Data-Driven Predictive Maintenance Planning for Maritime Industry

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| Type of project | MSc Project |
| ECTS | 30 |
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| Company 1 | MAN energy solutions |
| Company supervisor(s) | Henrik Bruun |
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| Thesis primarily done at: | Company |
|  |  |
| Start date | 13/9/2022 |
| End date | 13/2/2023 |

## Project description

With an increased pressure on marine traffic (regulations, more goods being transported, increasing fuel prices, green transition), higher effectivity is needed. MAN ES Primeserv provides spare parts for the engines for the global maritime industry. A vessel’s engine that is under scheduled repair needs spare parts that are ordered from the company or its competitors. When the order is made, MAN often needs to source the parts, receive them (for quality control) and then send them to the vessel’s location. This process might take time and delays become more possible. Having delays means that the ship gets off-hire or risks breakdown, thing that leads to money loss for the customers. In order to serve customers faster and cheaper, they are to a large degree expecting MAN ES Primeserv to predict the need for spare parts for maintenance and overhauls. Predicting the maintenance schedule of the customers will allow MAN to be prepared for the order intake for an upcoming period. This way the parts will already be in the company’s warehouse ready for shipping, therefore minimizing the risk of delays.

By using customers’ own data (PMS data) and vessel movement data (AIS data) the ambition is to build a model that will enable:

1. Budgeting for the customers: By being able to budget (i.e., for 1 year), larger orders can be placed.
2. Just in time: Ensuring that the right parts are at the right place, the right time.
3. Proactiveness: By being able to predict customer needs, to serve customers more proactively.

This data will be integrated in machine learning models that will be able to predict how many and what type of scheduled maintenance will MAN ES customers need in the upcoming year.

## Research Questions:

* What type of model, using AIS data, predicts more accurately the amount and the type of spare parts MAN’s customers will order from the company in the next 1 year?
* Does expanding the dataset with customers’ data (PMS) improve predictions’ accuracy?
* Which model would be more beneficial for the company to use, considering other parameters except accuracy (e.g., explainability, flexibility, resource demand etc.)?

## Project objectives

* Perform data cleaning and preparation of the company’s data on the customers’ vessels.
* Describe the dataset and give summary statistics.
* Apply machine learning algorithms to the given problem.
* Evaluate and compare the algorithms’ ability to give accurate prediction.
* Analyze and illustrate the best model’s architecture.
* Design a process that will deal with the problem of predicting customers’ maintenance schedule.

**NOTE:** You will need to prepare a project plan (Gantt chart) of your thesis approximately one month after the beginning of the project. Aligning the activities of the project plan and the objectives is a good exercise.

1. Literature review on the following topics:
   1. Predictive maintenance using machine learning
   2. Designing algorithms for predictive maintenance
   3. Putting literature in context of MAN
2. Data Preparation
   1. Data collection
   2. Data cleaning - Preprocessing
   3. Exploratory analysis (Descriptive statistics - Visualization of the datasets)
3. Model Building:
   1. Train- test and Exploratory analysis of models
   2. Tweak hyperparameters, compare results
   3. Model validation - Benchmarking of predictive models
4. Thesis Writing

## Project Plan

