkan ketergantungan pada proses manual dan komputer sehingga mengakibatkan tertundanya pengadaan material dan peningkatan biaya. Untuk mengatasi permasalahan tersebut, penelitian ini mengusulkan penerapan sistem Material Requirement Planning (MRP) berbasis Aplikasi. Sistem ini diharapkan dapat meminimalkan ketergantungan terhadap proses manual dan komputer, memperlancar proses pengadaan material, meningkatkan akurasi data, memudahkan komunikasi antardepartemen, dan mengurangi pemborosan material. Penerapan sistem MRP berbasis aplikasi diharapkan dapat meningkatkan efisiensi pengelolaan material di PT Merpati Marine Service, pada akhirnya memberikan dampak positif terhadap kualitas produk, pengendalian biaya, dan profitabilitas.

***Kata kunci**: Industri Galangan Kapal, Manajemen Material, Perencanaan Kebutuhan Material, Efisiensi Operasional.*

INTRODUCTION

The shipbuilding industry is a very complex industry and involves various stages that require various types of different materials. Starting from raw materials such as metal and wood to electronic components and special equipment, all these materials must be available on time and in the right quantities to ensure a smooth production process. The quality of the materials used in shipbuilding has a direct impact on the quality, safety and durability of the resulting ship. Therefore, effective material procurement management is key to ensuring that only high-quality materials are used in the manufacturing process (Dallasega, 2018; Patrucco et al., 2020). The shipbuilding industry in Indonesia has a very important role in the country's economy (Suryadi, 2012). This sector contributes to the growth of Gross Domestic Product (GDP), job creation and increased exports. Based on data obtained from the Ministry of Industry, it was recorded that there were 363 applications for the construction of new ships in domestic shipyards during the period January to August 2022. This plan aims to increase the number of Indonesian ships to 836 units. Previously, during the 2019-2021 period, 473 ships had been successfully built. According to the Minister of Industry, Agus Gumiwang, the largest proportion of ships built in the 2019-2021 period were barges, with a total of 274 units, and tugs with 100 units. With this effort to build new ships, it is hoped that it can make a positive contribution to the development of the domestic shipping industry and increase Indonesia's competitiveness in the global market.

It should be noted that when compiling the text, it is important to avoid plagiarism by re-arranging the information from the source that was originally quoted and quoting appropriately when necessary. Currently, there are around 250 shipyards in Indonesia, the majority of which are small-scale, only 4 of them owned by the government. One example of a shipbuilding company is PT Merpati Marine Service in Marunda, North Jakarta, which specializes in fiberglass boat production and ship repair.

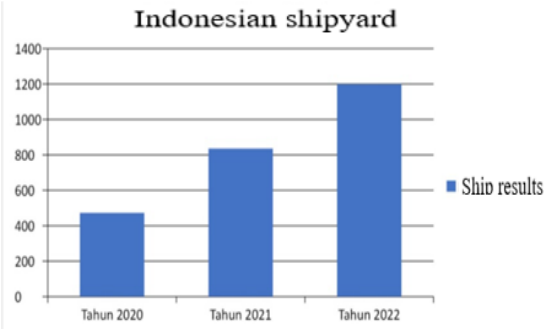

Figure 1. Ship Production Diagram in Indonesian Shipyards

The increase in the number of ships planned to be built in Indonesia is a positive indication for the growth of the shipbuilding sector. This can make a significant contribution to the growth of the country's Gross Domestic Product (GDP), job creation, and increased exports, as the shipbuilding industry plays an important role in the national economy. Based on this data, even though it has great potential, the Indonesian shipbuilding industry is still faced with several challenges, one of which is inefficiency in material management, especially (Chandra et al., 2017; Mariana, 2017; Cendana & Barusman, 2023). This can create the potential for delays in the production process and a decrease in product quality. One of the main factors causing this is the complexity in fulfilling contract requirements for specific goods which are often not available on the local market, so an effective materials management system is the key to overcoming this problem (Saputra, 2019). Material management is an integral part of the logistics system which aims to provide materials according to project needs. This management is a crucial managerial function, because project material supplies involve large investments (Kristanto & Kurniawati, 2023). Each project generally involves complex activities, and material procurement requires good planning and control considering the large cost of materials in total project costs (Mahapatni, 2019). Therefore, effective material handling is very important to ensure the smoothness and expected performance in the implementation of construction projects (Toor & Ogunlana, 2008; Khalef et al., 2022; Pan & Zhang 2023).

PT Merpati Marine Service, as one of the shipbuilding companies in Indonesia, faces several problems in material procurement management. Delays in procuring raw materials and poor material handling are some of the problems faced by these companies. Evidence of inadequate material handling at PT Merpati Marine Service is reflected in several clear signs. For example, there are repeated delays in getting raw materials. Apart from that, the material management system at PT Merpati Marine Service is still conventional. This is known from the results of observations and interviews that researchers obtained from the project head of PT Merpati Marine Service. Conventional material procurement management system at PT. Merpati Marine Service may not be fully capable of managing material needs that are custom or have special specifications efficiently. Procurement processes based on manual or traditional methods may not be flexible in handling unusual material requests, such as materials with special dimensions or qualities required in shipbuilding. If local goods do not meet the quality standards ordered, for example when ordering glass material and there is a discrepancy between the dimensions of the glass material and what was ordered, this could indicate weaknesses in the management of local raw materials, which could potentially result in a defective final product. Additionally, inefficient company operations, such as wasted resources or unstructured processes, can also reflect suboptimal material handling. Therefore, it is important for companies to maintain an optimal amount of inventory and carry out production planning and scheduling well.

LITERATURE REVIEW

According to Harlan & Putri (2023), procurement is an activity related to producing or obtaining goods and materials from external suppliers. Apart from that, the procurement of goods or services is essentially an effort by the user to obtain or realize the goods and services they desire, using certain methods and processes to reach an agreement on price, time and other agreements. Purchasing is the process of purchasing, searching for needs, selecting suppliers, negotiating prices, and controlling to ensure delivery on time. Purchasing raw materials has important potential in increasing a company's efficiency, thereby making it more competitive. The procurement department is a key part that must comply with basic management policies. In carrying out its duties, this department must provide optimal contributions to company management. This is an important aspect in an organization that plays a role in achieving profit targets set by management, as well as ensuring compliance with applicable ethical standards and principles. Based on the statements of Budiartami & Wijaya (2019) and Rudiawan (2021), production has a crucial role in the performance of a business organization. The production department is considered a management function that has a major influence in the product creation process and can significantly influence sales. The production process is the core of economic activities in various sectors, including the shipbuilding industry. According to Azhar (2008), production in the shipbuilding industry refers to the results of processing or managing farmers' businesses. Profits in this industry can be measured by the amount of production produced.

According to Wicaksono et al. (2023), effective inventory management is the key to maintaining a smooth production process. Good inventory management ensures the availability of raw materials and components needed so that production can run efficiently and on time. Therefore, there is a close relationship between production concepts, profit evaluation and inventory management in the shipbuilding industry, all of which play an important role in maintaining the company's survival and the success of quality production. From these three views, it can be concluded that production plays an important role in the overall performance of business organizations, including the shipbuilding industry. A deep understanding of production processes and efficiency in managing them can have a direct impact on a company's success. Material Requirement Planning (MRP) is a material planning and scheduling system used in the production process (Uyun et al., 2020). MRP involves a series of process stages to convert production plans from finished products to required raw materials or components. This is done by taking into account the available time, thus making it possible to determine the time and amount of material that must be ordered for each component of the product to be produced (Sinaga et al., 2020). MRP is used as a material requirement planning technique in the production process. This system uses a master production schedule and a list of material components (Bill of Material) to calculate material requirements based on a predetermined production schedule (Limbong et al., 2013; Chamidah & Auliandri, 2019).

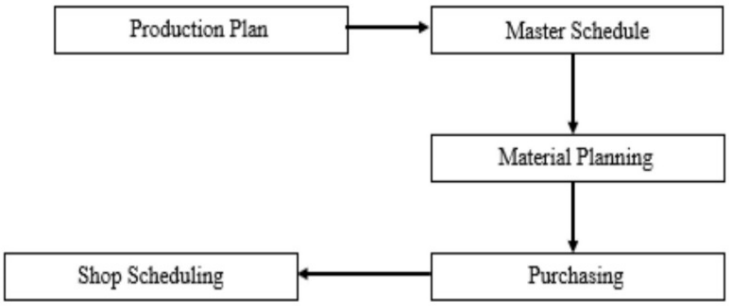

Figure 2. Material Requirement Planning (MRP) Scheme

MRP goals include several important things. First, MRP helps in determining the number of components needed and the order time. This allows managers to prepare components when needed, avoiding unnecessary excess costs. Second, MRP helps in reducing production time and delivery delays by identifying the quantity of materials required, their availability, acquisition time, and appropriate production schedules. Lastly, MRP increases efficiency by providing good coordination between the various divisions involved in the production process (Emawati, 2010; Aziz & Suyatno, 2019). This ensures that the production process runs on schedule and reduces the possibility of unplanned production interruptions, which in turn can reduce labor costs and unwanted production disruptions.

METHOD

This research is a field study where the researcher chooses several data collection methods that are in accordance with the research objectives (Sugiyono, 2022). The type of research used in this research is qualitative research. Observation is a data collection method that has certain characteristics that differentiate it from other methods. Observations are not limited to humans, but also to other natural objects. This method is carried out by observing the ship repair process at PT Merpati Marine Service located in Marunda, North Jakarta. Observations are carried out carefully to record all symptoms or events that are relevant to the research object. Interviews are a data collection method used for initial exploration in finding the problems to be researched. The interview method is used to collect data through direct interaction between researchers and respondents. The respondents interviewed in this research were the project head and supervisor of shipbuilding consultants at PT Merpati Marine Service. Interviews were conducted face to face to gain a deeper understanding of the ship repair process. This literature study method is used to search for theoretical references that are relevant to the research topic. Researchers conducted a literature study to learn about business process analysis using fishbone diagrams (Sugiyono, 2017). The first step is to clearly write down the problem being faced, including when and where the problem occurred, and who was involved in it. Next, identify the main factors that contribute to the problem, such as personnel, systems, equipment, or materials. Based on the previous steps, identify the potential causes of the problem that occurred.

RESULT

After successfully winning the tender, PT Merpati Service will receive an official letter of appointment as the tender winner. After that, the ship design stage is carried out starting with the ship design process carried out by the design and engineering department. The ship design is made by referring to the ship's technical specifications stated in the contract. The completed design will undergo model tests in the hydrodynamics laboratory to evaluate the ship's stability and estimate the maximum speed that the ship can reach. The results of this model test need to obtain approval from the appointed classification body. The ship design drawings are then outlined into more detailed production drawings. By referring to this production drawing, material requirements in the form of plates and profiles can be calculated, which includes detailed aspects of volume, size and specifications.

In general, every process of building a new ship involves various quite complex activities, both in the ship material procurement process and in the ship design process, therefore if the handling or management is less effective it will cause losses in terms of cost, time and quality. This problem must be given more attention by the company so that it can reduce these losses. The management system currently implemented by PT Merpati Service is a conventional management system where in this conventional management system the shipyard only relies on n data. from several works on ships that have been built previously in recent years. This system is often used as a reference in the material procurement process for building new ships. This system is not only used by PT Merpati Service but is also widely used by other shipyards.

The order process is the initial stage of PT Merpati Service in the process of building the ship that will be designed, in this order process it can be through auctions or direct orders from relevant customers, at this order stage PT Merpati Service will record what types of materials are suitable for use in shipbuilding as ordered. Procurement of materials is the next stage which is also an important stage in ship design, at this stage PT Merpati Service will purchase materials according to the ship specifications that have been determined previously. The shipyard will purchase ship materials through several subscription shops or via E-Commerce to obtain goods according to predetermined specifications. When purchasing the required materials, the shipyard orders via E-Commerce but the problem that occurs is that the purchase is not made. in one place but in various places so that data collection on goods is quite difficult and also causes some materials to be scarce, if there is a scarcity of materials such as flashlights with certain specifications then the shipyard will import to fulfill the materials in ship construction, and also if in the shipbuilding process there are the material needed quickly but the shipyard does not have the desired goods, the shipyard will collaborate with other shipyards (neighboring shipyards) to lend the required materials.

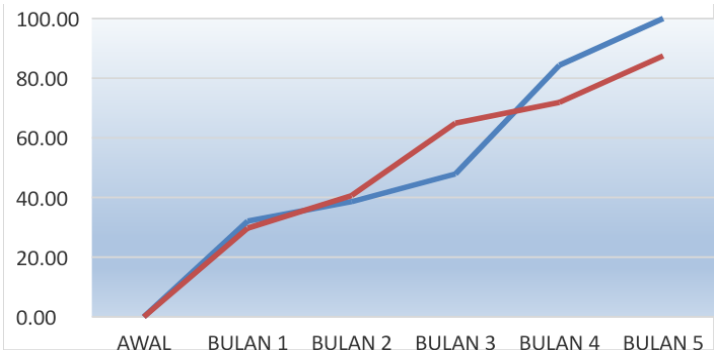

Figure 3. Physical Progress Curve for the Construction of a 12 Meter Speed Boat

Table 1. Physical Progress of Construction of a 12 Meter Speedboat

Progress	Initial Contract	1st month	2nd month	3rd month	4th month	5th month
Planned Cumulative (%)	0.00	32.10	38.60	47.90	84.30	100.00
Actual Cumulative (%)	0.00	29.72	40.65	64.93	71.84	87.47

Based on the physical progress curve of ship construction, the project to procure a 12-meter surveillance speedboat for DAK 2023 is being carried out by the Maluku Provincial Maritime Affairs and Fisheries Service at the PT shipyard. Merpati Marine Service is still not according to plan. In the 5th month, actual physical progress reached 87.47%, while planned physical progress was 100%. Although the supervisory consultant from PT. Angelia Oerip Mandiri is involved in the monitoring process, the project is still 12.53% behind the target that has been set, so a holistic solution is needed for this problem.

Ships are products that require various types of materials to manufacture. Therefore, a list is needed that includes all material requirements, known as a Bill of Materials (BOM). This BOM is essential initial data in the ship building process. This BOM data is the basis for Planning and Production Control (PPC) to prepare a production schedule called the Master Production Schedule (MPS). This MPS is the main reference in ship construction. If the construction does not comply with the MPS, this can cause delays in ship delivery. After being planned by the PPC, the MPS will be implemented and procurement will carry out purchases according to the predetermined schedule. The auction process is carried out to obtain the appropriate price and quantity of goods from several suppliers with the aim of obtaining the lowest price for the quantity of goods required.

After the material arrives at the yard, quality, quantity and accompanying documents will be checked. If the material meets the specified standards and passes inspection, it will be accepted and put into the warehouse. However, if there is a discrepancy, the material will be returned to the sender (vendor) in accordance with the previously agreed contract provisions. The exit and entry of materials in ship construction occurs through the warehouse. Warehouses provide effective control over material flow, reducing the possibility of idle time. Monitoring material flows also allows better monitoring of ship construction progress. Groups directly involved in ship building activities are called production. Specifically, the entities directly involved in this production process include workshops and project managers. In material management, the project manager has the authority to determine the implementation time or retrieval of certain materials from the warehouse.

The material transaction form is a document issued by the shipyard to record every activity related to the use of materials. Below, the author presents an example of a material transaction form obtained from PT Merpati Marine Service.

MERPATI MARINE		NO BUKTI	NO PROYEK	NO PO	YANG MENERBITKAN			M07
NO URUT	KODE MATERIAL	ORDER BRANCH	NAMA MATERIAL	JUMLAH	SAT	AMOUNT	NO KEM	NO GUDANG
Catatan:			Divisi Logistik			Bagian Yang Menerbitkan		
			Kadep Pergudangan	Kepala Gudang		Kadep PPC		Karo

Figure 4. Example of a Material Transaction form

Figure 4 shows an example of a material transaction form used in a shipyard to facilitate the release of materials from the warehouse for work purposes, whether carried out in the building berth or in the workshop. Material management at PT Merpati Marine Service is still very conventional. The system used is too dependent on computers, which makes the field inspection process difficult. This causes high dependence on computers, making the field inspection process difficult. The material management process is still carried out manually using varying forms, depending on the type of material used. Delays in delivering information often occur as a result of processes that are still manual in nature. Apart from that, the material management process at PT Merpati Marine Service is also hampered by slow speed, starting from checking stock, processing requests, picking up, to returning materials. All of these processes can only be done via computers which are limited to the employee's room and cannot be taken into the field. This limitation results in a decrease in effectiveness and efficiency in the new ship building process. In addition, storing paper-based forms also increases the risk of document loss or damage. With the introduction of this new application, it is hoped that the process of conveying information for material management can be improved significantly, thereby correcting the weaknesses that exist in the conventional system currently used.

The Shipmate application is a program developed using the Android platform so that it can be used portability. This application is intended for users who have experience in material management activities in shipyards and have in-depth knowledge in the shipping sector. Shipmate has five types of accounts that can be accessed according to material management needs. The five types of accounts include planning and production control, procurement, quality control, warehouse, and production. As an administrator, planning and production control is responsible for user registration, database updates, and recording material requirements. Meanwhile, procurement is tasked with recording data on materials that have been purchased and updating the status of these material purchases. Quality control is responsible for inspection of

materials received from suppliers. The warehouse is tasked with managing material supplies and providing approval for material collection by production. Production can submit requests for material collection and place orders for the required materials.

Figure 5. ShipMate App Logo

The preparation of the database for this application refers to material transaction forms that have been collected and analyzed further. Although each shipyard has a different form, the material transaction form obtained will be adapted to a form that can be applied generally to all new shipyards. This is done through adjustments to the format, standards and certain relevant elements to ensure consistency and continuity in the use of the form across various shipyards. Material transaction forms include several types, such as receiving materials, picking up and leaving materials, ordering materials, and returning materials.

A system interface diagram is a visual representation that displays the interface of an application that has been designed. In this diagram, there is a sequence of processes that occur in the application starting from when the application is run until the logout process. All processes occurring in the application, including submenus associated with each process, will be listed in the system interface diagram. The system interface diagram for the admin interface of this application is shown in Figure 6.

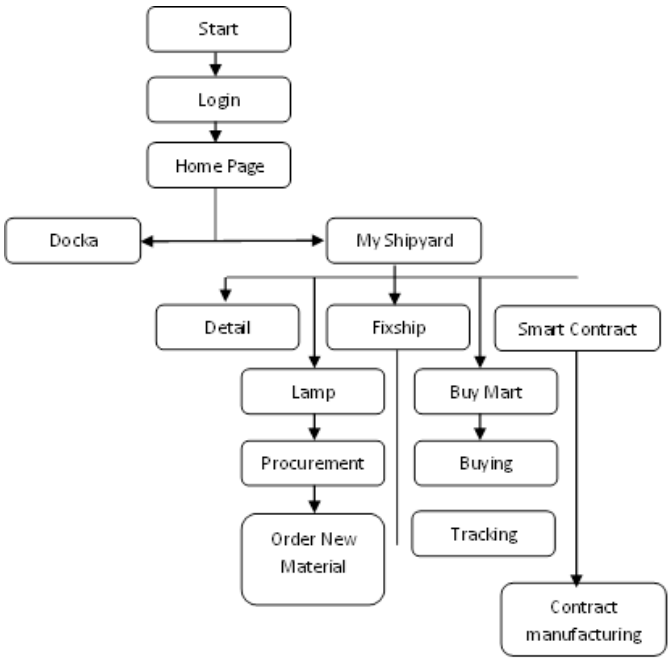

Figure 6. System Interface Diagrams

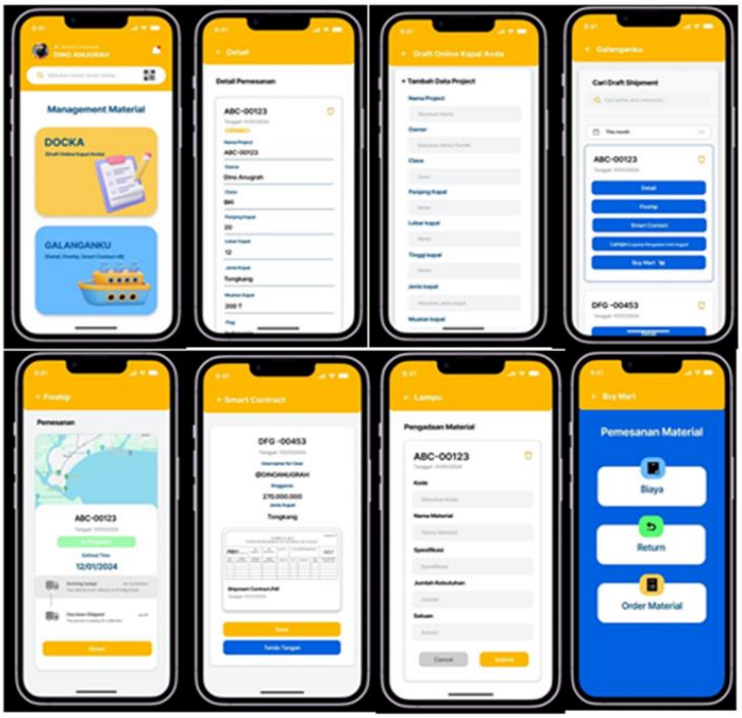

Figure 7. ShipMate Features

The ShipMate login page is designed to provide security and ease of access while providing an efficient user experience. When logging into the platform, users are asked to enter the ID and password that have been provided via company email by BKPM (Investment Coordinating Board), which is managed by the Ministry of Investment. After successful login, users will be directed to the main page, where they are greeted with various features designed to simplify the process of procuring ship materials. The two main features to emphasize are new project and view project. New project allows users to create drafts for future ship projects, while view project facilitates monitoring of ongoing project progress. The Docka (Online Draft Your Ship) feature helps in drafting new projects by collecting information such as project name, owner, ship specifications, and more. Once the data is collected, users can access Galanganku to monitor project progress. My Galangan is the place where all project drafts are displayed, with options to access project details, edit information, or access other features such as Letters, Material Requirements, and Material Purchases. The details feature allows users to view and edit project information, while the FixShip feature facilitates material order editing and order status tracking.

The letters feature allows users to create material purchase contracts electronically, while the lights feature simplifies the process of communicating material requirements to suppliers. The Buy Mart feature allows users to submit material purchase requests to suppliers and complete the purchasing process transparently and according to requirements. ShipMate provides an integrated platform to manage the entire ship material procurement process, from creating project drafts to purchasing materials. The features provided not only aim to increase work efficiency, but also to ensure security and transparency in every business transaction carried out through their platform.

Table 2. Comparison of Conventional Management Systems with the ShipMate Application

Item	Conventional System	ShipMate App
Time	In the conventional system, the time required to procure materials is quite long, this is because the purchase of materials is carried out during the shipbuilding process, this creates a risk of delays in the arrival of goods which affects the shipbuilding time.	By implementing this application, the time required has the potential to be faster and timelier because there is a Fixship feature where this feature can edit orders that have been made. This feature also allows users to track the status of material orders that are being processed, so that the goods will arrive on time. has been determined
Cost	By implementing this management system, the allocation of funds is limited to purchasing materials, material maintenance costs in the warehouse, and handling time delays that may arise due to scarcity of ordered materials. The available funds cannot be allocated for investment.	Implementing MRP using the Ship Mate application has the potential to reduce setup costs, reduce lead time, increase production efficiency, and minimize investment in material inventory in the warehouse, because with the Lampu (Superior Procurement Material Service) feature, this feature helps companies' shipyards in communicating their needs to suppliers, reducing the possibility of errors or shortages in material procurement.
Performance	Even though the company's current performance is quite good. However, there are weaknesses in the material management system that need to be corrected. This is caused by a lack of attention from the shipyard in managing costs and wasted time due to the inaccuracy of the management system used.	A system using the Ship Mate application has the potential to increase company performance efficiency by reducing optimal use of time and costs, by utilizing superior features of the Ship Mate application such as the FixShip feature, the Lights feature, and the Buy Mart feature, thereby minimizing waste of resources and optimizing investment in low levels of material inventory.

CONCLUSION

Analysis of PT Merpati Marine Service reveals several material managements issues, including difficulties in obtaining materials from various sources, inadequate material availability, and discrepancies between the physical progress curve of ship construction and the plans. Additionally, there are weaknesses in material management activities, such as conventional systems that hinder efficiency and effectiveness, from stock checking to material processing, retrieval, and return. The development of the ShipMate application is proposed as a solution to enhance the material management system at PT Merpati Marine Service. ShipMate features offer the potential to simplify, optimize, and automate various activities, from procurement to project monitoring. Therefore, the ShipMate application has the potential to address the challenges faced by the company in material management and improve overall performance. With the implementation of ShipMate, it is expected that PT Merpati Marine Service can effectively and efficiently tackle material challenges, as well as enhance productivity and accuracy in managing ship construction projects.

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