Plan Maintenance System (PMS) and Technical Assistance software.

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Abstract: This document describes what parts a ship is composed of, operating regulations and ship management, in accordance with international regulations. Also, we will see that it is related to Preventive Maintenance PM in shipping. Lastly we will study the analysis of a CMMS system AMOS-D.

1. Introduction(Heading1)

I. Types of ships & their operations

Ships are used for two main purposes:

- For the carriage of passengers,
- For the transport of merchandise.

While passenger ships are limited to two main categories, line vessels and cruise ships, merchant ships are divided into several categories that have to do mainly with the cargo they carry. So merchant- cargo ships, divide them into the following categories:

1. General cargo ships (various types of cargo)
2. Bulk carriers (eg coal, cement, wheat, iron ore etc.)
3. Ships carrying liquid cargo (petroleum tankers, chemical liquids, etc.)
4. Gas transport vessels
5. Containers

cargo ships, divide them into the following categories:

6. Car ferry boats
7. Other special categories

II. Description of ships

Ships are divided into the following main sections:

• The construction of the ship including the shell, decks, watertight hedges, various tanks, cargo spaces and accommodation compartments. All these parts are usually iron structures and the purpose of their maintenance is to avoid damage to the plates and reinforcements.

• The propulsion system consisting of the main engine, axle system, propeller and rudder.

• The power-generating pairs for the ship's energy needs.

• Auxiliary mechanical systems for the operation of the main engine, power generators and other auxiliary systems.

• Load-lifting machines which are usually cranes for dry cargo vessels and liquid cargo pumps.

• Navigation systems.

• The telecommunications system

• Safety systems (rescue boats, inflatable drums, etc.)

• Fire detection and fire protection systems.

• Sea pollution prevention systems.

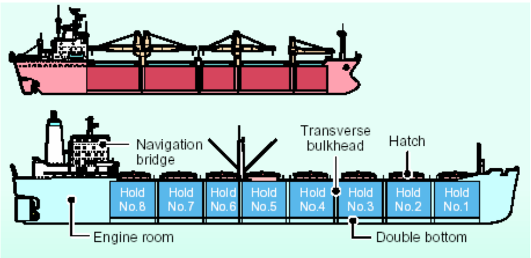
These are the main segments in which a ship is usually divided, but there may still be some systems, depending on the type of ship and the type of maintenance system each company wants to implement.

In our study, we will examine the required maintenance to be carried out on Bulk Carriers, the so-called Bulk Carriers, as well as the new methods and trends for the development and monitoring of these ships.

These commercial bulk carriers, as we have already mentioned above, were originally created for the transport of bulk dry bulk cargoes that were moved in large quantities and did not require their packing. The main bulk cargoes were charcoal, iron ore, bauxite, salt and various grains such as wheat and others.

The biggest advantage of carrying these loads in bulk is initially a very large reduction in the cost of packaging, since they do not need it, and secondly, the rapid loading that can be achieved. Nevertheless, before the Second World War, heavy bulk transport was not necessary. The total

merchandise that was transported in 1937 was only 25 tonnes a year and could carry small cargo ships on the line.
In 1950, however, the bulk transport began to grow. The goods and raw materials were far farther from where they needed them, and the cheapest and quickest way to transport them was the sea. Companies based in the United States of America, Europe and Japan have started to build bulk carriers. As demand, demand and technology grew in the shipbuilding sector, these ships were becoming larger in size and capacity. By doubling the amount of iron originally built by Bulk Carriers, they allowed them to carry huge amounts of cargo, storing it in cubic form, without increasing the demands of cargo ships on the number of crew members that should manned as well as the fuel that should be used since the speed they would be called upon to develop was not necessarily high. Today's Bulk Carriers have developed a lot, but since 1960 there is a predefined design. This consists of the mainframe of the double-bottomed vessel, large cargo-carrying cranes, the cargo storage tanks covered by hatches, the engine room, the bridge, and finally the crew's accommodation area almost always in the stern ship.
Today Bulk Carriers carry a very large proportion of the world's freight transported and in most cases do it safely. More specifically, according to the International Cargo Owners Organization (Intercargo), 99.90% of bulk cargo has been delivered safely over the last five years. Nevertheless, considering the size of this load, even 0.1% corresponds to hundreds of thousands of tonnes. The maintenance sector of Bulk Carriers seeks and implements ways to further reduce this percentage.



Picture 1: Description of the parts of the ship

III. Dangerous operation of ships

The operation of ships involves dangerous factors related to:

- ❖ Risk of loss of life (passengers in passenger and crew on both passenger and commercial ships).
- ❖ Risk of damage to the transported load.
- ❖ Risk of environmental pollution

2. Ship security and quality laws.(Heading 2).

I. Ship Operation & Management Regulations

Since, beyond the safe shipbuilding, a factor on which ship security is dependent is also their management, since 1998 another International regulation, known as the International Safety Management Code (ISM)). This regulation lays down conditions for companies managing ships in relation to:
The selection of personnel employed on board ships and offices
The training of the above personnel
Procedures related to ship's operating activities (eg navigation, loading, etc.)
Ensuring correct and systematic maintenance on board ships,
Systematic control over the implementation of the safe ship management system
II. Shipbuilding Regulations
In order to minimize the risks at sea, international regulations concerning the construction and equipment of the various categories of ships have been adopted. These regulations are:
SOLAS (Safety of Life at Sea), which deals with how ships are constructed in order to be safe in the event of fire and concerns the equipment of ships for proper telecommunication, navigation systems, and occupant safety equipment.
The Load Line Convention, which deals with the loading of ships to ensure buoyancy and stability.
The Marine Pollution Convention Regulation known as MARPOL.
In addition to the above-mentioned international regulations adopted by the United Nations International Maritime Organization (IMO), vessels are constructed and operated by the classification societies. The classification societies ensure that ships are constructed in a safe manner and in accordance with international regulations and monitor during ship operation that they are kept in the condition required by the regulations. The classification societies are the

ones issuing the ship's certificates without which ships are not allowed to travel.

III. International Convention for the Safety of Life at Sea (Solas)

The SOLAS Convention, in its successive forms, is generally considered to be the most important of all international treaties in relation to the safety of merchant vessels. The first edition was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948 and the fourth in 1960.

Due to the rapid growth of the merchant shipping sector and the technology in general, it was necessary to update the treaty by periodic amendments. Unfortunately, in practice the incorporation process of the amendments proved to be very slow. It became clear that it would be impossible to ensure the entry into force of the amendments within a reasonable period of time. As a result, a completely new treaty was adopted in 1974 which included not only the amendments up to that date but a new process of amendments - the tacit acceptance procedure - in order to ensure that changes could be made within a defined (and acceptable) period. The new procedure concerned how the new SOLAS amendments would be made. Thus, instead of necessity to agree a fixed number of IMO members, e.g. two-thirds of the members, in order for a new amendment to come into force, the amendment would still enter into force at a predetermined, reasonable date after its creation, unless a specified number of IMO members objected to it. Consequently, the 1974 Treaty has been updated and amended on numerous occasions. The current treaty today is sometimes referred to as SOLAS-1974, after amendment.

IV. Solas's goal

The main objective of the SOLAS Convention is to clarify the minimum levels for shipbuilding, equipment and operation that are compatible with their safety. The Flag State of each vessel is responsible for ensuring that vessels flying their flag comply with SOLAS requirements, and this is done through various certificates defined in the Treaty as proof that this has been done. Control facilities also enable governments to inspect vessels of other Contracting States if there are clear grounds for believing that the vessel and its equipment are not in line with Treaty requirements - a process known as state port control.

3. Technical Assistant Duties(Heading 3)

ShipManager Technical is the technical ship management system for both planned and unplanned maintenance, defect reporting and technical asset and data management. A Planned Maintenance System streamlines the planning, documentation and implementation of maintenance work and surveys onboard ship. Technical assistants offer ongoing support to make sure developments of a client company's business model are handled efficiently. The main responsibility of a technical assistant is to provide advice, assistance and training relevant to the installation, functioning and ongoing maintenance of equipment or software. Technical assistants are employed in a range of industries, from manufacturing to media to software development.

Administrative Role

A technical assistant provides support for technical staff by reviewing incoming mail and determining an appropriate course of action. Technical assistants need to prepare correspondence to delegate technical tasks to other employees so they need to possess good writing skills and a solid grasp of mathematics. A technical assistant is also responsible for transcribing any corporate strategies from higher management and finalizing draft documents. He will also proofread instruction manuals and services manuals relating to the implementation of new machinery or computer software to ensure accuracy. Technical assistants also produce all relevant documentation whenever a design model is modified, and are responsible for coordinating off-site travel plans and appointments.

II. Communications Role

Technical assistants should possess excellent communication skills as they are expected to provide efficient assistance to both internal and external customers, as indicated on the HR Management website. They often work in conjunction with the quality assurance department, consistently addressing any anomalies in a product's key specifications or efficiency levels. Technical assistants also conduct ongoing analysis of product research results and utilize their findings to report to higher management or relevant departments on any barriers to continuing progression. A technical assistant should be adept at liaising with various departments, accepting criticism and reworking a design implementation to suit business needs. She should also be able to communicate with employees from all levels of a business and field inquiries from the public on technical issues relating to a product or service.

III. Specific Skills

4. Shipbuilding Regulations(Heading 4)

Technical assistants are required to continually assess a product's performance level to ensure the design and functionality meet predetermined criteria. A technical assistant will typically need to be proficient in maintaining accurate digital records in the form of databases, spreadsheets or key technical files via set automated systems. A technical assistant will also need to be adept at identifying any barriers to a product's development and liaise with suppliers to buy relevant tools and design blueprints for development purposes where necessary.

I. Systematic & preventive maintenance of ships

Due to the introduction of the aforementioned "Safe Ship Management" Code, it has become more urgent for shipping companies to implement some proactive maintenance systems. Thus, several programs have been launched in the shipping market to facilitate shipping companies in the implementation of preventive maintenance It should be clarified here that: The "Safe Ship Management" Code does not require the monitoring of preventive maintenance on ships by computer programs. This can also be done with a form-based system. Of course, due to the development of IT applications, many shipping companies prefer to modernize and apply information technology also in this area.

Systems applied to ships are usually based on maintenance through inspections and not on maintenance through scheduled replacement of machinery

Total productive maintenance (TPM)

TPM is a method of achieving maximum equipment efficiency and minimizing downtime due to failures, through the involvement of management and employee operators and conservators. Workers and maintainers should behave in the equipment as they do to something they own. TPM standardizes a full maintenance program. Operators know their machine well and perform simple maintenance tasks. Conservators spend less time on fault repair procedures and generally create a more team climate in the day-to-day team that comes in contact with the equipment. PM is the forerunner of certifying our processes by trying to maintain engine specifications within the specified limits. TPM greatly improves equipment availability (less damage and downtime), reliability, and just-in-time (JIT) logic in inventory.

Application TPM

Instructions to users - shipkeepers - engineers.

Responsibilities of the shift engineer

The engineer of the shift or the engineer in charge is the first engineer's representative and is in this form the complete authority for the operation of all machines as well as the beginning of all the engine staff in the shift. During his shift, he is helped by the assistant engineer, who works under his guidance. If machines are in a phase that is being tested, the engineer or his assistant should remain in the control room to respond promptly to commands given by the telegraph navigation bridge.

Preparing for the beginning of the shift

Before commencing its shift, the engineer must examine all machinery and installations, in particular the steering system, the refrigeration machinery, the boiler, the main engine, the turbine engine and the auxiliary machinery. You should also inspect all fuel and oil pipes for leaks and ensure they are clean. Any imperfections must be reported immediately to the engineer of the previous shift who leaves. He, in turn, must inform the chief inspector of all machines and advise him properly in any emergency situations. To undertake a shift, the engineer must familiarize himself with the applicable instructions in the chief engineer's book and follow these engine maintenance and monitoring instructions by validating it with his own signature for the completion of the shift. Similarly, the engineer's assistant should do the same.

Basic instructions and responsibilities of staff at sea:

Tracking machines from the bridge:

In ships equipped with special machinery with indications to control the machines from the bridge, staff are obliged to check everything through these machines on the bridge. However, the first engineer is required to ensure that all senior engineers and controllers are fully familiar with and fully trained in ship machines in an emergency where the indications of the bridge fail.

Power of the Main Engine:

The instructions for maintaining and maintaining the normal power of the main engine during the journey are contained in the instructions for the first engineer, who should take them to the other engineers under him. These have been sent with a special letter from the headquarters of the company. The first engineer is required to follow these instructions unless he or she finds otherwise or finds himself in an emergency that involves a risk to the life of one of the crew members. If, for any reason, a change is made to the maintenance routine of the main engine of the ship, the personnel responsible for supervising the main engine room, you will have to record this change as well as the reason that is done in the book that records everything about the main machine (engine room calendars). The owner's headquarters should then be informed.

Physiological Conditions of Operation

The main engine shall operate within the limits of its power at the pressure, fuel consumption and speed limits prescribed for the first time it has been

commissioned unless specific written instructions have been given and are inconsistent with the above.

Inspections of machinery

The shift engineer must perform regular and frequent inspections of all machines during his shift monitoring and must ensure that the plants operate safely and effectively. All temperatures, pressures, levels, flows, loads, etc. should be supervised and operate at their prescribed limits for each machine. If something abnormal is observed, the engineer of the shift should immediately take action to correct this dysfunction.

Inspections of navigation equipment

The supervisor shift engineer is required to supervise at least once the machines that have to do with the navigation system inspections should consist, but not be limited only, by checks on the general condition of the room with the navigation equipment, the level of the hydraulic oil in the tank, check for leaks at the connection points of the machines, the valves, the tightness of the flanges, the abnormal sound, if any, when operating the enginesvalve positions, lubrication of frequently moving parts, and finally the temperature of all machines in the navigation room.

Checking the water level in boilers and heat exchangers

The shift engineer is required to keep the correct water level in the boilers and to have all the steam generators under regular supervision. It must regularly check all the indications of the equipment that it is at normal operation levels. Where it faces difficulty for any reason in maintaining the boiler water stations within certain safe limits, he must take the immediate corrective measures to protect the boiler and inform the engineer accordingly.

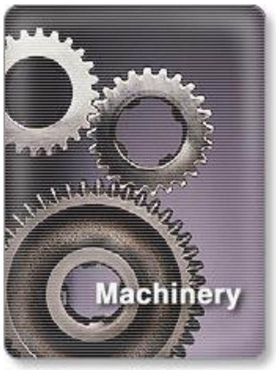
Changes to main engine speed

In addition to monitoring for any commands from the bridge via a telegraph and being there to prevent some damage to the machines, the mechanic working on his shift must never and for no reason change the speed of the main engine. If in any case a state of urgency emerged in the engine room it would require to reduce the speed or to stop the main engine, he is obliged to inform directly the first mechanic as well as the bridge of the ship. Only in an emergency will he be able to get permission to reduce the speed of the engine and clean for the safety of the ship. Finally in extreme cases beyond the control of the engineer he has the ability to stop the engine immediately after he has followed the following procedures:

1. Send 'STOP' to the ship's bridge
2. Turn on the engine room alarm
3. Stop the Main Engine

Procedure in case of engine failure

At the first indication of an interruption or any other defect of any machinery, the engineer of duty must to take the necessary steps to prevent further damage and to call the chief engineer immediately.



Lubrication of Engineering Equipment
The shift engineer has the obligation to be sure that the quantities of lubricants needed for the various parts of the machine are at good levels, as well as to ensure that there will be no shortage of these in the future. It also has the duty to check that the lubricating oils used are those consisting of the manufacturer and the requirements of the main engine.
Oscillations
Vibrations in the machine can cause serious damage to machinery, bearings, pipes and machine assemblies. If the vessel is tested under strong oscillations, the first engineer must reduce the speed of the boat vessel in order to minimize damage to the main machinery. If the oscillation is a big problem, the first engineer should pay special attention to balancing of the roller loads in diesel engines and the compression of the bolt holding on all machines. At the same time, it should fully exploit all the control equipment provided to detect and measure the oscillation. If any increase in the level of oscillation is detected, which the First Engineer can not justify, then instructed to notify the company's headquarters for this event.
Economy in Fuels
The shift engineer should pay attention to issues that have an impact on fuel consumption and fuel economy. He must pay close attention to the instructions on proper combustion of fuel and proper supply of air to boilers. It must ensure that any auxiliary equipment, which is not really required, is closed.
Accident prevention
The shift engineer must be particularly alert in preventing accidents in personnel and machinery, and always apply the company's procedures and instructions related to safe management and accident reporting.
Calendar
Before leaving the post, the shift engineer must ensure that all the details in the machine log on his shift are accurately recorded. It is very important to note any damage or unusual event.
Stay in port
The engineer has a shifting ship while staying at the port he must do his duties as if the ship was at sea, with any additional instructions to him from the First Engineer.
On-board activities according to specific cases
Activities as the ship is in a port
When the ship is in the port, the chief engineer must ensure that there is always a competent validated senior engineer, except in those cases, which has been authorized by the captain, in which all ship surveillance and maintenance activities have been suspended. Sufficient workforce should always be available to meet the operational requirements
Stand By Position
It is the responsibility of the first engineer to ensure that the machinery spaces are adequately manned while the ship is waiting for a command to sail. At the same time, the second engineer should be present on the machinery spaces during this time. During the waiting of the ship to sail, the first engineer should always be present at the engine room. If for any reason he has to leave the engine room, the engineer performing his shift at that time should know where he is in need.
MAINTENANCE-SURVEILLANCE OF THE MAIN MACHINE
Testing and post-machine maintenance
When Finished With Engines (FWE) is ordered, the settings required by the machine manufacturer must be made. Oil lubricant oil pumps and rotary turn tool are to run for at least two hours after FWE. The senior engineer officer will receive confirmation from the senior officer in service that it is safe to use the machine's rotation tool before performing any tests.
Current repairs
Current repairs to all machines should normally be carried out by engineer crew whenever possible and not postponed until the scheduled main repair period.
Diesel engines
The Diesel Engines used by most ships vary mainly in size and power. They all consist of some main parts and components whose proper maintenance and supervision is more than

critical. The general rule is to observe the maintenance and maintenance instructions given by the manufacturer.

Preventive maintenance program

Preventive maintenance is scheduled maintenance facilities and equipment designed to lengthen the life of equipment and to avoid any unplanned maintenance activity. Preventive maintenance (PM) includes painting, lubricating, cleaning, adjusting, and replacing damaged parts of the equipment to extend its life and facilities. Also, a major goal of using preventive maintenance is to minimize breaks in the production or use of break-down equipment. Neither the equipment nor the facilities should reach the point of interrupting their operations.

A preventative maintenance program must include:

Non-destructive tests

Periodic inspections

Pre-planned maintenance activities

Maintenance to remedy the deficiencies in the equipment or facilities found through the test or inspections.

Reasons for preventive maintenance:

• Increased automation

• Loss for business due to production delays

Reduction of insurance benefits for equipment or installation

Producing a higher quality product

Using Just-in-Time in production

Reducing equipment redundancy

Minimize energy consumption

Need for an organized, planned environment

Why Use Preventative Maintenance?

The most important reason for using a Preventive Maintenance program is reduced costs as this is apparent from the following reasons:

• Reduced downtime, resulting in fewer interruptions

Break-Downs.

• Better maintenance of the pieces of equipment and increasing their estimated service life, thereby avoiding premature replacement of machinery and equipment.

• Reduced overtime costs and more cost-effective use of maintenance workers since they will work on

a planned workplace rather than in times of need when trouble occurs (Trouble Calls)

• Timely, scheduled repairs result in fewer, larger and less expensive repairs.

• Reduced repair costs by reducing the failure of individual parts of the equipment. When parts fail during their operation, they usually damage other parts.

• Reduced waste and product waste due to the overall better state of the equipment

• Determination of equipment with excessive maintenance costs, operator training and replacement of obsolete equipment

• Improved safety and quality terms.

• If it can not be proven by numbers and calculations that a preventative maintenance program will reduce costs, there is probably no good reason other than security to implement a Preventive Maintenance program.

The essence of a Preventive Conservation Program:

There are many advantages that arise from a good preventative maintenance program. The advantages apply to each type and size of the plant. As much as the higher the value of plant equipment per square meter, the greater the return to value from a preventive maintenance program.

Risks from Using a Preventative Maintenance Program:

Preventative maintenance includes risk factors. The risk is clearly related to the creation of imperfections of the various types of equipment or installations, with the objective of preventive maintenance. In other words, human mistakes that occur during proactive maintenance, and infant mortality of newly installed or re-installed equipment ultimately leads to additional failures of the equipment in which preventive maintenance was performed. Often, these failures occur very soon after a preventive maintenance program. Typically, the following errors or damages occur during the proactive maintenance procedures and other types of service interruptions for maintenance.

• Damage to an adjacent equipment during proactive maintenance.

• Damage to equipment under preventive maintenance,

• Damage during an inspection, repair, setup, or installation of a replacement part

• Installing the defective hardware by incorrectly installing a replacement part

• Reinforcing child mortality by installing new parts or materials.
• Damage due to error in repositioning the equipment in its original position

Infant mortality

The case where a failure occurs in equipment and is observed when it is new or when disassembled for maintenance purposes.

How to Perform a Successful Preventive Maintenance Program:

The key to a successful Preventive Maintenance Program (PM) is in designing and executing. The project must be automated to its fullest extent. Priority should be given to possible control of the entire preventive maintenance program. This test, whether made by specialized software or by people, should be fully reliable so that the maintenance program is completely reliable.

Run a Preventative Maintenance Program:

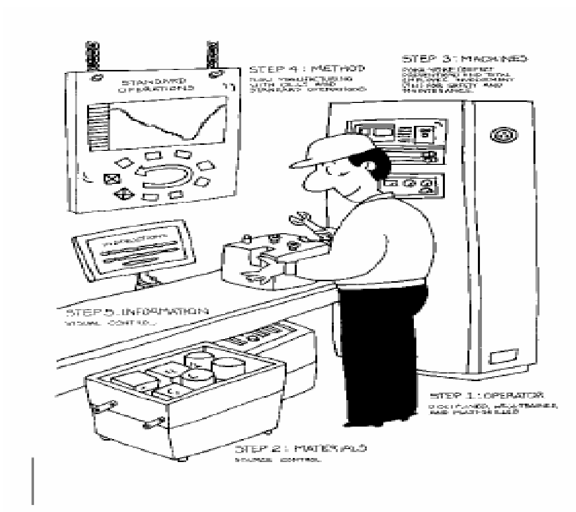
Traditional preventive maintenance was based on the concept of bathtub curve (Bathtub Curve). The new parts have gone through three stages: **the first is the infant-mortality stage**, the second is **the long run stage** and the third stage is the **wear-out stage**. The concept of preventive maintenance was to replace these parts before they were introduced into the last phase of their decline. Unfortunately, in order to get as close as possible to the term maintenance with credibility, a survey was conducted with United Airlines and the rest of the aircraft industry, and showed that very few non-structural parts of the aircraft have the bathtub curve characteristics. Their research has shown that only about 11% of all mechanical parts have characteristics of their stage wear-out stage, but 72% of the parties have the characteristics of the first stage of infant mortality. These same features have proven to be valid in the Defense Systems Research as well as power plant installations. It is very likely that they are generally valid worldwide. Therefore, they should be taken into account in the development of preventive maintenance in industrial equipment.

Preventive maintenance should focus on cleaning, lubrication, and occasional repairs to equipment faults through testing and inspections. When there is a need to adjust or replace parts of the equipment, it must be done by highly trained and skilled professionals. Predefined parts replacement must be minimal and take place only where the statistics show clearly that part of the equipment being inspected or corrected has reached its wear-out stage. In the absence of data to calculate the time that the parts of the equipment should be replaced, would help an age setting software or data collection for statistical analysis to determine when to replace parts of the equipment. For example borrowed from the Japanese way is the red mark of the points which must be lubricated with bright red circles to ensure that the lubrication targets have been lubricated. Cleaning of mechanical equipment should be done frequently to remove dust, dirt, and accumulated dirt because they all cover imperfections and can cause unplanned operating interruptions of the equipment Shut-Downs.

Preventive Maintenance with staff motivation:

A quality preventive maintenance program requires a highly motivated maintenance staff. The following activities proposed may provide an appropriate incentive for staff:

• Establishment of equipment inspection and proactive maintenance as a fully recognized, important part of the general maintenance program.
• Appointment of competent, competent people in the preventive maintenance program.
• Providing proper training resulting in training in precision maintenance practices and training in the proper techniques and procedures for preventive maintenance in the particular equipment
• Requirements of high standards in all issues related to maintenance
• Communicating reduced spending with improved early-time payroll, which is the result of effective preventive maintenance



Is Preventive Maintenance Essential?

The truth is that most manufacturing and production facilities would benefit from a good preventative maintenance program. But a preventative maintenance program is potentially dangerous so it needs to be addressed and executed appropriately to be successful.

Conclusions:

It is possible to have a successful preventative maintenance program. In terms of cost reduction, it is substantial, but also involves a number of risks. However, when careful attention is given, these risks can be minimized. In order to minimize the risk, preventive maintenance should be carefully planned and carried out by well trained and motivated workers. The biggest benefits of a proactive maintenance program come through painting, lubrication, cleaning and adjustment, and the secondary replacement component which together all extend the life of the equipment and plant.

5. Scheduled Maintenance Systems in Shippin(Heading 5)

Basic question: Are the planned maintenance systems used in ship?

The Oil Companies International Marine Forum (OCIMF) has the requirement to be used on board tankers fully automated for scheduled ship maintenance programs.ing too specialized. The crucial question for all other shipowners is: "Do businesses need to use a simple Excel spreadsheet or a planned software-based maintenance system to calculate the planned maintenance of their ships" .Many businesses have used Excel spreadsheet calculations as a guideline for planning their ship maintenance for many years and find that this allows for adequate coordination of the design they need. When faced with the decision whether to buy a more comprehensive and planned maintenance system their reaction is: "Why is something that works well so far, and why load the crew with even more bureaucratic work". A complete scheduled software maintenance system can benefit in order to save considerable time and cost at sea and on land, because it has the ability in particular to remove a lot of office work done by the first engineers.

Computerized Maintenance Management System Planned Maintenance

To plan the work that has to do with the maintenance report for next week, is a basic task for every first engineer of a ship, no matter how, complicated or not doing so. What should be done is to compare this programming time between a basic spreadsheet and a complete system. In a spreadsheet, keep in mind that there will be no more than 500 past activities. This may sound great, but the coverage of all machines on a tanker ship reaches about 800 activities. More than 500 activities make it very difficult to find the appropriate activity in the spreadsheet calculation. Also, spreadsheet calculations do not have the ability to sort and research activities by hierarchical machine segments as well as dates. However, these are secondary activities such as alarm and instrument control that attract the best investigation and monitoring. In fact, secondary elements in general are those with more planning need. The primary and important elements are easy to remember the first engineers and watch them. Secondary elements are not easy to remember, and many of them pose enormous risks. For example, failure to observe the records of emergency stop inspections, monitoring of limit switches, gas leakage alarms, etc. may be subject to high criminal penalties for inspections because they are highly incriminating in the event of an accident. Therefore, a maintenance system will typically require more than 800 activities to be sufficient. This means 3 to 4 items per day for the first engineer to select and report. If compared to a full scheduled maintenance system that itself can instantly look at the requested item to report and report in total for each working day, the first engineer makes more quickly about an hour.

Running Hours for each accessory

In a spreadsheet calculation system, it will never be possible to convert a machine's operating hours to hours of operation remaining to be maintained. Therefore, the current hours of the activities and machines to be tested should necessarily be compared with the total hours allowed for continuous operation and to estimate how long they will still be able to operate before their planned maintenance. This will take another hour if you compare 48 machines with the current number of spreadsheet hours, for example 1 main machine with 6 cylinder units and 3 auxiliary machines. However, modern vessels may be equipped with machines for recording hours of operation. Comparing 200 or more machines of subsequent due hours with the remaining hours that can work in the spreadsheet calculation is an exercise that could take many hours if not no more than the time it would end if it were done automatically from a program.

Weaknesses and unscheduled activities

A spreadsheet calculation system will never in itself design the imperfections and activities that need to be recorded because they have occurred unexpectedly. Therefore, any such activities have arisen should be designed and recorded by the first engineer and in a quick time depending on the urgency of their situation. The shortcomings in the equipment that contain a great risk must be examined in great detail and scheduled by the responsible engineer for a lot of work, while automated calculations should normally be made by a monitoring program to work and shorten the job. and avoiding some human errors in the maintenance control schedule.

Spare parts

With a spreadsheet calculation system, there will be no main list of spare parts from which the first engineer will choose according to the requirements he needs. The chief engineer should use the manuals and copy the numbers on the request for new spare parts. This is much slower than choosing an item on a line and ordering it directly, and much more prone to mistake. This possibility of error is reintroduced to shore as the staff who must buy the spare parts copies the number up to 3 more times. The chief engineer must make sure that there are sufficient spare parts for the upcoming maintenance. This is impractically complex without a suitable automated primary list that lists the available spare parts. Most companies follow the tactics of ordering only the spare parts they need and hope they never have more surplus on board at the time of travel but they will also not be left behind due to an unexpected event without spare parts.

Maintenance report

The chief engineer should make a report on each maintenance item that is completed. Reporting maintenance to a spreadsheet system means the note on each item that was maintained on the date of maintenance, in other words, passing from the 500 item list, changing the date or time of completion maintenance of each item. The chief engineer must then complete a list of the maintenance completion details such as the identity of the maintenance machinery, the work identity of the staff, the date of completion, the spare parts consumed, the man-hours, etc. All of the above requires copying and scanning with the eye a very large number of spare parts IDs, a long process with a tendency for many human errors. Reports should be shipped on land and kept on a server of records with adequate research facilities, which is very inefficient considering the similarity in words between many maintenance and equipment activities. In a full scheduled maintenance system reporting on maintenance needs the report on planned maintenance takes no more than a few mouse clicks on a computer and the mandatory completion of some of the documents that is otherwise made.

History of maintenance

In order to inspect the history of a ship's maintenance, using previously-completed documents is quite time-consuming. In order to make these documents more easily "searchable", it is necessary to purchase a document management system that separates them at least into archived structures so that searches are easier to do. Anyway, the responsible engineer or an inspector who wants to look for historical data to know more about the maintenance of a piece of equipment will not do it because he will lose more than long-term search rather than win.

CMMS Selection Criteria

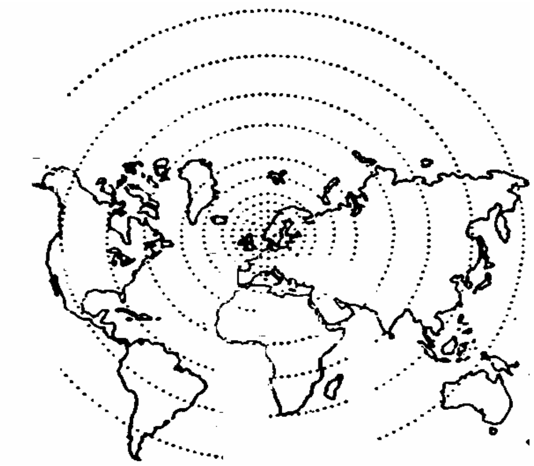
According to global research there are more than 400 CMMS solutions. Most of these are attempts by companies that have developed applications on the needs of specific customers, which is true for the Greek market, thus limiting their customers to specific practices and functions. But how can you choose the best maintenance management software? The first and most basic criterion is the functionalities of the product itself. Does it incorporate the above three areas of activity (equipment maintenance, inventory management, market management), regardless of how the organization will use it? What is the clientele of this software, a criterion that shows how much it has tested and succeeded as a solution? CMMS's investment in research and development is also a very important criterion, since knowing the dynamics and requirements of industry and shipping a static product will never meet the needs of tomorrow? What are the capabilities of the reporting software? Are there restrictions on the format and breadth of the information that can be entered in a report? How friendly and easy to customize is software, since it should be able to be used by people who are not close to computing and computer use? What is the expertise and experience of both the software developer and the company that has supported it? The requirements and organization of the maintenance of each organization vary. Therefore, there is a need for software that includes all the modern maintenance organization tools, leaving it at the disposal of the organization to choose the parts of the software to use. In this way, the software is adapted to the organizational structure of the company, while at the same time it is possible to continuously improve its methods. This software should be able to work independently of other applications but at the same time be open architecture to be able to connect and get data from SCADA, PLC, hand helds or communicate in two ways with ERP systems.

Analysis of a CMMS system

What is AMOS-D?

AMOS-D is a maintenance-related software that has to do with it and is specially designed for shipboard use. The main purpose of AMOS-D is to offer as many of the advantages as possible from the use of automated preventive and corrective maintenance. At the same time it has the potential to give access to a large amount of information on technical and market-related issues related to ship maintenance (spare parts, machines, etc.) The AMOS-D originals come from the Administration of Maintenance, Operations and Spares, which is the management of maintenance and spare parts. The D letter comes from Data or Data that indicates that it is a software that uses a Database. AMOS-D is an advanced software that is easy to learn by an operator but also with many innovations in maintenance. Finally, it is an adaptable software and, depending on the needs of each business, can offer a very large number of automations. AMOS-D is used and supported in over 40 countries around the world and is translated into an approximately equal number of languages. In general, the number of AMOS-D users is increasing daily. At the same time, a great effort has been made to teach the use of software to hundreds of technology college students around the world. In addition to the above, a system of automated maintenance has as its primary purpose to adapt and develop according to the needs of the target group of users. So, Spectec, the company that introduced AMOS-D, is trying to keep up-to-date with software surveys and changes that can handle the maintenance problems that users encounter. The four main sectors related to ship maintenance and AMOS-D has evolved are as follows:

• Management of maintenance procedures
• Manage stored spare parts belonging to the company
• Purchases and orders that have to do with maintenance issues
• Check the Budget for maintenance

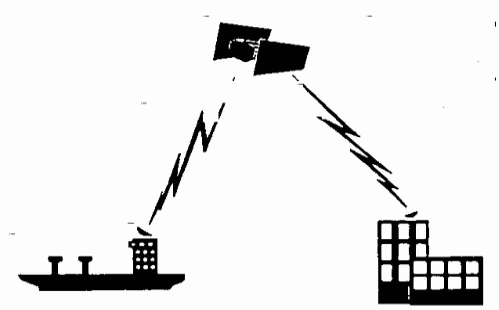


Despite the fact that the above program separations may exist and regardless of whether they are requested by a company, when they are operational they are all directly linked together by sharing the AMOS-D database. For example, when a replacement price is changed and a user passes on purchases and orders automatically, it recognizes the part of the resource management for maintenance. So there is no reason to rerun a data in the system once it has been passed once, which means huge time gain and a reduction in human errors. The simplest way to describe the first AMOS-D specimen, that of the maintenance administration, is to resemble it with a continuously closed circle. Initially, we plan the maintenance tasks, then print and share work orders, then perform the scheduled or unscheduled maintenance work (breakdowns), and then report the system for the maintenance work that took place, including items such as the condition of the equipment, the spare parts used, the hours worked and other costs. All of this information will be used in the future to schedule the next maintenance work. So while the entire maintenance cycle can become more complex, we will be profitable in the future, since every instance of damage is recorded and can then be dealt with more easily and correctly.

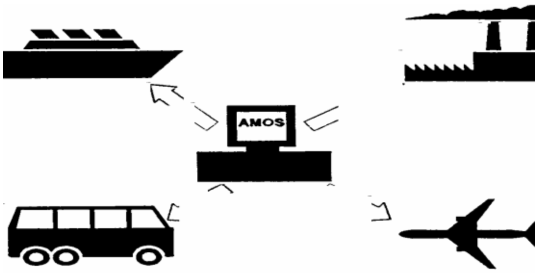
AMOS-D's second specialization is the stock control of the spare parts. AMOS-D's operations for this track include the tracking of spare parts and tools throughout their journeys to the company's warehouses. This is done in great detail, and references to these items include information such as the location of the spare part or tool, its code, the price provided by the supplier, the hours and days of receipt, etc. The AMOS-D in this field is fully sophisticated with the ability to immediately update the central warehouse for the use of a spare part, even when calculating the spare parts that will be used for maintenance before it even begins. At the same time, in order to make the management of spare parts easier for the user, he fully uses the advantages and functions of the barcode on the parts of the spare parts.

Directly connected to the spare part management department is the AMOS-D specialization section of the purchase of pre-requisite materials for maintenance. Its main advantage is that it helps to acquire the goods needed for maintenance wherever and whenever they need it. This piece of AMOS-D is made to handle everything in order to order materials and parts from a simple order form to automatic inventory stock control to create automatic orders. AMOS-D's order program is made even more powerful by directly linking the database to both the company's headquarters and onboard ships.

651.01.03.001
O-Ring 10 mm



This link allows for the transfer and exchange of information relating not only to ship maintenance issues but also to information on the stock of spare parts and the purchases made. The AMOS-D purchase is fully customizable, as well as the entire program, so that when installing, all the details that are required in the purchase forms are selected. The fourth and final piece of AMOS-D is that of resource management for maintenance. In this, we can introduce maintenance budgets for a monthly or annual period, and in this way also through AMOS-D, monitor how our costs change over time, but also be warned by the program in the event of a large deviation from the costs we have planned for a unit, spare part, etc. In order to operate all the above parts, the AMOS-D program must have a set of data describing the equipment to be maintained, indicate the various scheduled tasks, record the spare parts already in the warehouses and related with such information as their supplie All the above are passed to the AMOS-D database (AMOS-D database). At the center of this database are the equipment and parts to be maintained, which consist of various parts ordered and purchased for their maintenance. Maintenance equipment is in fact the heart of this database and its predetermination is the first and the most basic step in creating the AMOS-D database. Also, once the database is maintained, the parts to be maintained are automatically linked to their data and features with the functions that concern them and make up the entire database.rs' addresses, prices, etc. Virtually the above can be seen more clearly in the following figure:



As we use the AMOS-D database, the most basic element entered in all forms is the identity number of the selected part of the equipment (or CID from ComponentID). This number is in fact the link and the common point of all reports for the maintenance of a particular piece of equipment. For example, this is evidenced by the fact that in AMOS-D an identification number of a replacement is in fact the identification number of the part of the equipment in which the replacement will end, followed by three more numbers.

The identity number of the track to be maintained is the one that determines the hierarchy of the parts that make up a large mechanical part of the equipment. The most common way of numbering is code 3-2-2 and this is shown in the example below:

ID Number: 651.02.03

In code 3-2-2 the first three digits are the basic mechanical part of the equipment (for example auxiliary diesel engine No.1), the two digits the coded number for the piece of equipment (in our case 02 is code for the cylinders) and the last two digits denote the order of the component or piece of mechanical equipment (in the example the third 3 cylinder).

The above identification number can be translated as:

"Cylinder No. 3 of the auxiliary Diesel Engine " Accordingly, the first replacement part of this Diesel engine will have an ID number of 651.02.03.001.

Because of the importance of counting parts of equipment for maintenance for the whole system, careful consideration must be given to how this numbering will be as operational as possible before deciding on the way the parts of the equipment are numbered. Those responsible for installing the system will reasonably suggest the most advantageous numbering and with the variety available to the program, it will surely be the most ideal way to number the system.

MAINTENANCE IN AMOS-D:

Maintenance functions are divided into three categories in the AMOS-D Automated Maintenance Program.

Planned Maintenance

This category includes all scheduled maintenance tasks for which work orders are issued. In turn, this category is divided into two subcategories:

A 1. Periodic Maintenance:

It is the work that is repeated all the time. In fact, once it is reported that one of these maintenance tasks on a particular machine or equipment is over, the next one that will be in a relatively short period of time on the same machine or equipment is automatically scheduled.

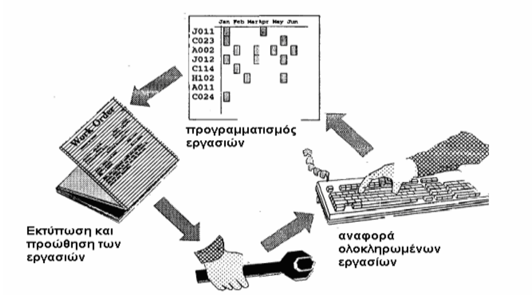
A 2. Special Work Orders:

They are maintenance tasks that are done once and then simply recorded for future needs.

B. Opportunity to Service or Maintenance Due to Damage:

This piece of AMOS-D represents the most expensive time for companies, due to various factors such as human errors, accidents, poor maintenance, etc. and its consequences cost a lot to one business. AMOS-D can help to greatly reduce faults due to incorrect maintenance on equipment.

Maintenance under the supervision of the condition of the equipment.
Evaluation of a CMMS system
The CBM system is, in fact, the great advantage of the AMOS-D program, since it updates on a live connection and contains all information related to the maintenance of a mechanical equipment (operating hours, last maintenance, recent damage, etc.) the best possible maintenance on the equipment. An illustration of the maintenance cycle that runs the program is shown in the figure below:



6. Case Study(Heading 6)

Implementation of a CMMS system in a shipping company

Company Mpaikousy Shipping Co.
Mpaikousy Shipping Co, since 1975 it has been one of the five most powerful shipping companies in Greece in the carriage of dry cargo by cargo ships. Over the years it has operated and marketed over 150 cargo ships and is trying to play a leading role not only in the Greek area but also in the world shipping happenings. The fleet of the company consists of cargo ships of 130,000 to 180,000 tons, which are the largest trucks currently in shipping. The most popular routes of the company's fleet are those with destinations in China, Africa, Brazil, Japan and the European continent. The entire fleet is controlled from the headquarters of the company in Greece. Nevertheless, the company has set up training schools for its Manila-based crew.

The overwhelming majority of the crew consists of highly trained Filipino sailors. The ship's engineers are for the most part Ukrainians. The company has managed to maintain its high quality service levels in the years to come, but also to be at the same time following the new trends in technology and development in the shipping sector. It has received all the necessary ISO 9002 and ISM certificates and has recognized the quality of its services by many global maritime safety agencies. Proof of the excellent services offered by the company are agreements with major charter companies abroad that prefer Mpaikousy Spipping Co. and they work with her with many years of contracts.

Company's objectives regarding the maintenance of its vessels:

The main objective of the company in matters relating to the maintenance and then security of ships is to ensure that each ship complies with statutory safety requirements. To do this, it has implemented all sorts of checks by state controllers along with the implementation of programs to oversee ship maintenance procedures.
Company's goal of maintenance and safety:
All the procedures that the company has in place for the proper maintenance of its ships are grouped in the following five areas, the proper maintenance of which is the overall purpose of the shipowning company:

1. Maintenance in the equipment that protects human life on ships (sailing boats, fire-fighting system, etc.)
2. Maintenance on the ship itself.
3. Maintenance of the system that protects against environmental contamination.
4. Maintenance of the mechanical equipment on board ships.
5. Effort to meet all requirements for proper ship maintenance in general.

Maintenance procedures

Maintenance of ships:

The maintenance program of each ship is developed, executed, and tested against the two following criteria:
A) Scheduled Maintenance of the Deck
B) Planned Maintenance of Machines
• Ship The way in which ships are maintained and their mechanical equipment is determined by the following four criteria:
A) Manufacturer's instructions

B) Company's requirements
C) Experience of engineers and operators
D) Legal requirements and suggestions
The company's scheduled maintenance on its ships is based solely on the above criteria.

- <u>Damage to a ship or ship's mechanical equipment:</u>

Inevitably, at random times some ships or some mechanical ship equipment will be damaged. In these cases Telex should be shipped from the ship to the technical department of the company by notifying them of the problem. The technical manager and the ship's supervisor will have to deal with the damage until it is fully corrected. The degree of attention that engineers should show is always proportional to the criticality of the damage that has arisen. The more important the damage to the ship the more intense the mobilization should be done by the engineers.

- <u>Inspection of ships:</u>

At least twice a year, company inspectors should visit the ships to inspect and inspect the existing maintenance conditions. The Technical Director is responsible for issuing the program of inspections, which parts of the ship should be inspected more carefully but also to check the auditor's report after the end of the inspection.

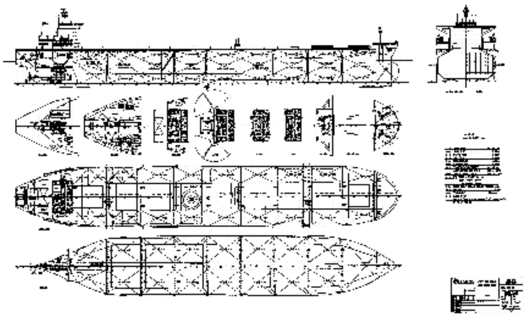
• <u>"Important" parts of the equipment and technical issues:</u>

The company, in its years of operation and with its experience, has defined some parts of its ship's equipment as most crucial for their proper operation. Damage to these parts of the machinery would have very bad consequences for the continued smooth operation of the ships. Instructions for the maintenance of these specific pieces of equipment vary and the measures to be taken to protect critical equipment from damage are more stringent. The first engineer of the ship is responsible for any damage to the "important" mechanical equipment.

• <u>Maintenance Responsibilities:</u>

<u>Technical director:</u>

i. Supervision of inspection reports for ship preservation.
ii. Supervision of the entire fleet maintenance program.
iii. Decisions as to which parts of the ship are to be maintained or inspected during a ship's inspection and inspection.



First engineer:
1. Continuous communication with the company for any matter of maintenance.
2. Continuous inspections of the ship on a weekly basis and preparation of maintenance programs that he considers necessary depending on the ship's condition.

• Calendars - Maintenance report records:
i. Engine room log
ii. Day work calendar
iii. Maintenance records
iv. Monthly maintenance report
v. Ship inspection logbook

MAIN MAINTENANCE FUNCTION:
Most shipping companies in the Greek and not only space, do not use a computer program for the maintenance of their ships. The most widely used way is spreadsheets, or so-called excel sheets. Depending on the components they maintain on each ship, a sheet has been created in the well-known Excel program which lists the hours or months of operation that a component or machine can continue to operate without stopping for maintenance or replacement of some of its parts. So the first engineer of each ship completes on this form all the maintenance work done on the ship's mechanical equipment and sends it to the headquarters of the company so that they are assured in the technical department that they are all properly maintained.
Hours for non-operation of ships (Damage due to poor maintenance):
According to the company's data when about 30 years ago no preventive maintenance rules were applied, the Down-Times' downtimes were 5-10 per year per ship. By implementing the precautionary maintenance rules for the last 20 years and helping with the instructions for maintenance of mechanical equipment by their manufacturing companies, this Down-Time time

has been significantly reduced to 2-3 days a year per ship.

CMMS application

Software Application (CMMS) (Computerized Maintenance Management System)

Since the application of CMMS to shipping companies abroad, it is estimated that there is a 30-40% reduction in damage to ships. This is due to the minimization of the human error in ship maintenance issues as well as to the timely supply of spare parts.

Conclusions

The numbers representing the cold case study logic of the company we are examining show us that implementing an automated preventive maintenance program on a PC is a positive solution, a step forward for a company. Nevertheless, because seeing the program in practice was not feasible our conclusions have a strong hypothetical character. A major drawback that may be experienced is the slow adaptation of the staff of the first engineers to the correct and quick use of the program. However, given the ease described in previous sections, it is most likely that in a two-month period the staff would have adjusted to a large extent.

At the same time, the fast two-month depreciation of the investment to install a software is another strong asset for the company. For a medium to large shipping company, installing a CMMS Software is a big step forward, which, if done with caution, will bring enormous profits in the future (in the form of cost reductions) and will also ensure better ship maintenance and use, for the crew on them.

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