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USING CMMS FOR TEACHING LOGISTICS PROCESSES

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Abstract. Spare parts management in the maritime industry is a very complex supply chain process that requires exceptional management and logistics skills. One of the useful tools for spare parts management in the maritime industry, from the determination of requirements to the delivery of spare parts to the ship, is a Computerized Maintenance Management System (CMMS). The system helps to organize the entire process and speed up certain procedures. The aim of this article is to explain the structure of the spare parts management process in the maritime industry in detail and to show the different situations and phases of the process with the help of the CMMS. In this paper, the whole process is presented in a very simple form that helps students to understand the complexity of the supply chain and all the operations in this process. The inclusion of working with CMMS in teaching about spare parts management in the maritime industry has not only facilitated the learning of the subject, but has also given students the opportunity to practice one of the basic methods used for this purpose in the maritime industry. An older and still widely used CMMS is used in this paper as a model for further investigation with newer versions of CMMS and in combination with various other teaching methods.

Keywords: Maritime Industry; Management; Logistic; Spare Parts; Supply Chain, CMMS.

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1. INTRODUCTION

The process of ordering spare parts in the maritime industry begins on board with the determination that a certain quantity of spare parts is needed or will be needed in the near future, and ends with the delivery of the ordered goods to the ship. This process sounds very simple, but there are many people involved and it consists of many actions (main and secondary actions). For an ordinary person or a student of maritime faculty, it is somewhat difficult to understand (visualize) all the actions and levels in this process, as well as the number of people involved in this process. The aim of this article is to explain in detail how the process is structured and to demonstrate various stages of the process using a Computerized Maintenance Management System (CMMS).

1.1. Computerized Maintenance Management Systems

According to IBM, a CMMS is "*software that centralizes maintenance information and facilitates the processes of maintenance operations*" (IBM, 2025). The basic idea is to integrate all necessary information in a centralised database (i.e. planned and unplanned maintenance events, machinery monitoring, inventory/spare parts lists, etc.) that links the different departments of a shipping company with the ship itself (Lazakis, 2009).

Various techniques can be used for decision-making using CMMS, but its significant role in maintenance management (Rastegeri and Mobin, 2016.) cannot be underestimated, which is why it is extremely important to know the process well and introduce it into teaching. A study conducted in 2019 shows the application of CMMS at the University of South Africa for use in their laboratories or for learning purposes. Research has shown that CMMS can significantly improve the work and control system with proper user training (Pita and Ramdass, 2019). An example of the use of CMMS in education was also presented in the work of Mmelesi et al. (2020), and it was found to be a tool that significantly improves the teaching process (Mmelesi and Nwaigwe, 2020). However, the implementation of CMMS is associated with certain challenges, which was shown in the 2023 study. It concludes that by presenting all the benefits of CMMS in a simple and concrete way, it is possible to adequately deal with all the challenges due to the long-term positive results (Makhanya et al., 2023).

The importance of CMMS for the successful management of small and medium-sized enterprises is clearly emphasized in the study by Abbas et al. (2023), which concludes that this system is a useful tool for decision-making for safe and healthy companies (Aliyu et al., D. 2023).

It is stated that knowledge of CMMS brings various benefits, including in education. It is necessary that future users are familiar with the system and its possibilities that can improve work processes in different areas.

1.2. Spare Parts

CMMS is used in the maritime industry as one of the management methods for more successful and simpler operations, focusing on spare parts management, and it can be used in combination with other programs and methods (Lazakis, 2009).

Supply chain and logistics management for spare parts is critical in the maritime industry to ensure high availability and reliability of assets while keeping operating costs within acceptable limits. According to (Mouschoutzi and Ponis, 2022), supply chain and logistics operations for spare parts are associated with high complexity, uncertainty and cost due to the unique characteristics of the maritime sector, such as movable assets, globally dispersed supply and demand points, strict time windows and a multi-stakeholder environment. They examined the academic literature on the subject and concluded that the issue of spare parts needed to keep business processes running smoothly on ships is extremely complex. The academic literature review conducted by (Bhalla et al., 2021) on the topic of spare parts in the maritime industry concluded that the topic of spare parts in the maritime industry is researched from the perspective of ship owners rather than from the perspective of manufacturers and suppliers of spare parts, which would provide a more comprehensive picture of the entire process.

One of the challenges associated with spare parts on ships and in the maritime industry is the question of how to achieve the optimum quantity of spare parts. Research points to the need to optimize the initial stock of spare parts for the ship (Nenni and Schiraldi, 2013). Appropriately procured spare parts greatly facilitate business process, reduce costs and fulfill certain conditions or contracts, so it is necessary to plan and predict the need for spare parts as much as possible (Kian et al., 2018). Efforts are constantly being made to improve the supply chain for spare parts in the maritime industry by exploring new methods and improving existing ones to reduce costs, shorten delivery times and avoid unnecessary accumulation of spare parts (Kostidi and Nikitakos, 2024).

It is concluded that CMMS plays an important role in achieving the set goals in the supply chain for spare parts in the maritime industry, taking into account the necessary continuous progress and teaching as

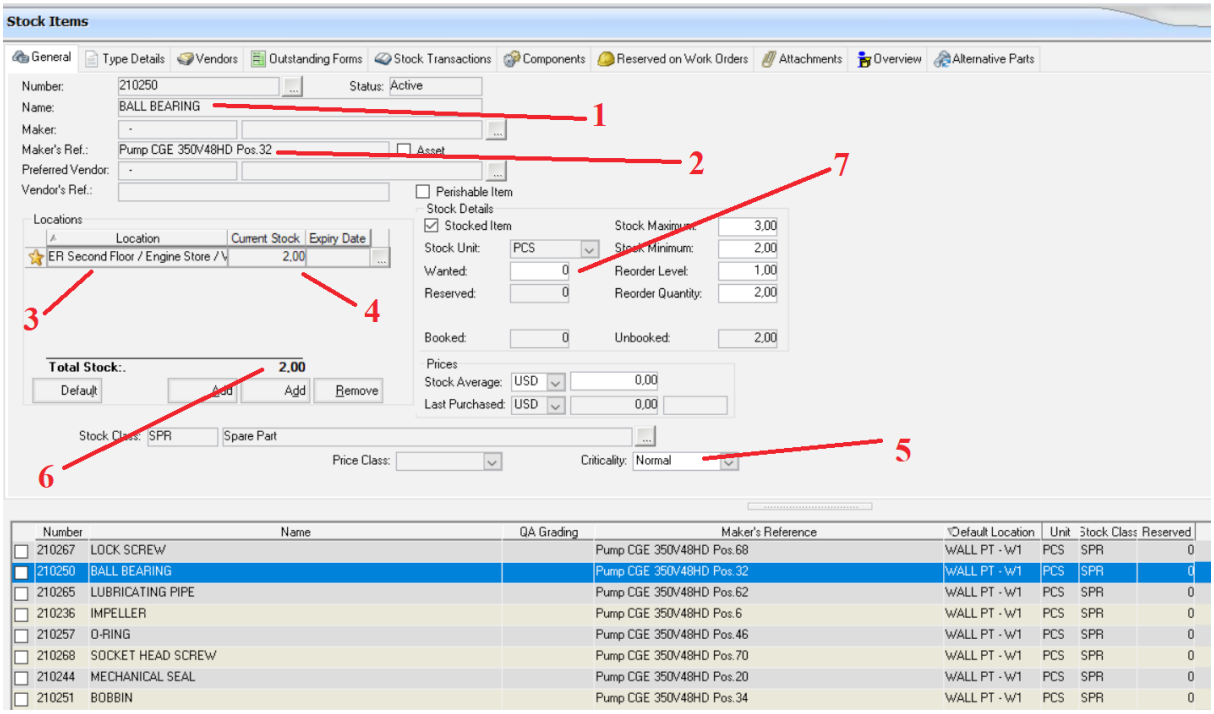


Figure 1. Spare parts in a CMMS.

well as the introduction of new methods and the improvement of existing methods.

2. SPARE PARTS PURCHASING PROCESS

This process takes place in several places and involves a large number of people, each person being responsible for a specific part of the process. The whole process starts on the ship, where the information that spare parts are needed is created. The whole process is explained using the CMMS program AMOS 9.2.00, which was once the most widely used program in the world. With the introduction of its new versions and the emergence of numerous competitors, its use has declined. There are different scenarios of how the information that spare parts (Figure 1) are needed is received. The most common is the realization gained by updating the spare parts inventory, i.e. the realization that there are not enough (or even none at all) spare parts on board. Another scenario is the planning of future maintenance work, where the stock lists are checked again and it is realized that there are not enough spare parts for future maintenance work.

At the bottom of Figure 1 there is a list of spare parts with the most important information such as name, manufacturer, where the part can be found, etc. When a part is selected (blue in Figure 1), additional data is displayed in the upper part of the screen. The name of the spare part is marked with the number 1, the description of the spare part is marked with the number 2 and the location where the spare part is stored is marked with the number 3. For each storage location (there may be more than one), the number of parts stored there is indicated by the number 4, while the total number of spare parts on board is indicated by the number 6. Since the criticality of spare parts in the maritime industry is governed by various rules and regulations (OCIMF, 2018), the CMMS has provided a field for this, marked with the number 5.

2.1. Phase One of the Process

The realization that spare parts are needed is the starting point for any spare parts ordering process in the maritime industry. Today, a CMMS is usually used to update the spare parts inventory and plan future maintenance work. Since spare parts are one of the most important features of the maintenance process, information about spare parts is included in these systems where quantities and related information are in the system and can be easily viewed and updated. Figure 2 shows the beginning of the process that takes place on board and the people involved in it.

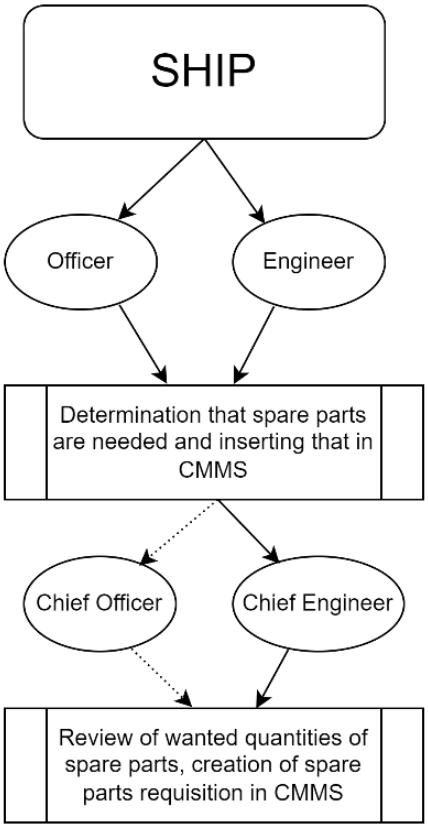


Figure 2. Initial phase of the process.

As can be seen in Figure 2, the person in charge notices the lack of spare parts while working on the ship and enters this in the CMMS (see Figure 3).

The Chief Engineer, or less frequently the Chief Officer, checks the quantities of spare parts required (Figure 4) and creates a Requisition form (Figure 5) in the CMMS.

Requisition form is then automatically sent to the office with the scheduled information exchange in the CMMS (this process takes place regularly, usually once a day).

With the creation of the Requisition form, the first part of the process, namely that on the ship, is completed. The ship's crew is only involved in the process again at the very end, when they receive the ordered parts, which should arrive before the date specified in the requisition form.

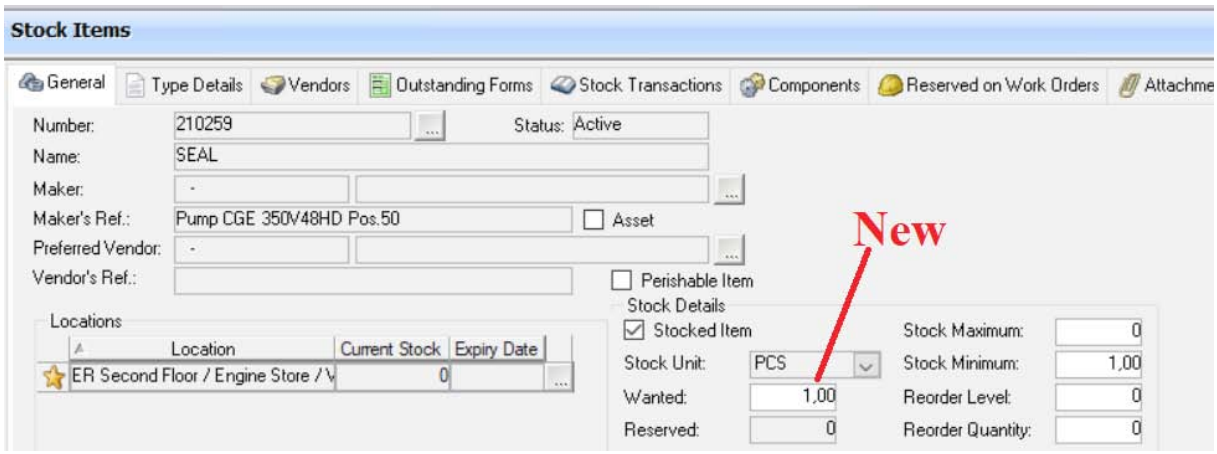
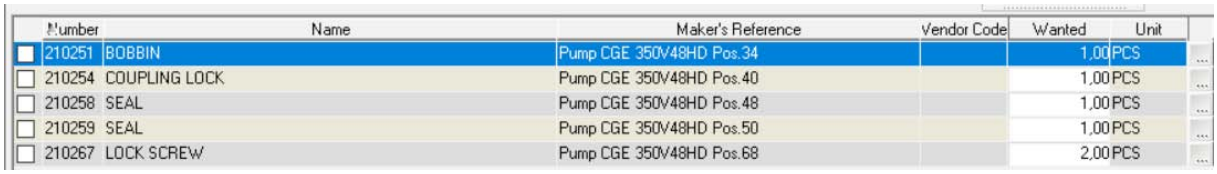


Figure 3. Insertion of the wanted quantity by responsible person(s).



Number	Name	Maker's Reference	Vendor Code	Wanted	Unit
210251	BOBBIN	Pump CGE 350V48HD Pos.34		1,00	PCS
210254	COUPLING LOCK	Pump CGE 350V48HD Pos.40		1,00	PCS
210258	SEAL	Pump CGE 350V48HD Pos.48		1,00	PCS
210259	SEAL	Pump CGE 350V48HD Pos.50		1,00	PCS
210267	LOCK SCREW	Pump CGE 350V48HD Pos.68		2,00	PCS

Figure 4. Rechecking the quantities of spare parts required.

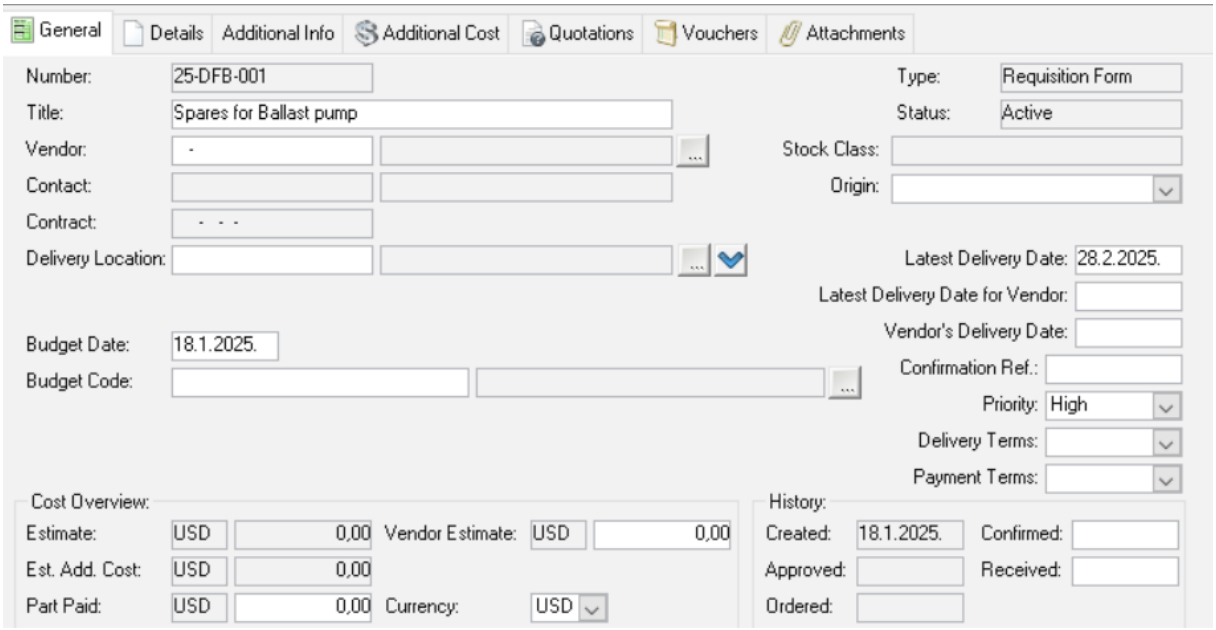


Figure 5. Requisition form in the CMMS.

2.2. Phase Two of the Process, the First Part

The next phase of the process takes place in the office after the requisition has been received from the ship as part of the regular data exchange within the CMMS. In the office, the process continues with the Technical Superintendent responsible for the vessel checking the Requisition form received (Figure 6). If he finds that the request contains what is really necessary for the vessel at that time, he approves the request (Figure 7).

It is important to emphasize that the Technical Superintendent is a highly qualified person, usually a former Chief Engineer on one of the company's ships, who is usually well versed in technical systems and their requirements.

The Chief Purchaser has the task of checking the approved Requisition Forms, adding the budget code to them and converting them into a query in CMMS. This is the next step in the office, which can be seen in Figure 8.

After this step, the process continues in the purchasing department, where the purchaser (usually a younger and less experienced member of the department) sends Queries to several addresses of potential suppliers so that they can submit their offers (order price, delivery options, delivery time, etc.).

With this step, the shipping company's activity in the process decreases, and now it is the suppliers' turn to send a response to the Query, which takes some time, usually about two weeks.

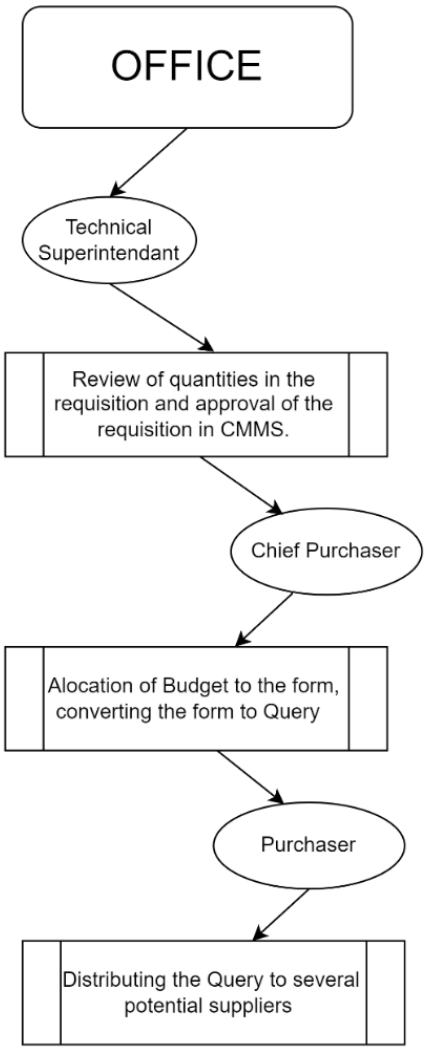


Figure 6. The first stage of the second phase of the process.

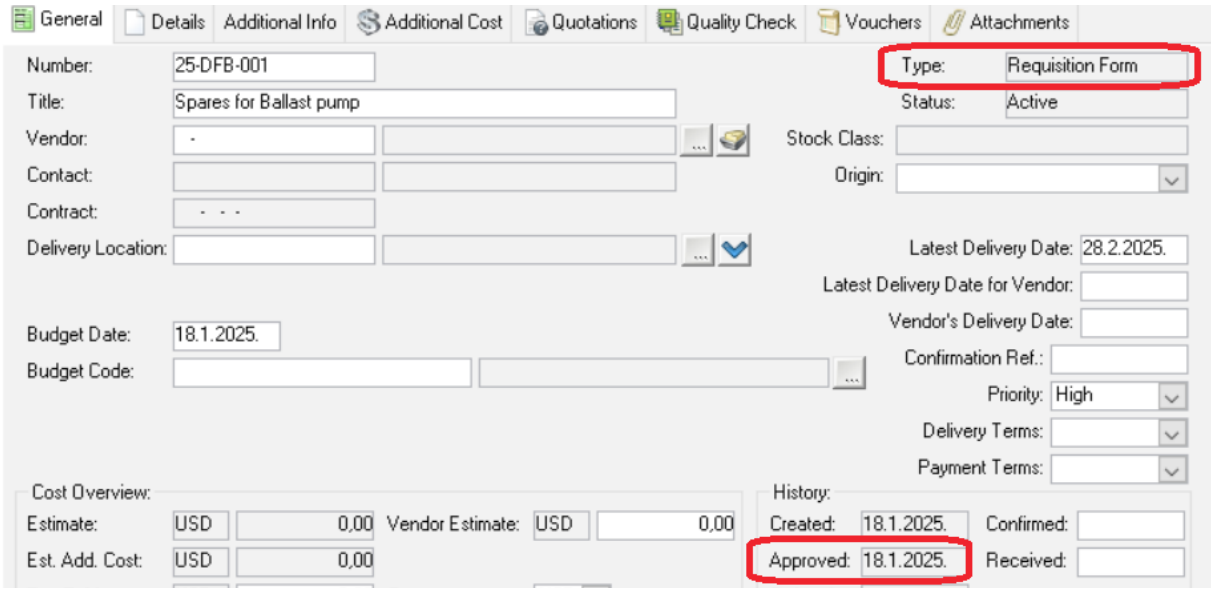


Figure 7. Approved Requisition Form.

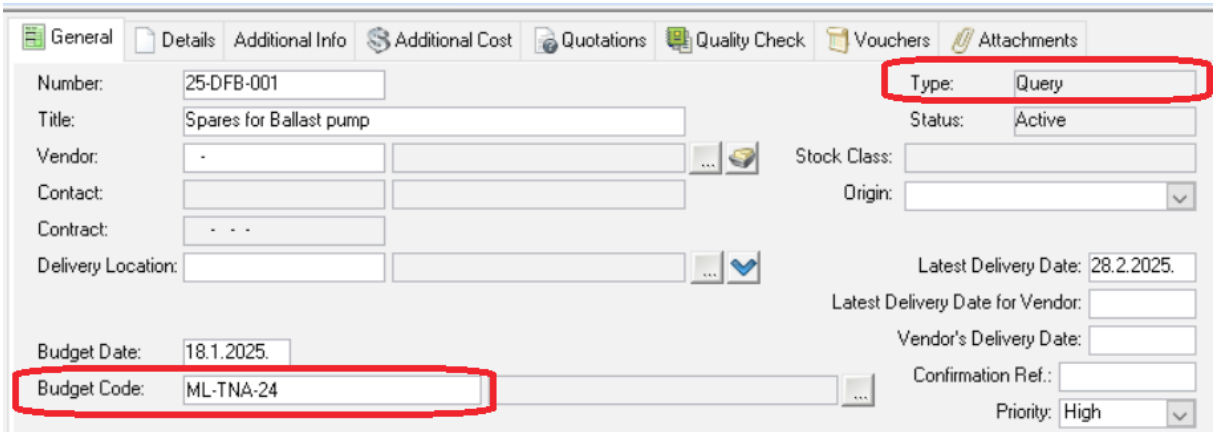


Figure 8. Creation of Query.

2.3. Phase Two of the Process, the Second Part

After the suppliers have submitted their bids, the second part of the second phase of the procedure begins (Figure 9). The offers are forwarded to the Purchaser, who examines them and selects the best offers.

They are checked and compared by the Chief Purchaser, who selects the most favorable offer and approves one in the CMMS (Figure 10).

As can be seen in Figure 9, the process continues in the same department where the Purchaser converts the file into a Purchase Order. He then sends the order to the supplier (usually directly via CMMS) and enters the relevant information into the system. The appearance of the file after dispatch is shown in Figure 11.

The final action in this phase is to enter the supplier's confirmation that the parts will be delivered as agreed. This is also done by the purchaser after receiving the notification (Figure 12).

By entering the confirmation data, the office and its employees have completed their part of the spare parts procurement process. The spare parts are now on their way to their destination, where they will be delivered to the ship.

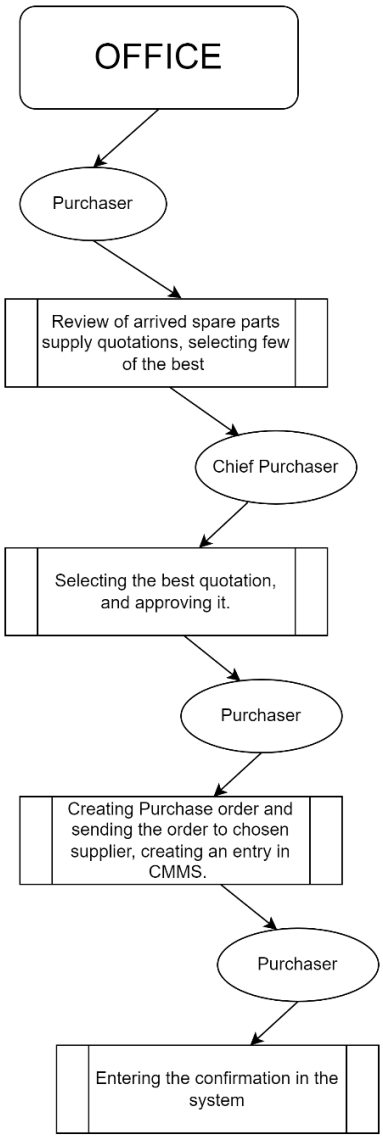


Figure 9. Second stage of the Phase Two.

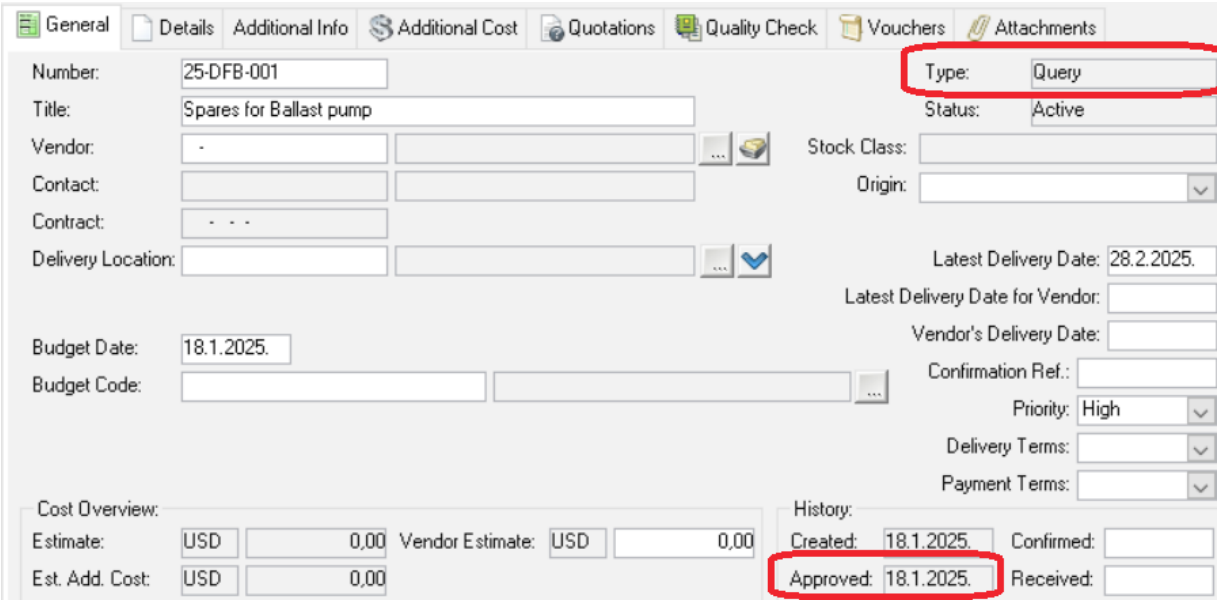


Figure 10. Approved query.

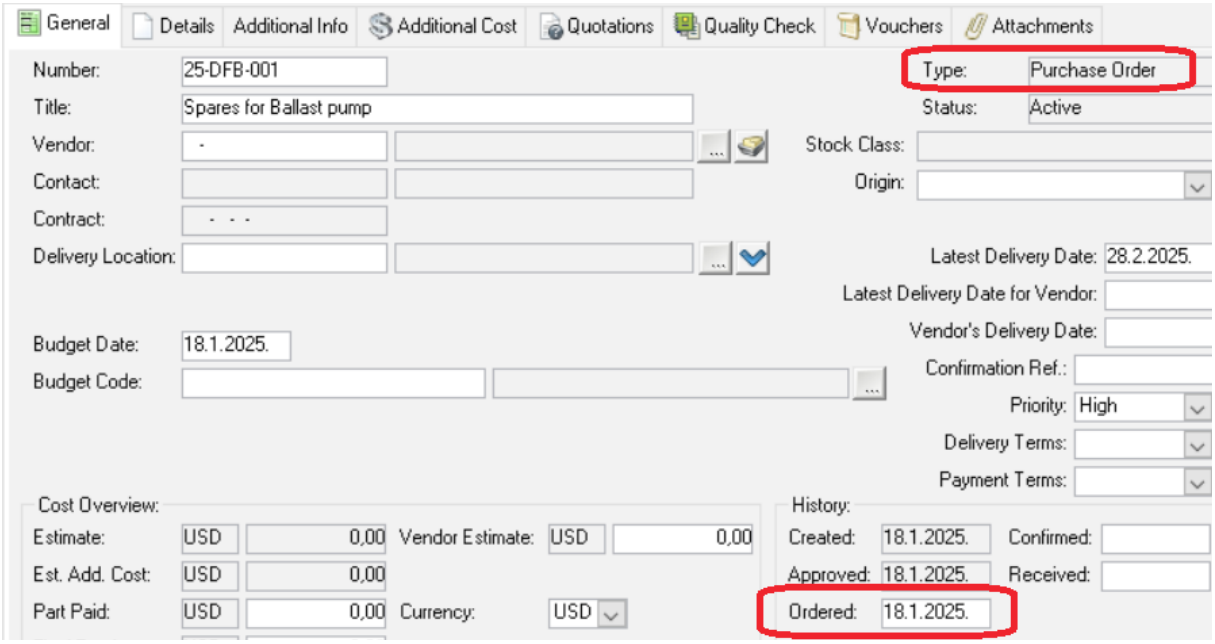


Figure 11. Purchase order with note that it is ordered.

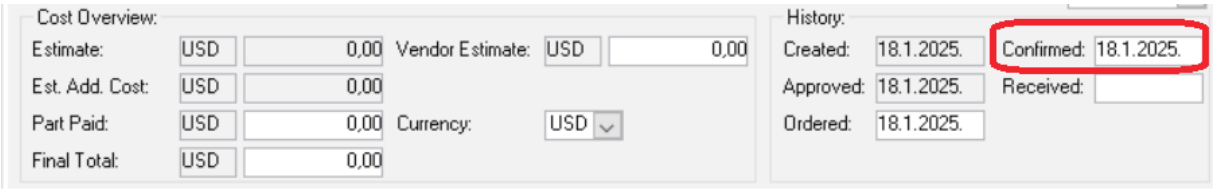


Figure 12. Purchase order with note that delivery options are confirmed.

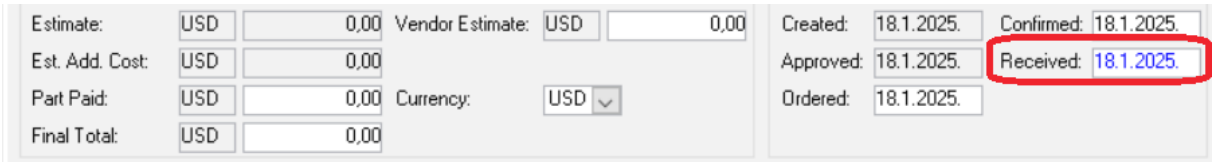


Figure 13. Received Purchase.

2.4. Final Phase of the Process

The last part of the spare parts procurement process takes place on the ship, in port. The ordered parts arrive on the ship, where the crew inspects them, determines their condition and quantity and enters this information into the CMMS. Data entry into the CMMS is usually carried out by the deck or engine officer who initiated the entire process.

This action completes the procurement process for spare parts and the order automatically goes to the "Filed" folder.

3. CONCLUSION

This article explains the process of spare parts procurement using CMMS and screenshots from the system in which the process was simulated for the purposes of this article. These screenshots and inserted images with people working on the ship and in the office facilitate the explanation of the process for the students, who can understand the complexity of the process and procedures much better.

Although this purpose was the basis for the introduction of the CMMS in this part of the lesson, the benefit to the students is much greater. Although the CMMS shown in the paper is somewhat outdated and there are newer versions, it still has a large number of users around the world, and by using this system, students gain an insight into how the whole process works in reality. Furthermore, students are forced to understand and work with the CMMS, which can prove useful in the future.

To summarize, this type of teaching has the following advantages:

- It helps students to better understand the whole process and its complexity and to realize how many different people are involved in the process,
- It provides useful training in one of the CMMS used, enabling students to understand how the system works and its basic principles. Although they will probably come into contact with different CMMS (read BIKE), there is a well-known saying that goes "Once you learn to ride a bike, you never forget it".

Further research with newer versions of CMMS is underway and the next article will give an insight into this aspect in conjunction with various other teaching methods.

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