

CoCoS Maintenance

Designed for Maintenance Excellence

Contents:

	Page
Abstract	3
Introduction	3
Life Cycle Costs (LCC)	3
Procurement Cost	4
Effectiveness	5
Reliability	5
Availability	5
Maintainability	5
Maintenance Management's Challenge	6
Computer Controlled Surveillance (CoCoS Maintenance) .	7
Conclusion	8

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Abstract

The intention with this paper is to give a short and simple overview of some of the elements related to the maintenance, reliability and operation of MAN B&W engines seen from a holistic viewpoint, i.e. many factors will affect your maintenance performance no matter what maintenance strategy you pursue.

The recommendations made in this paper are given on the basis of the principles of the various tools and improvement methodologies that MAN B&W Diesel can supply in a way they may fit your organisation on its path to a well-designed maintenance strategy.

Introduction

Today – more than 100 years since the basic principles of the diesel engine were patented by Rudolf Diesel – we as engine designers are facing an increasing challenge to meet market demands.

The enormous pressure on costs, also caused by cut-throat competition, is compelling shipping companies to make drastic economies.

There are a number of factors that determine whether a ship is being used profitably or not.

The production in shipping business is normally to transport from A to B. The challenge consists in that the production and delivery of service is taking place at the same time, and it is not possible to produce to stock. One lost trip is lost forever.

Reliability is the key word for today's marine diesel engines, in ships that need to be kept precisely on schedule, with minimum operating costs and greatest degree of safety. Safe and stable running of the engine is crucial to

be able to arrive at the next port or destination on schedule.

The development of diesel engines, like all commercial activities, needs to serve the needs of the customers, the users of the engines.

The ever increasing competition, and the need for a commercial efficiency in ship operation, typically reveals the following parameters:

- short turn-around times in ports,
- tight schedules,
- reduced crew size, and
- changing crews.

The economical advantage of a propulsion plant depends (among other factors) heavily on the invested capital, operational costs, availability and resale value.

Optimised operation and maintenance will reduce the running costs, increase availability, and have a positive economical effect.

However, a company's value is determined not only by the amount of its assets, but also by its efficiency in utilising those assets to rapidly respond to customer and market demands.

Although many are dreaming of the maintenance-free diesel engine, one cannot ignore the laws of physics. But the progress of technology optimises the durability and efficiency of the equipment, which makes it possible to achieve minimal maintenance.

MAN B&W Diesel have continually revised and improved the design for maintainability, maintenance philosophies, and maintenance systems from an overall perspective.

This includes:

- safety,
- availability,
- reliability,
- operating efficiency,
- operability,
- maintainability,
- logistics (support and spare parts)
- training,
- maintenance management support, and
- exchange of data and information.

In short, optimised maintenance, prolonged Time Between Overhaul (TBO), and equipment management are essential to lifetime profit.

Life Cycle Costs (LCC)

Life cycle costs are the total costs from design to disposal as shown in Fig. 1. The objective of LCC is to choose the most cost-effective approach, so that the lowest long-term cost of ownership is achieved.

Life cycle costs are the total costs estimated for a product over the equipments anticipated useful life span:

- design
- development
- production
- operation
- maintenance
- support and
- final disposition

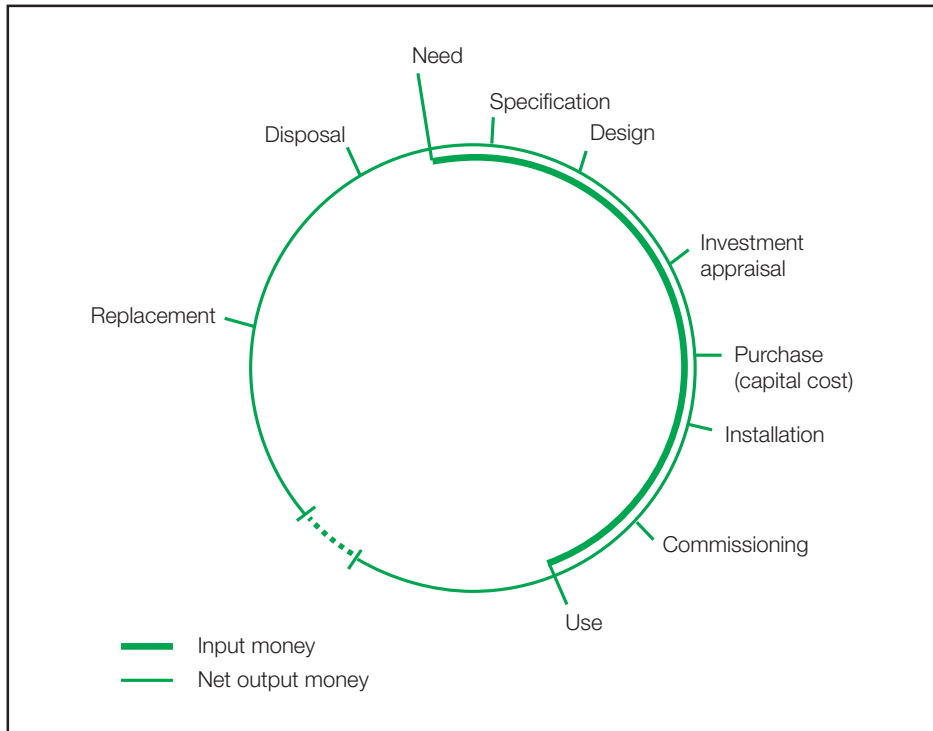


Fig. 1: Life cycle and costs

Usually, the only value in the life cycle cost equation, which is well known and clearly identified, is procurement cost – but it is only the tip of the iceberg, as shown in Fig. 2. Seeing the tip of an iceberg (similar to the obviousness of procurement cost) does not guarantee a clear and safe passage around it. The hidden underlying substructures of an iceberg contain the hazards (similar to the bulk of other costs associated with life cycle costs for equipment and systems).

These are important factors for the final balance sheet. In other words, a possible cost advantage for the initially invested amount for a new plant can be lost quite rapidly by downtimes, high consumption figures, high maintenance costs and lack of well-educated crews. Numerous examples exist to show that the use of grey market spares and unqualified personnel for operational and maintenance work can be a very costly exercise.

Procurement Cost

Procurement cost is widely used as the primary (and sometimes only) criterion for equipment, spare parts or system selection (i.e. the cheaper the better).

The procurement cost is a simple criterion. It is easy to use, however, this often results in bad financial decisions! The procurement cost only tells one part of the story. The major costs lie in the care and operation of equipment during its life. A simple procurement criterion often damages the financial well-being of the business enterprise, as a simple procurement criterion is so cheap it is not affordable. Although everyone in an operating organisation is required to do more with less, companies cannot starve themselves to prosperity.

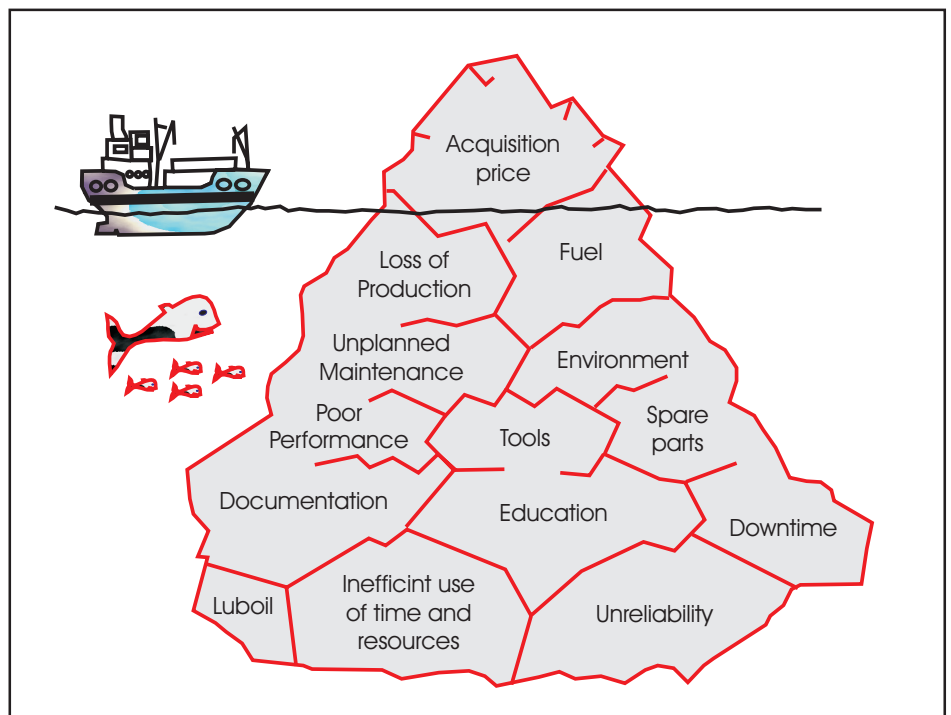


Fig. 2: Lifetime costs

Effectiveness

An important element in life cycle costs is effectiveness, which is a measure of value received. Effectiveness describes how well the product/system satisfies end user demands.

In other words, the effectiveness is the product of the chance that the equipment or system:

- will be available to perform its duty,
- will operate for a given time without failure,
- is repaired without excessive lost maintenance time, and
- can perform its intended function according to the standard.

Reliability

Another important element is reliability, which deals with reducing the frequency of failures over a time interval, and is a measure of success for a failure free operation.

A yardstick for reliability is the Mean Time Between Failure (MTBF). For a given mission time, high reliability requires a long MTBF. Long periods of failure free operation result in increased productive capability, while requiring fewer spare parts and less manpower for maintenance activities, which results in lower costs.

To the engine supplier, reliability is measured by completing a failure-free warranty period under specified operating conditions, and with few failures during the design life of the engine.

Improved reliability is often achieved by reducing the number of errors from

people by improving training, and processes/procedures, which can usually be achieved at low costs.

Reliability improvements bring expectations for increased availability, reduced downtime and maintenance costs, improved secondary failure costs and, thus, better chances of making profits.

Availability

Availability deals with the duration of up-time for operations, and is a measure of how often the system is alive and well. Availability gives information about how you use time, and is normally expressed as Mean Time To Repair or Replace (MTTR).

If Mean Time Between Failure (MTBF) is very long compared with the Mean Time To Repair (MTTR), then you will see a high availability.

Maintainability

Maintainability deals with the duration of maintenance outages, i.e. how long (ease and speed) it takes to perform the maintenance actions compared to datum. The datum includes maintenance (all actions necessary for retaining an item in, or restoring an item to, a specified, good condition) performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance.

The maintainability target is to achieve short repair times, and thus high availability, so that downtime of equipment is minimised when availability is critical.

Maintainability is primarily a design parameter. The design for maintainability determines how long time equipment will be down and unavailable. You can, of course, reduce the amount of time spent on maintenance by having a highly trained crew and a responsive supply system, which paces the speed of maintenance to achieve minimum downtimes.

As a rule of thumb for any engine designer, the cost factor changes for a better design for maintainability as follows:

Cost factor	Stage
1	Concept stage
10	Design stage
100	Manufacturing stage
1000	Operation stage

Improving and maintaining equipment reliability at an early stage is obviously relatively easier than at a later stage. Therefore, the thinking should start at the very first stage of the equipment life cycle.

However, designing for maintainability is in vain, if the crew do not have the right maintenance tools for:

- planning,
- controlling,
- managing of resources, and
- training.

High reliability (few failures) and high maintainability (predictable maintenance time) tend towards highly effective systems. Designing for efficient operation and maintenance is important, but not cost-free. The cost balance of reliability is illustrated in Fig. 3.

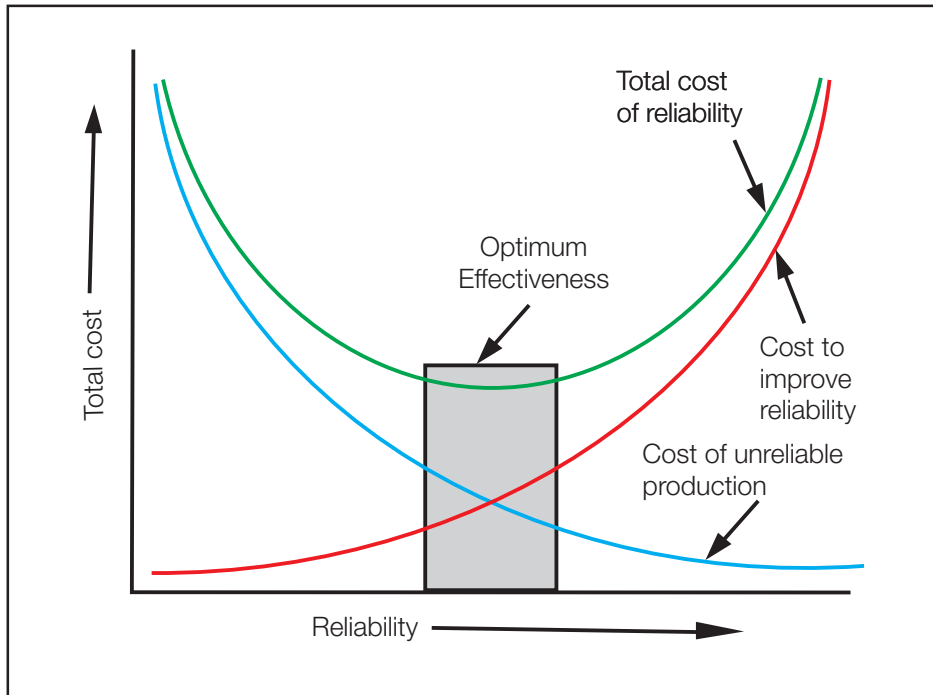


Fig. 3: Reliability cost balance

Maintenance Management's Challenge

Designing for efficient operation and maintenance is important, but even more important is the operating context of the engine and the management of maintenance.

Best maintenance has its foundation in best maintenance practices. Solid maintenance practices support a strong maintenance system geared towards proactive activities involving a dedicated organisation. Improving those practices requires leadership and dedication, as well as the willingness to make it happen through well-conceived plans and actions.

Success will require a visible commitment at top management level to permanent, sustainable improvements to meet maintenance objectives. If a major change in culture is required, success will not occur without the commitment, drive, inspiration, and thorough involvement of senior management.

Gaining maximum results from a change in the maintenance process requires establishing optimistic objectives, and defining strategies that transform the

maintenance process from traditional repair-focused culture to a proactive reliability-focused culture, as illustrated in Fig. 4.

Default operation to failure is typically the most expensive and least effective form of maintenance strategy.

However, a decision on optimum methods recognises that a comprehensive maintenance strategy will include a blend of reactive, preventive, and proactive elements based on the specific circumstances, probability, and consequences (risk) of failure.

Maintenance is a key component within the organisation that ensures the capacity necessary to meet production commitments, and makes a strong contribution to the bottom line. Maintenance should be viewed as an investment in future profits, capacity assurance, improved regularity, safety and quality. In short, optimised maintenance and equipment management are essential to lifetime profit.

To operate a world-class maintenance organisation, you need precise information combined with the ability to act quickly in response to impending emergencies.

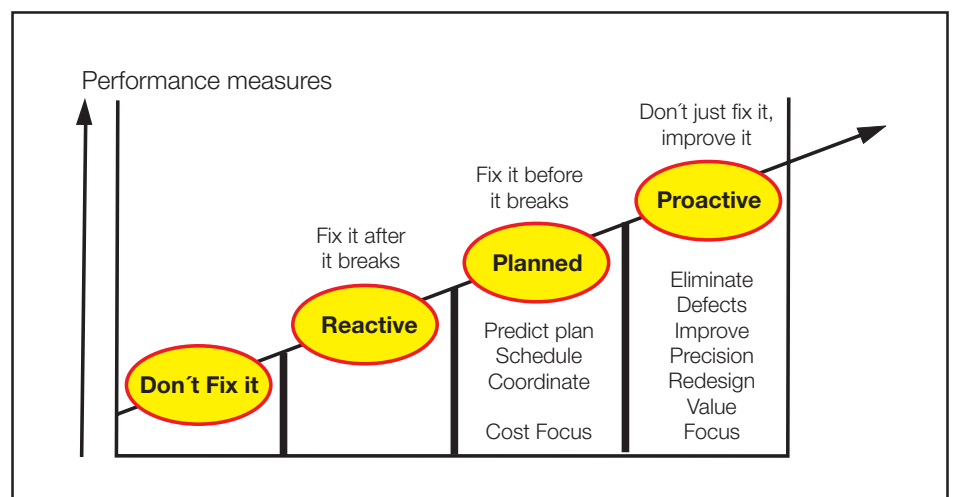


Fig. 4: From repair-focused to reliability-focused culture

Information is the lifeblood of successful maintenance, and is required for effective equipment and logistics management. This includes equipment-specific information such as operating and maintenance history.

Successful maintenance practice depends a great deal on a robust information system. This involves having a computerised maintenance management system that is suitable, well supported, and easy to use.

Computer Controlled Surveillance (CoCoS Maintenance)

CoCoS Maintenance is a computerised maintenance management system, developed by MAN B&W Diesel, which is tailor-made for ship management.

CoCoS Maintenance provides the management and crew involved in the maintenance process with a comprehensive tool for assistance, diagnostics, maintenance planning and spare parts stock handling.

The benefits of the CoCoS Maintenance software products are:

- Increased availability and reliability of diesel engines and other technical equipment.
- Reduction of operating costs and losses.
- Ready planning of engine maintenance for optimum utilisation of available resources.
- Easy and unambiguous identification of spare parts.
- Integrated stock handling and spare part ordering.

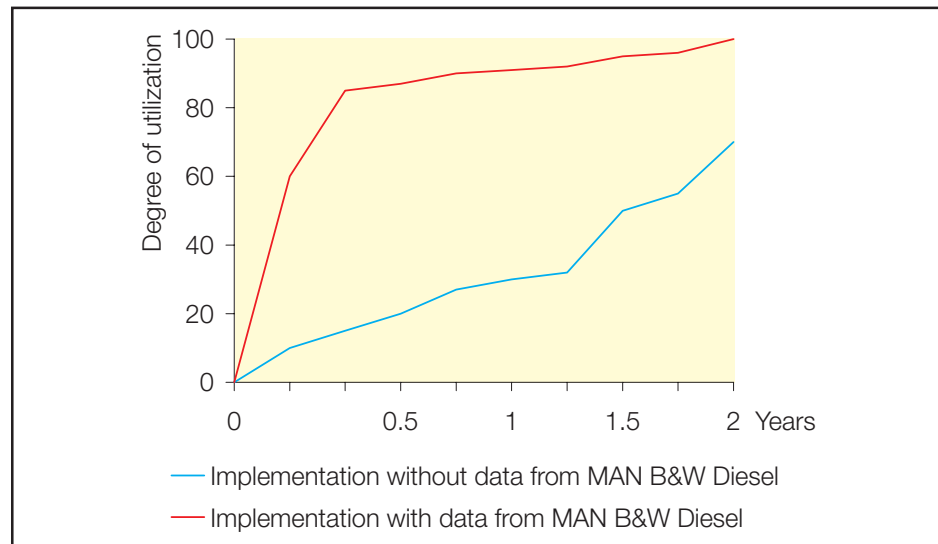


Fig. 5: Implementation method

These objectives are achieved by incorporating the extensive expertise and know-how of our designers and engineers into the CoCoS Maintenance software.

This strong combination of expertise, software development and practical maintenance experience, supports optimum functionality and quality, and meets most company requirements regarding a state-of-the-art maintenance system.

One major advantage of CoCoS Maintenance is the access to MAN B&W Diesel's comprehensive and high quality databases on MAN B&W Diesel's products. This will assist companies in reaching the desired results and, at the same time, shorten the time used for implementing the system. As illustrated in Fig. 5, it is highly recommended to use CoCoS Maintenance with data implemented by MAN B&W Diesel.

All CoCoS Maintenance modules are supplied with engine specific data, but can also be extended to other system sections and operate as an open system, thereby permitting coordination of maintenance with other technical equipment (not just engine plant), for optimal utilisation of available resources.

The CoCoS software package comprises two individual software products:

- CoCoS EDS – the Engine Diagnostics System handles data logging, monitoring, trends and diagnostics.
- CoCoS Maintenance – the maintenance planning system processes scheduling, work cards, work instructions, lists of required spare parts and tools, and provides estimates of the required man hours for the work, as illustrated in Fig. 6.

The integrated spare parts catalogue is a computerised catalogue that provides easy and unambiguous spare parts identification, spare parts information, graphics and illustrations, as shown in Fig. 7.

The integrated stock handling and spare parts ordering system assists the staff in optimising the control of spare parts.

The CoCoS Maintenance and CoCoS EDS are available separately, but the CoCoS modules in combination is the optimal solution.

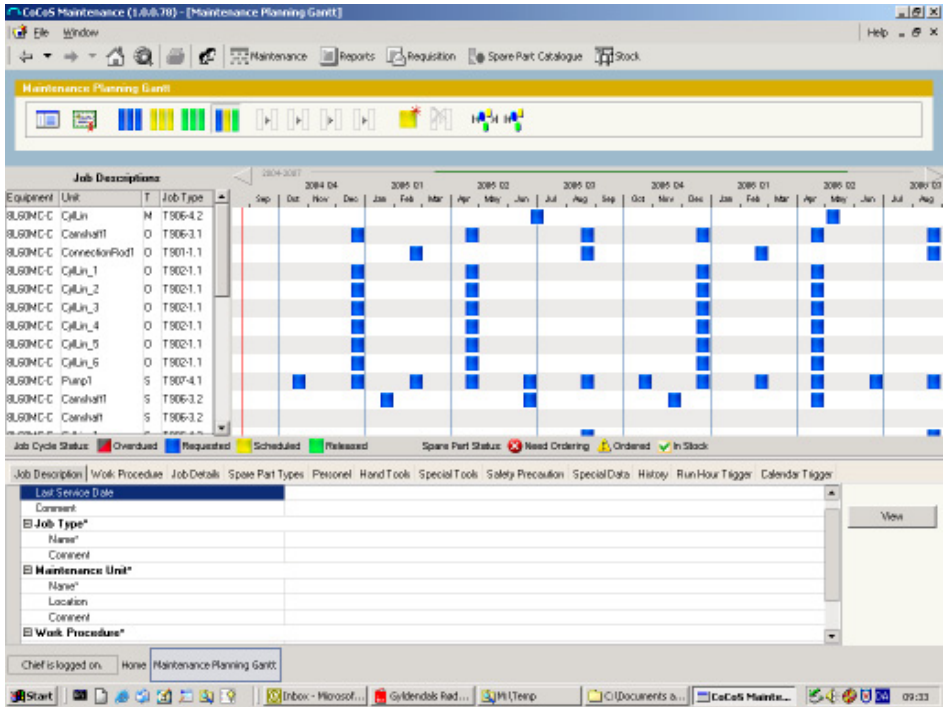


Fig. 6: CoCoS Maintenance - Planning Gantt

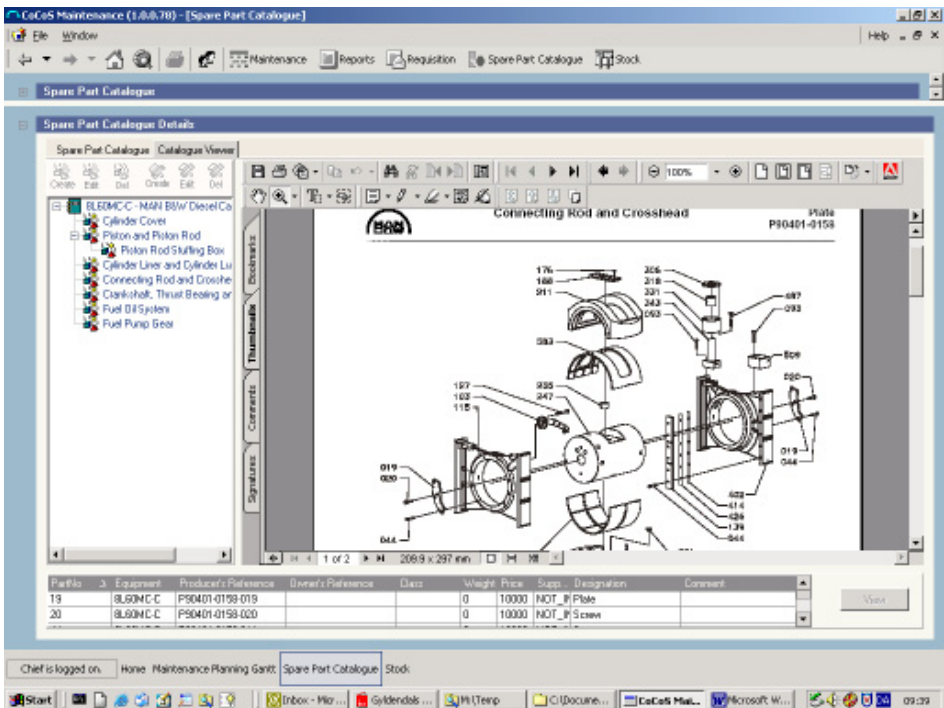


Fig. 7: CoCoS Maintenance - Spare Parts Catalogue

CoCoS Maintenance provides integrated stock handling with an easy overview of the availability of spare parts, and ensures the precise spare part identification and thus eliminates the inconveniences caused by incorrect spare parts ordering.

Together with CoCoS EDS, CoCoS Maintenance paves the way for automated predictive maintenance, which is demanded by many plant operators and ship owners.

The system offers an increased functionality, which is already being widely used today, and which will gain more importance in the future.

Conclusion

Ship owners and engine operators demand a propulsion or power plant with high reliability, high availability, high degree of maintainability, low first costs and economical operation.

MAN B&W Diesel meets these requirements with a complete product, containing not only a well designed diesel engine package, but also engine performance optimisation, optimised maintenance management support, technical service, support of original spare parts, consultancy, and training of crew.

Every shipping company needs to follow sound business practices to manage their operations efficiently and effectively, and MAN B&W Diesel can be a true partner in reaching the costumers' goals.