

Winterthur Gas & Diesel Ltd. (WinGD) is a leading developer of two-stroke low-speed gas and diesel engines used for propulsion power in merchant shipping. WinGD's target is to set the industry standard for reliability, efficiency and environmental sustainability. WinGD provides designs, licences and technical support to manufacturers, shipbuilders and ship operators worldwide. The engines are manufactured under licence in four shipbuilding countries. WinGD has its headquarters in Winterthur, Switzerland, where, as one of the earliest developers of diesel technology, it started the design of large internal combustion engines in 1898 under the "Sulzer" name.

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[www.wingd.com](http://www.wingd.com)

**WIN GD**  
*Simply a better different*

# WiDE WinGD Integrated Digital Expert

## Creating value from engine and ship data

WinGD recognises that data is invaluable. It forms the foundation and the starting point for a new value-creation process. Digital technologies offer new opportunities to operate the ship and its machinery more efficiently, and to manage the fleet in an optimised way.

Providing ship owners and operators with full awareness of their ships' operating condition, allows the necessary control needed to optimise their asset and their fleet operations.

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# Digital solutions

The WinGD Integrated Digital Expert (WiDE) provides digital solutions that enhance the operational efficiency and crew decision-making processes related to the engine and ship operations.

WinGD has developed a system which harnesses the full power of the engine and machinery data, extracting value from it by using expert engine knowledge combined with advanced data analytics techniques.

# WiDE

**DATA COLLECTION AND MONITORING  
ENGINE DIAGNOSTIC SYSTEM  
REMOTE SUPPORT**

WiDE is a comprehensive, integrated system for creating value from engine and ship data. WiDE allows the collection and analysis of ship and machinery data to predict component malfunctions, and support with live troubleshooting and diagnostic advice to the crew.

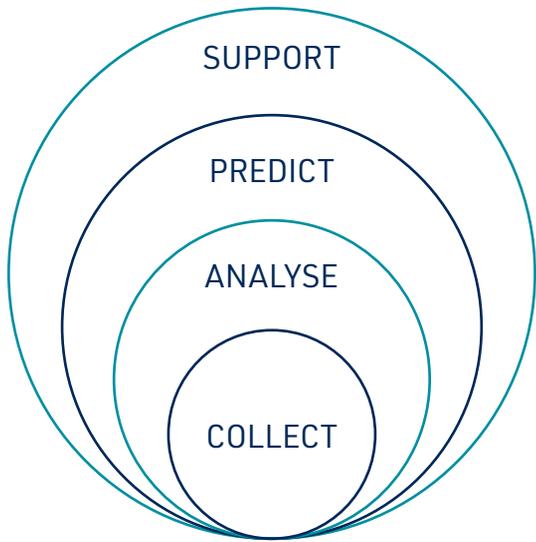


Fig. 1. The WinGD WiDE process

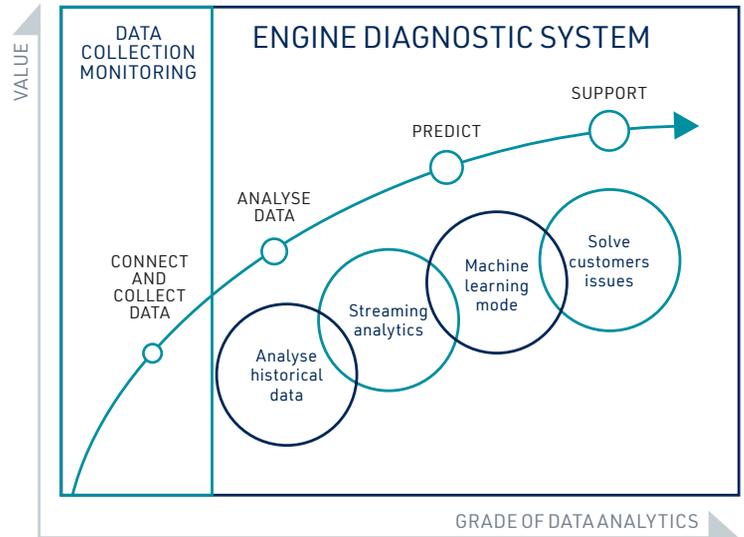


Fig. 2. The WinGD integrated digital expert path to value

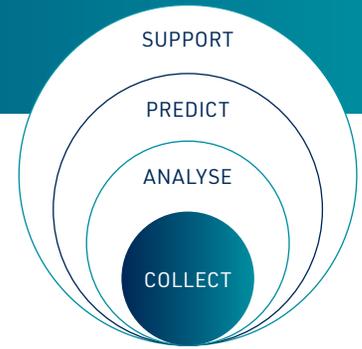
WiDE is based on the Data Collection Monitoring (DCM) unit for collecting and visualising the engine and ship data, as well as the Engine Diagnostic System (EDS) software. It analyses the data and creates valuable information.

These capabilities are integrated into a user-friendly on-board system comprising state-of-the-art hardware, expert software, and efficient data analytics techniques.

WinGD Integrated Digital Expert - WiDE				
	Collect	Analyse	Predict	Support
Digital solution	Data Collection and Monitoring (DCM)	EDS Performance EDS Components EDS Troubleshooting EDS Spare parts	EDS Maintenance	WinGD Expert remote support centre
Description	Collect engine and ship data Display trend Communicate engine data ashore Store data in a secured environment Display cylinder pressure monitoring and other "fast signals"	Intelligently diagnose the engine status via performance information, sub-systems, and current behaviour of the components.  The analysis is completed with a troubleshooting module that guides the operator in solving the problem, and interactive training that helps familiarisation with the engine functionalities. Furthermore, the EDS spare parts module helps to identify the part to be changed.	Prediction and diagnosis of component malfunctions and extension of maintenance intervals	WinGD experts provide periodic reports on the engine status, and recommendations on how to optimise performance of the engines. Troubleshoots abnormalities by providing customers with more detailed information on the key components that are affected, and the relevant steps needed to fix the malfunction

Fig. 3. WinGD digital solution overview

# Data Collection Monitoring (DCM)<sup>1</sup>: providing access to machinery data



The first step in the value creation process is to collect the engine and ship data.

The Data Collection and Monitoring (DCM) unit collects slow and fast signals from the WinGD main engine and other ship machinery. It allows the visualisation of the data, both locally on-board the ship and remotely at the operator's office.

The DCM allows data to be sent, using a secure encrypted communication channel, to an external server. The engine and ship data are made available on the WinGD website, accessible by a protected user account. The collected data are stored both on-board and ashore in a database designed for data analytics applications.

The Engine Diagnostic System (EDS) software is installed into the DCM computer, and uses this database to perform the engine diagnostic analyses. DCM enables remote support collaboration between WinGD and the shipping company.

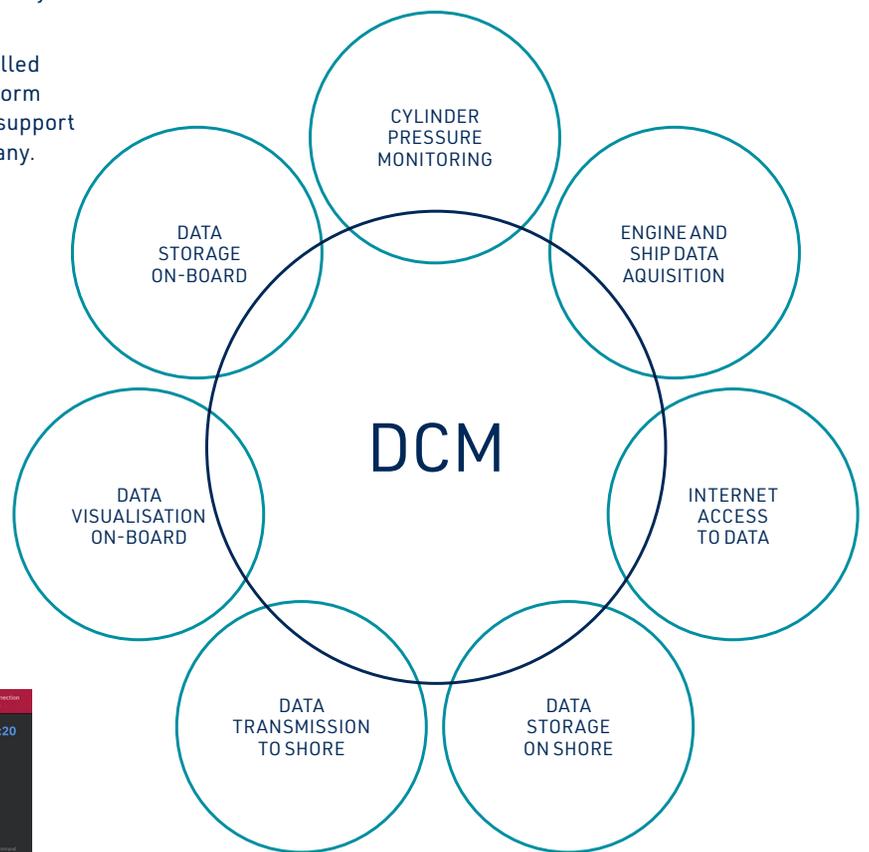
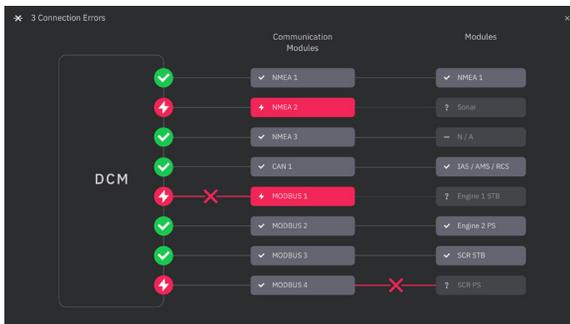
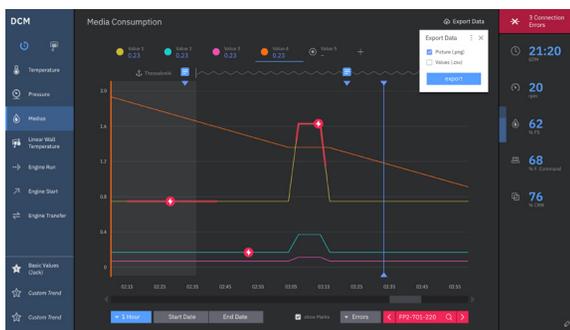
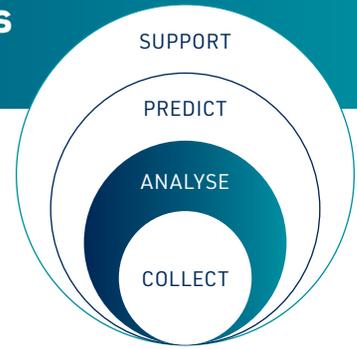


Fig. 4. WinGD's Data Collection Monitoring provides access to and visualisation of engine and ship data

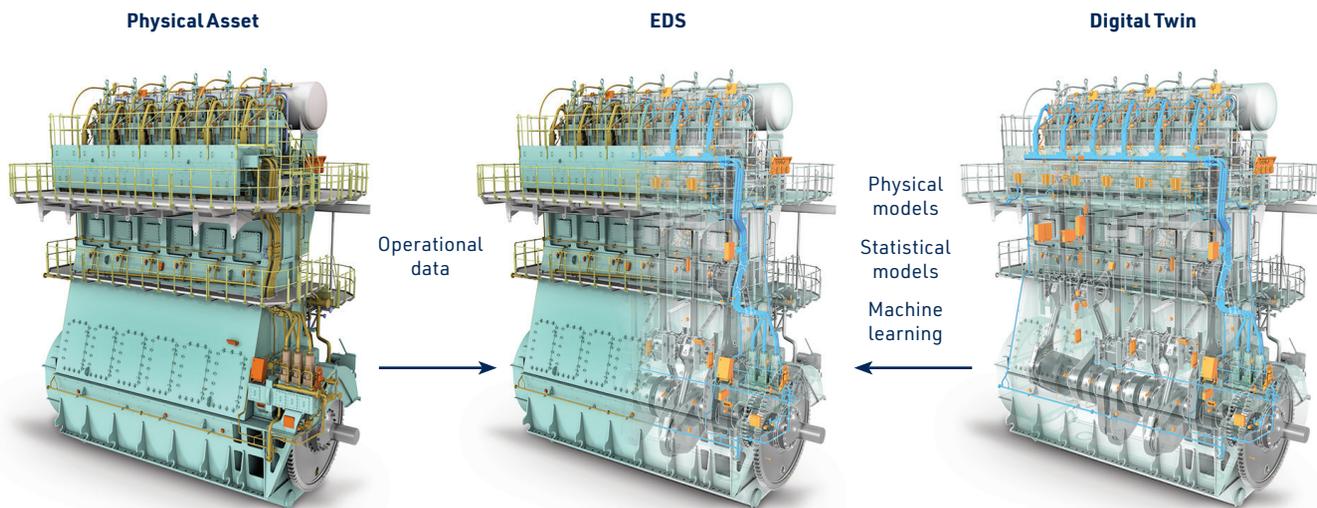


Data Collection Monitoring

# Engine Diagnostic System is the engine's digital twin which provides a unique expert engine analysis



The EDS uses the power of modern digital data monitoring to deliver customers with valuable information. It provides remote support to assist the operator in optimising the ship's performance.



## The Engine Diagnostic System (EDS) is a modular software solution which includes the following applications:



### EDS Performance

EDS Performance is the digital twin of the real engine. It is based on a thermodynamic engine model that constantly calculates the ideal engine performance and defines a "reference optimal condition". The reference condition varies

depending on the environmental conditions measured in real-time on the ship.

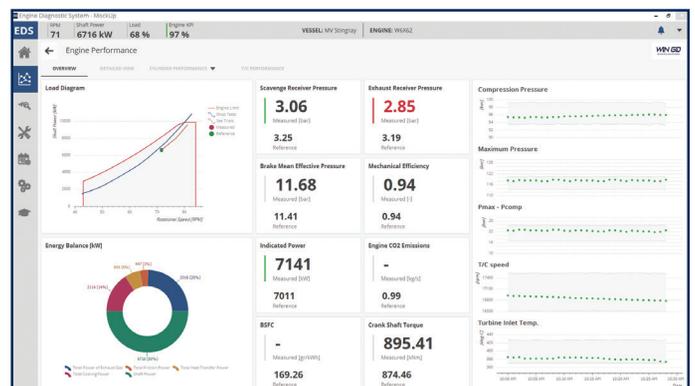
Using the DCM hardware, the actual engine operating performance is measured by collecting relevant information from the engine and the ship. The deviation between the actual and optimal reference engine performance is quantified, and a root-cause analysis, with problem solving solutions, is provided.

The EDS Performance detects and analyses actual engine performance, and evaluates any gaps with respect to the optimal reference conditions.

The engine performance analysis is based on a detailed thermo-physical process model of the engine, custom-produced for each vessel engine. The engine simulation thermodynamic model provides the "reference" engine performance for any

possible engine operation setting, the ambient conditions, and the type of fuel. The model is tuned separately for each individual engine, and calibrated using the recorded data from that engine's shop tests. It is validated using the sea trials data. As a result, the model is the digital twin of the engine in operation.

The EDS Performance detects and analyses actual engine





## EDS Components

The EDS Components application collects and monitors signals from all engine sub-systems. It analyses the received data using advanced analytics techniques and defined correlations between the signals to predict engine component malfunctions, and to generate actionable insights.

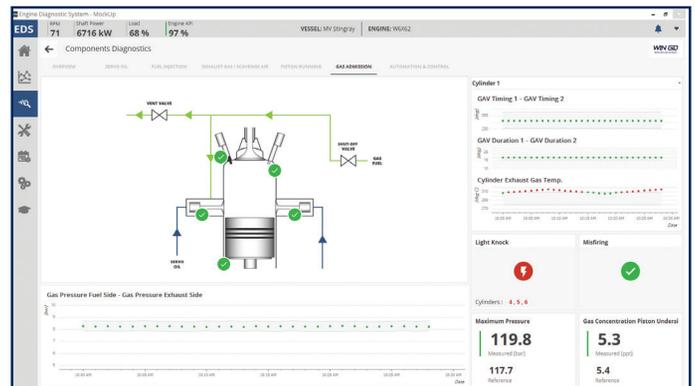
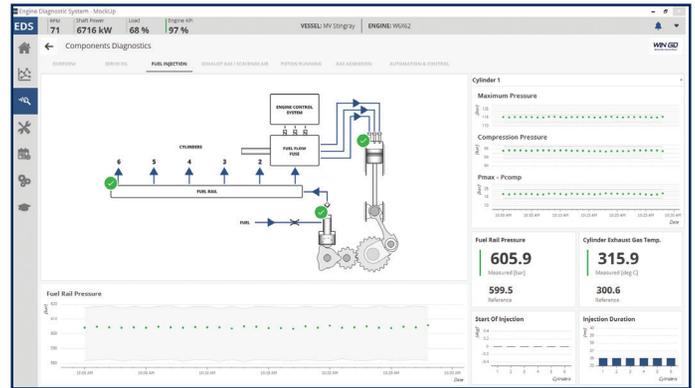
The analytics used are based on WinGD's expertise, statistical and predictive models, and machine learning algorithms.

The following engine components data are monitored and analysed:

- Fuel injection system
- Exhaust valve gas system
- Piston running behaviour
- Scavenge air system
- Turbo charger
- Engine control automation system
- Gas admission system (for X-DF engines)

The diagnostics of the engine components is a know-how-based analysis used to identify any faults or malfunctions in the various engine subsystems. The module uses the measured data already processed by the Data Collection Monitoring system, and is designed to monitor the performance of the engine components in real time, to predict component malfunctions and failures

The analysis and prediction algorithm is based on WinGD's unique expert engine analysis.



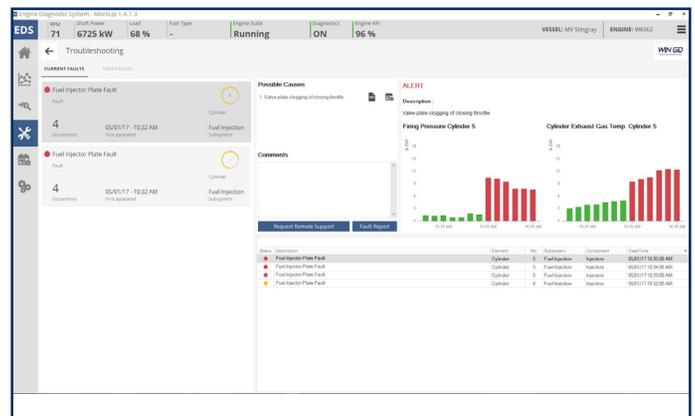
## To complete and support the analysis, the EDS provides the following additional modules:

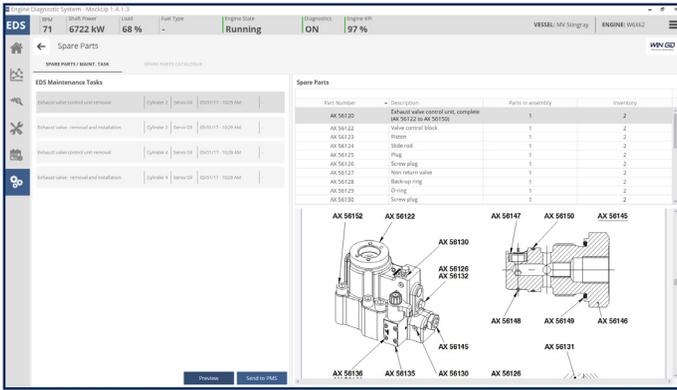


## EDS Troubleshooting

The troubleshooting application provides customers with instructions on how to solve engine problems in case of an alarm or if a failure occurs. It reports the problem, the list of alarms, identifies the part involved and automatically provides drawings and documents of the components affected.

EDS troubleshooting displays detailed instructions on how to solve the problem, for example, using extracts from the engine manual related to the problem.





### EDS Spare Parts

When a failure is predicted, it may be necessary to order a spare part. This application integrates the spare part codebook of the entire engine into the EDS. It can be used to create a parts-order to request delivery to external suppliers.

# Engine Diagnostic System (EDS): predicting malfunctions and failures through intelligent data analytics and machine learning

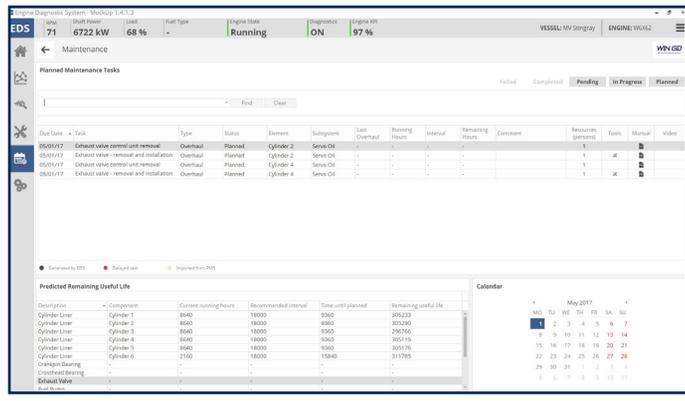
The EDS predicts component failures using advanced data analytic techniques to help avoid unplanned downtime. The predictive maintenance system makes it possible to obtain insights from machine data, and to utilise technology to analyse the data and predict failures. With the EDS and the data analytics approach, a broad data collection system, available in real time, allows access to engine data history and the systematic reporting of failure cases.

The EDS uses the large amount of engine data to extract insightful patterns and to identify dependencies by using techniques such as the association rules to find relationships between different parameters.

For example, the regression analysis evaluates the variation of a parameter when another is changing, providing new criteria to identify engine component or subsystem malfunctions.

Such techniques allow abnormalities to be identified, even if the standard static pre-set alarm does not activate. Without such a predictive maintenance system, the user would not be alerted and able to properly act to avoid unplanned engine stoppages and failures.

The machine-learning model is widely implemented in the Engine Diagnostic System. The system learns from the data provided to identify normal or abnormal engine behaviour, and to predict future behaviour.



### EDS Maintenance

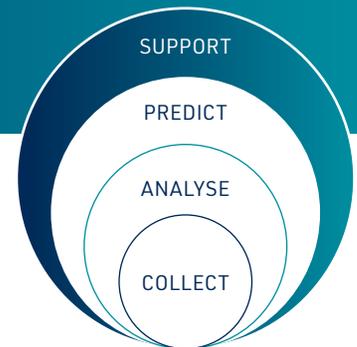
Engine data analytics enables predictive maintenance. Consequently, the engine maintenance plan becomes dynamic, based on the actual condition and prediction rather than calendar-based scheduling. EDS Maintenance helps customers obtain an overview of the maintenance schedule and record all maintenance actions.

# “Using the language of data to quickly solve issues”

## WinGD experts have a close look at your engine

Together with the Engine Diagnostic System, WinGD offers remote support directly to the shipping company. Use of the collected data will quickly solve issues, optimise the engine, provide operational recommendations, and coordinate further technical support.

As part of this service, the support centre provides regular reports on the health status of the machinery, including recommendations for optimal engine operations.



## WinGD Integrated Digital Expert: our know-how, your value

- Reduces unplanned stoppages
- Saves fuel costs through the engine performance optimiser
- Provides troubleshooting
- Extends and predicts Time Between Overhaul of components
- Accesses operational support remotely when needed
- Provides access to spare parts and field services when needed

