Dynamic Maintenance in Ships

S. Lampreia (1), V. Lobo (2) and V. Vairinhos (3)

(1) Science & Tecnology Department, *Portuguese Naval Academy – CINAV,* Almada, Portugal*,*
suzana.paula.lampreia@marinha.pt.
(2) Science & Tecnology Department, *Portuguese Naval Academy – CINAV,* Almada, Portugal.
(3) *Portuguese Naval Academy – CINAV,* Almada, Portugal.

ABSTRACT
One of the main objectives of naval mechanical engineers is to guarantee good maintenance of the ship's equipment and avoid unplanned downtime. This is a very important issue both in warships and merchant ships. In an environment with limited resources, optimizing and prioritizing maintenance actions is crucial and will contribute to reduce costs and increase the ship's availability and performance. Condition Based Maintenance policies have proven to be the most efficient in accomplishing that optimization, but they require a lot of data, and this data must be well organized in an appropriate data structure. Since a ship is complex system in constant modification, the maintenance priorities will change as more recent data is collected, giving rise to Dynamic Maintenance systems, that impose certain conditions on those data structures. In this paper we discuss the data structures for maintenance actions that should be available to enable efficient implementation of analysis, prediction, and planning algorithms to support Dynamic Maintenance Systems.

I. INTRODUCTION

All mechanical systems require maintenance, so there is a lot of research in this area, with an increasing number of scientific papers published in this area. For example, a search for the keyword "Maintenance" (M) in Google Scholar, will yield approximately 5.7 million papers.

Our interest in this area stems from the need of enhancing maintenance process performance, due to the lack of material and human resources.

II. DYNAMIC MAINTENANCE

There are several types of approaches regarding the different types of maintenance policies. In this paper we used the framework described in the European Standard for Maintenance Terminology EN (2017). This standard considers two types of maintenance, preventive, and corrective. The first one can be systematic, condition-based and on demand, and the second can be immediate or postponed.

Aside from considerations of existing types of maintenance, considering condition-based and data-based maintenance, various statistical and software approaches can be applied.

It is believed that modern maintenance can't be carried out without an implement condition-based maintenance system and decision based in algorithm that process selected data from equipment's and systems.

Dynamic Database-Driven value has been exposed by Davis & Robbins (2022) in a basis that dynamic database should always be available online and the systems must be constantly actualized because of the change in electronic sensors and resources.

By implementing intelligent systems in maintenance management in ships, these systems should be integrated in the Information Security Management Systems (ISMS) that are being implemented in merchant ships, and where should be implemented applied cybersecurity rules (DNV.GL, 2021) to mitigate eventual cyberattacks.

II. CASE STUDY - MAINTENANCE DATABASES

In the organization understudy there is a System of Data Treatment Collection (SRTD) (Marinha, 1984), that nowadays are represented by a software that supports the surface-ships maintenance requests and reports, SICALN.

The SICALN has various documents, the one used for requests and report maintenance is the DSM58, the one for time functioning, operationality report, and marine gasoil and lubricant consumption, it has also the DSM60 that are used for spare parts requests.

The database is constantly actualized, so the future applied decision algorithm results will be variable accordingly data variation.

III. Conclusions

Due the objective of high performance in companies and organizations, although means restriction, the maintenance responsible´s are changing maintenance philosophies and automatizing systems and databases processing.

The organization understudy already has a system of data treatment collection.

It is possible to develop a database that receive data from the already existing software, SICALN, and treat the information.

It was presented the sub-databases that should constitute the main database.

Further work will be developed for conceive a decision-making system.

References

[1] EN, 2017. EN 13306 – Maintenance Terminology. Europe: European Standards.

[2] Marinha , 1984. Data Collection and Processing System Manual (Manual do SRTD) (ILMANT512). Alfeite: Direção de Navios.

[3] Global, I. (2022). IGI Global - Publisher of Timely Knowledge. Obtido em 06 de Fevereiro de 2022, de https://www.igi-global.com/dictionary/dynamic-maintenance-chinagrid-support-platform/8509.

[4] Davis, F., & Robbins, L. (2022). Potentials of Dynamic Database-Driven Web Sites.

[5] He, Z., & Darmont, J. (2005). Evaluating the Dynamic Behavior of Database Applications. *Journal of Database Management, 16*(2), 25. doi:10.4018/jdm.2005040102.

[6] MIT, 2021. *Machine Learning Course.* Massachusetts Institute of Technology - Massachusetts: MIT-Professional Education.

[7] DNV.GL, Cyber security resilience management for ships and mobile offshore units in operation. Recommended Practice - DNVGL-RP-0496. [Online]. Available in: https://www.dnv.com/maritime/dnvgl-rp-0496-recommended-practice-cyber-security-download.html [Consulted 01 jul.2021], 2016, amended in October 2021.