

MARINTEK FACT SHEET

TeCoMan



TeCoMan - Control of Technical Operation

In stock marked different indexes are used to evaluate the "economic condition". For example, Dow Jones Industrial Average is among the most closely watched benchmark indices for stock marked activity, see Figure 1. To ensure consistency of measuring the "economic health" it is important to define and evaluate the importance of different input parameters:

- Market capital value
- Loan
- Expected competitive climate
- Cash flow

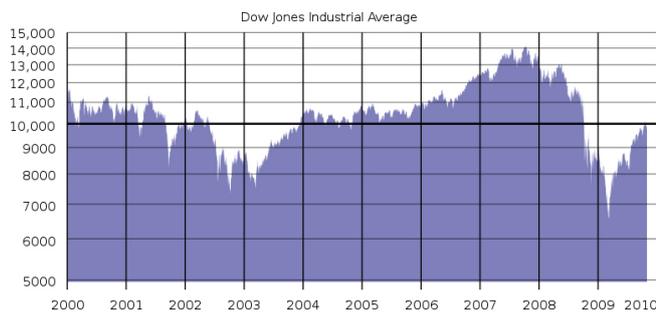


Figure 1. Graphical presentation of Dow Jones Industrial Average.

Like in the economical world, technical systems may also be indexed based on different criteria. TeCoMan is a tool which measures the Technical Condition Indexing (TCI). The development of TeCoMan started in 1995 and is now used within branches of industries like oil & gas and shipping. So why is it important to monitor the technical condition? A typical example of performance from a plant is illustrated in Figure 2.

If the management reduces the maintenance & operation budget with inadequate knowledge of organisations and asset, the result can be reduced regularity and, if worse, reduced safety. The bottom line will be extra expenditures correcting the unwanted situation. However, if the management receives information about the condition

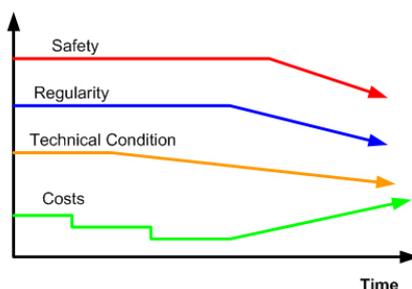


Figure 2. Feature of technical condition.

of the company asset, the management can react in a proactive manner and avoiding reduced regularity, safety with extra expenditures.

The concept TeCoMan

For quantifying and monitoring the technical condition, TeCoMan calculates a condition value (TCI) between 0 and 100, where the maximum value describes the design condition and the minimum value describes the state of total degradation.

The TCIs are calculated using an analytic hierarchy process, meaning it has been used a structured technique to calculate values. The hierarchy of a technical system can be illustrated in Figure 3 with TCIs for a car.

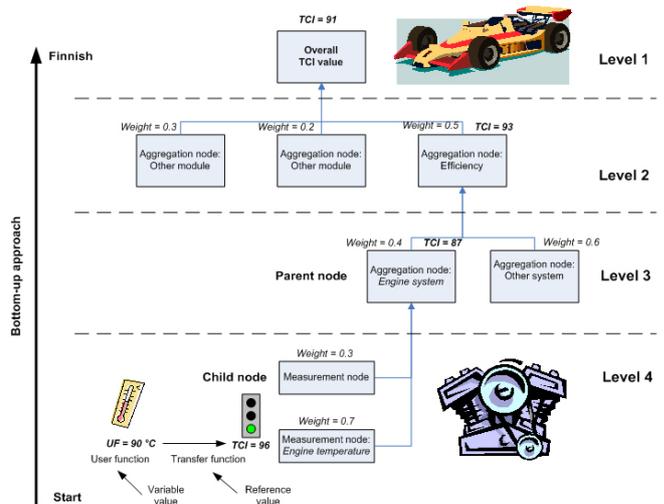


Figure 3. Analytic hierarchy process for calculating TCI of a car.

Before calculating the TCI, it is necessary to establish a hierarchy based on aggregation nodes and measurement nodes. There are different ways of identifying an aggregation node, depending on what status the TCI shall represent. A normal practice is to identify nodes into sufficient detailed level with different views of behaviour for the organisation:

- Performance of a system, process or organisation
- Efficiency, effectiveness or productivity
- Deteriorations
- Losses
- Waste
- Uptime

When considering how to link the mentioned behaviours into the structure hierarchy, existing hierarchy in ERP systems can be a starting point.

When calculating TCI, a bottom-up approach is used, meaning the calculation starts at lowest level and is finally aggregated to an overall TCI value at top level. In Figure 3 a user function (UF) for level 4 is calculated, in this case the engine temperature in a car. The user function could consist of one or several variables and parameters. Further, the user function must be transformed into a feasible TCI value, using a transfer function. A reference value of UF representing 100 TCI is therefore necessary. The reference value can be collected from different sources:

- The production manual
- Standards
- Results from tests in laboratory
- Expert judgment from operator of the car

When the TCI value has been calculated, a logic based on colour is used (see table below):

TCI interval	Colour	Countermeasure
90 - 100	GREEN	Target class, no further actions are required
80 - 90	YELLOW	Observe further development and assess the needs for improvements
0 - 80	RED	Need for actions and improvements

When aggregating TCI values from a lower following formula among others can be used:

$$TCI_{Parent} = \frac{\sum_i^n TCI_i * w_i}{\sum_i^n w_i}$$

TCI_i	Technical condition of child i
w_i	Weight of child i
n	Number of child nodes

A child node is simply a node with a lower level than the parent node as illustrated in Figure 3.

Software overview

Figure 4 illustrates the software package of TeCoMan with following modules:

- TeCoMan: Support the administrator to configure and analysing the system.
- TeCoView: Efficiently present the results both hierarchical and graphical
- TeCoImporter: Imports data into TeCoMan

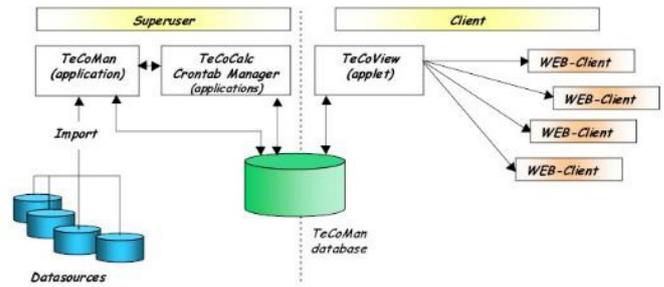


Figure 4. The TeCoMan software package

- TeCoCalc: Performs calculations both automatically and manually
- Crontab Manager: Updates the server with information about the schedule to import and calculate data.

The database could be either MySQL or Oracle with Java runtime system and JAVA applications. In addition a web server and browser must be used.

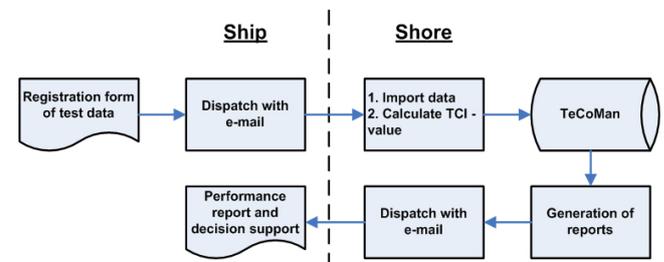


Figure 5. Business processes related to TeCoMan.

Example from shipping industry Figure 5 illustrates the business processes related to TeCoMan in shipping industry.

From the ship side relevant test data are collected in a registration form and dispatched to shore, where the data are imported into TeCoMan and necessary calculations are performed. Further, reports are generated automatically based on the results in TeCoMan. The reports are then dispatched back to the ship by e-mail and can be used as decision support.

As an example from shipping industry, Figure 6 illustrates how to present and analyse a result from the TeCoMan database. The overall TCI is measuring a main engine of a ship. By drilling down the hierarchy, it is possible to find a bad actor, in this case a fuel pump. Even though the overall TCI is above 90 and marked green, there still can be nodes with low TCI values. If the bad actor is not identified and controlled, it can in long term affect the overall TCI. When regarding the benchmarking graph, there seems to be a gap from rest of the fleet. However, when looking at the TCI graph it seems to be an improvement of the fuel pump at the end of the graph. Maybe the performance of the fuel pump will improve in the future?

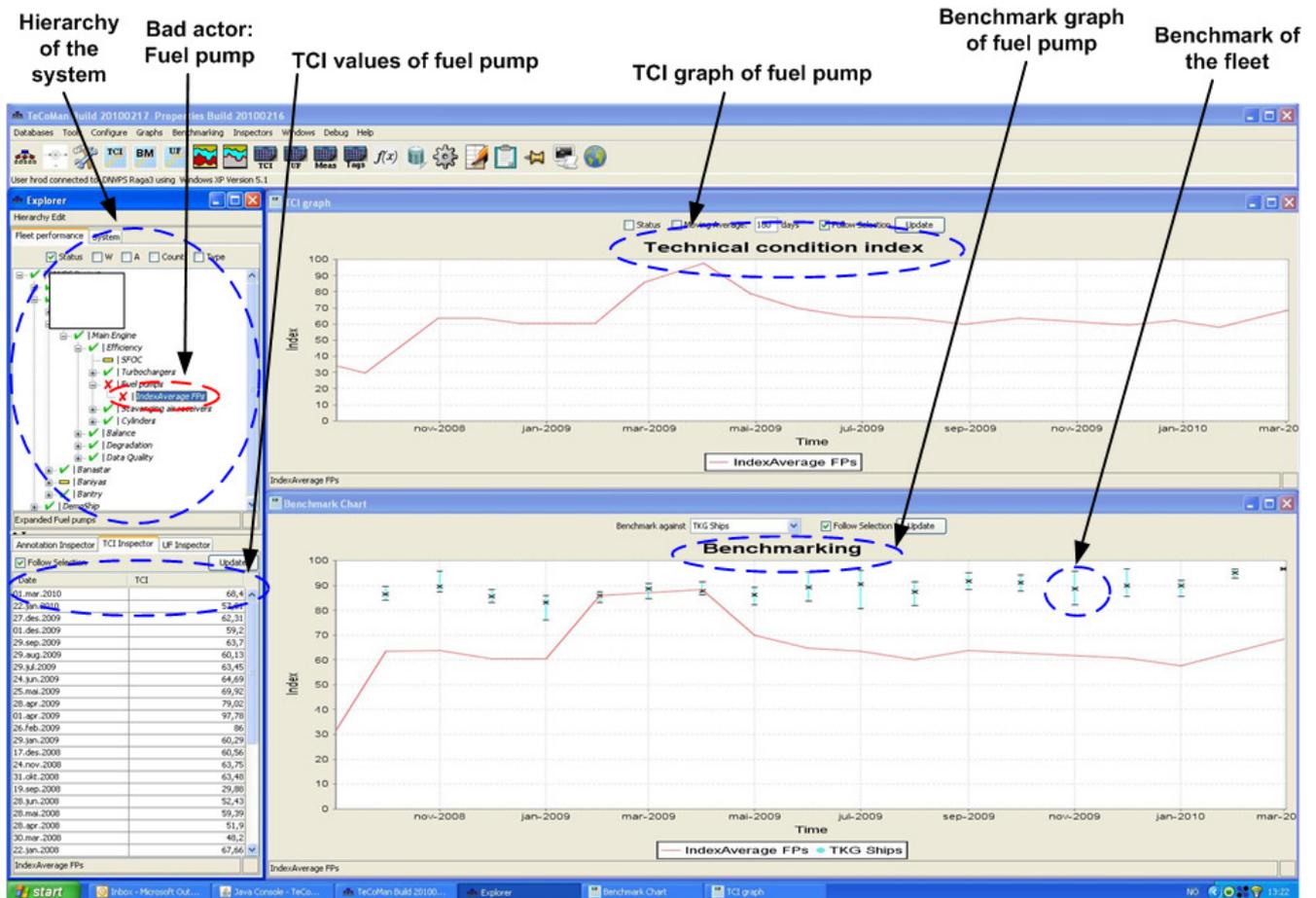


Figure 6 – Monitoring the fuel pump index.

Why use TeCoMan?

An overview of the concept, architecture and technology of TeCoMan has now been presented with an example from shipping industry. This provides several reasons for using TeCoMan:

- It is a suitable improvement tool which can measure and benchmark the technical condition and identifying bad actors.
- It can measure a variety of indicators like TCI and is applicable for any branch of industry.
- It can be used also to none technical system if measurement are adequately defined
- Aggregates decision support for management.
- It is highly applicable for complex systems and long term decisions.
- Builds ownership and competence of what you measure.
- Transparent analyses build a shared awareness for decision support of all levels in the organisation.