SIEMENS
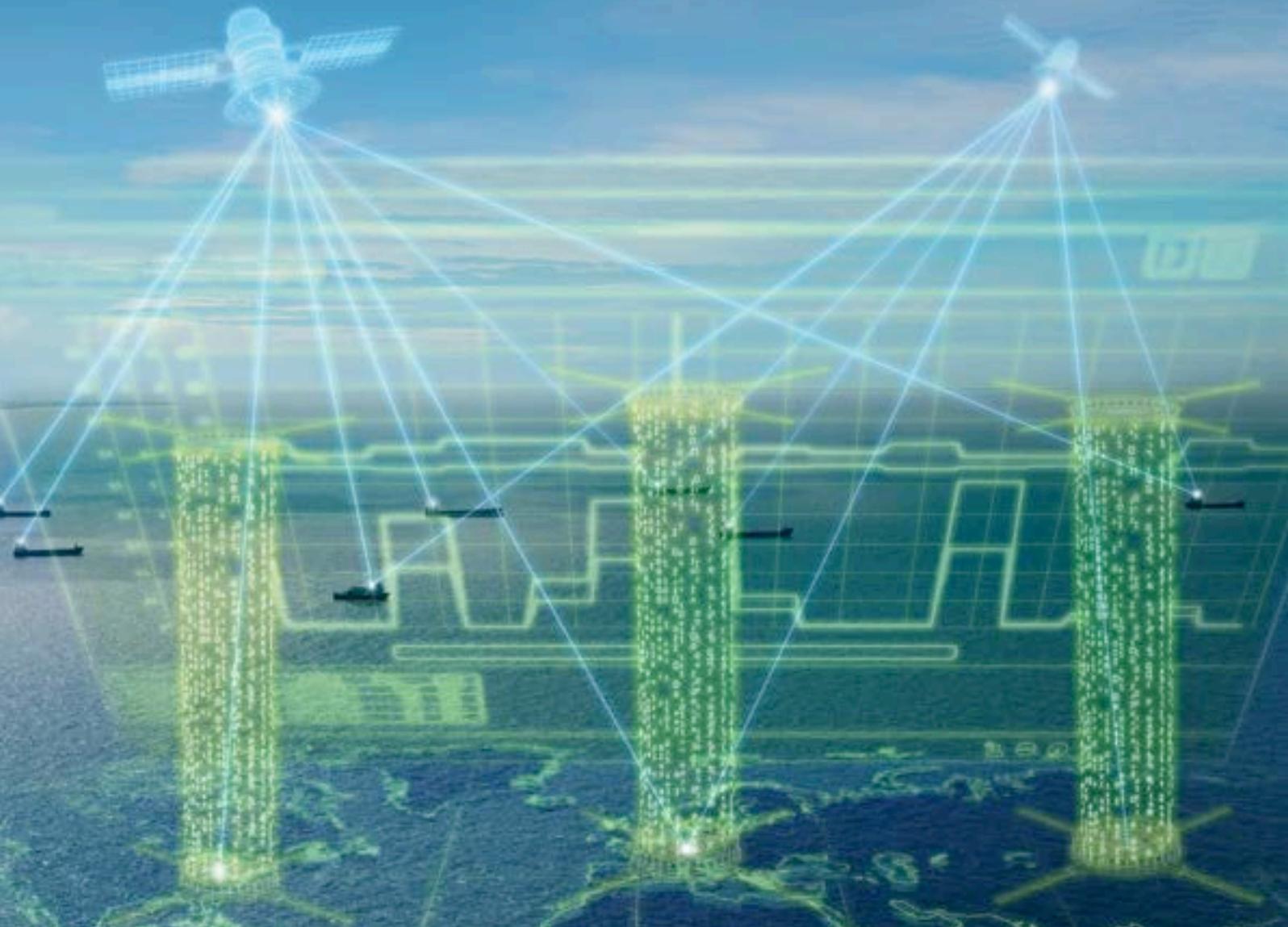*Ingenuity for life*

SISHIP and SINAVY EcoMAIN

The economical multi-application infrastructure network for better fleet performance

Contents

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EcoMAIN allows data exchange between different proprietary applications. Each application can return output data to the EcoMAIN database via the standard interface, which can be an input for other applications if needed. The applications represent real customer value by optimizing ship operation and saving operational costs.

These applications also become an integrated part of EcoMAIN even if they are third-party products. The flexible EcoMAIN data platform allows the customer to install several applications by minimizing installation costs.

The EcoMAIN principle allows an open and modular system that encourages customer input for future applications. Furthermore, EcoMAIN offers a fleet management system for transmission of the operational ships' key data to the owner's headquarters for data analysis and optimization of the entire fleet.

Applications

Waste Heat Recovery	Fluid Monitoring	Mainte-nance	Reporting	Electronic Logbook	SEEMP
Data Explorer	Energy Efficiency	Service	Documen-tation	Knowledge	Emissions

EcoMAIN Onboard Platform

EcoMAIN Fleet Manage-ment Platform

Driver

IGSS V6	SIMATIC OPC	WIN CC	OPC DA	NMEA	Lyngsoe
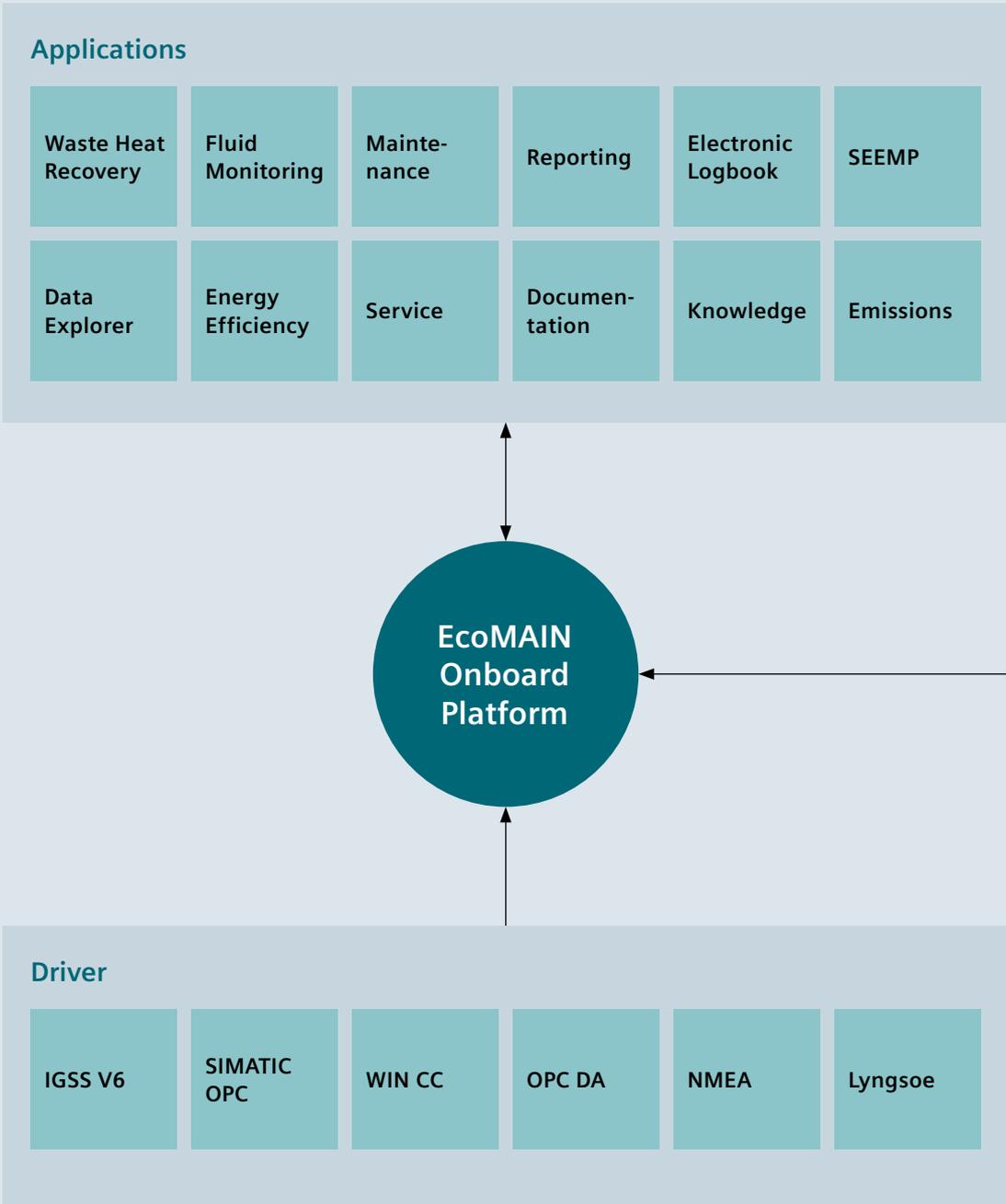
What does EcoMAIN mean?

Eco	Economical
M	Multi
A	Application
I	Infrastructure
N	Network

EcoMAIN –
Know more, pay less

Transparency is the key to success

Ship owners and ship operators rely on numerous software and hardware systems to answer ever more complex challenges in their daily business. With EcoMAIN, they can use data from any number of systems on board in a uniform platform to make better decisions and save costs.

### The challenge: prepare ship data for process analysis and management decisions

Today, ships use numerous sophisticated installations and systems on board, each delivering data on their status, performance, and efficiency. However, these data is of a proprietary, inconsistent nature and, therefore, cannot be used for process optimization. Furthermore, it is impossible to compare the performance of similar ships under different circumstances or to discover best practices for competitiveness or best operational results within an entire fleet.

The solution: EcoMAIN –
the intelligent intelligence system

Providing information in consistent format is the basic idea of EcoMAIN. To this end, EcoMAIN collects the entire ship operational data and consolidates and stores it in a database. By integrating data via modular and flexible interfaces (industrial standards such as Modbus, NMEA, Profibus, OPC, etc.) EcoMAIN can provide data access for analysis regardless of the supplier of the original systems.

Any actual and historical data may be retrieved from this database with the help of a standard application interface (API), and calculated data can also be returned. This serves as the basis for improved decision making for ship operators and owners and helps to fully exploit the commercial potential of their ships by optimizing operations.

EcoMAIN is based on the iPhone/app principle, and applications are installed in virtual machines on an EcoMAIN web/application server. A unique EcoMAIN graphical user interface (GUI) serves to visualize the apps and may be configured according to individual needs. Apps like Data Explorer can be used to select and display individual data in a graphical format for immediate fault tracking on board or in a table for further analysis ashore. For data security reasons, the system is protected by a user management and login procedure. In addition, onboard and ashore (fleet management) web clients are served by the EcoMAIN web server via an encrypted Internet connection. The versatile system is open for future applications introduced by customers or developed by Siemens.
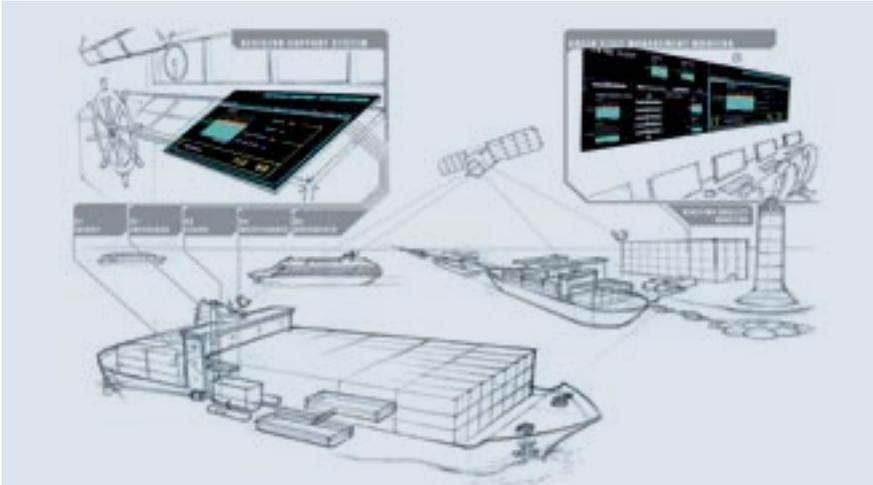
The benefits: targeted decision support and green fleet management

EcoMAIN complements Siemens' marine environmental portfolio and proves invaluable for decision making, because it allows for real-time monitoring and analyzing of the entire energy flow on board. A tailored app helps you optimize energy consumption and emissions by making the right decisions and addressing navigation (route optimization), power generation, propulsion, trim, waste heat, and HVAC. Other apps take care of bunkering fluids, service schedules, documentation, and information management, etc.

The optional real-time transmission of performance data on the Internet inspires transparent ship operation and facilitates a land-based preventive maintenance system as well as consistent ship documentation and best practice sharing.

Future extensions are easy, since the apps do not require dedicated hardware, and existing workstations (e.g. administrative network PCs installed with a web browser) can be used as EcoMAIN clients, saving costs and space on board. EcoMAIN: the one source providing the information crucial for competitive ship operation.
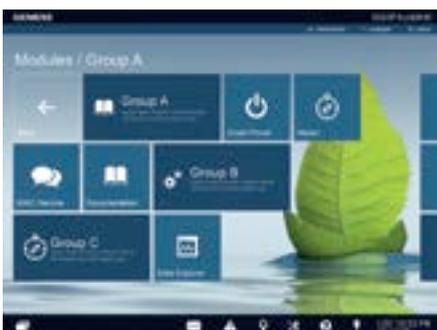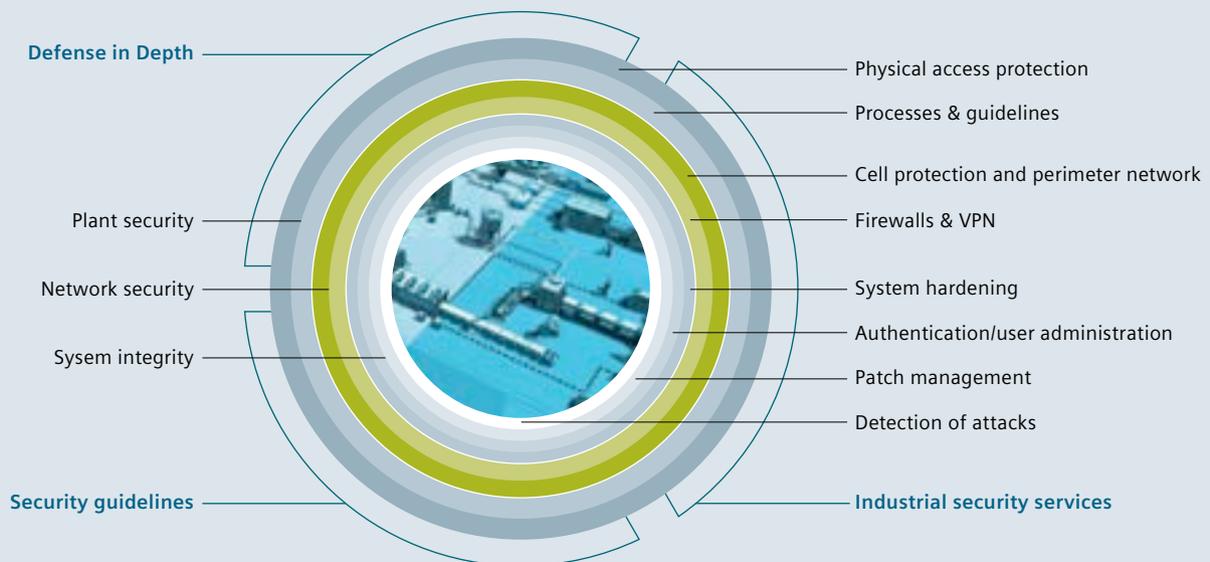
EcoMAIN onboard – Flexible hardware concept

Proven hardware concept based on standard IT Technology

EcoMAIN is a flexible and scalable system based on well-proven COTS products enabled for marine operation and provided by our partner Fujitsu. Spare parts for this standard hardware are available around the globe. The EcoMAIN hardware can also be provided by the customer based on a technical specification.

High security with Defense in Depth

EcoMAIN takes security seriously and addresses all necessarily measures. This is performed with the "Defense in Depth" concept. Following are some key facts:

- Multilayered concept to fully protect your ship based on plant security, network security, and system integrity and complying with ISA 99/IEC 62443
- Segmentation of subnetworks – to further increase security
- Reliable protection against unauthorized access with user authentication and allocation of access rights

Defense in Depth

Plant security

Network security

Sysem integrity

Security guidelines

Physical access protection

Processes & guidelines

Cell protection and perimeter network

Firewalls & VPN

System hardening

Authentication/user administration

Patch management

Detection of attacks

Industrial security services

Driver

IGSS V6	SIMATIC OPC	WIN CC	OPC DA	NMEA	Lyngsoe

A wide range of field drivers for EcoMAIN

Field driver philosophy

EcoMAIN is a flexible system with respect to onboard systems. The primary function of EcoMAIN is to read out and store all available information of onboard ship systems, such as the automation system, navigation system, or load computer. This functionality is realized with the EcoMAIN driver concept. Individual, proven drivers are available for different onboard ship systems. Special drivers for other systems can be implemented in the EcoMAIN system very easily on customer request.

IGSS V6

To read out data points from the SISHIP IMAC automation system, based on the visualization system from 7-Technology, the EcoMAIN driver IGSS V6 can be used. The driver communicates via a TCP/IP socket and reads out all the defined data points. A maximum of 10,000 data points per minute can be recorded.

SIMATIC OPC

With the EcoMAIN driver SIMATIC OPC data points from connected SIMATIC controllers can be recorded. The driver can communicate with several SIMATIC controllers by using an Ethernet bus system. Both controller families, SIMATIC S7 300 and SIMATIC S7 400, can be used. Via one driver 10,000 data points every 5 seconds can be read out. For time-critical data points the update cycle can be decreased to 1 second per 1,000 data points.

WIN CC

The WIN CC visualization system, which is used for the SISHIP IMAC V2 automation system, can be connected to EcoMAIN by using the EcoMAIN driver WIN CC. The driver communicates via a TCP/IP socket and reads out all available data points. 10,000 data points per 5 seconds can be recorded via this driver. For time-critical data points the update cycle can be decreased to 1 second per 1,000 data points.

OPC DA

A wide range of onboard ship systems can be connected via an OPC connection. The EcoMAIN driver OPC DA is used for this type of connection. The driver communicates via a TCP/IP socket and reads out all the defined data points using the OPC DA standard. 10,000 data points per 5 seconds can be recorded via this driver. For time-critical data points the update cycle can be decreased to 1 second per 1,000 data points.

NMEA

NMEA is a widely used standard protocol for communication with a navigation system. For this purpose EcoMAIN provides the NMEA driver. The driver uses a TCP/IP socket. Normally, NMEA uses a serial bus system like RS485. To avoid long cable lengths with a serial bus EcoMAIN uses converters that can be installed near the source of the NMEA telegram. The converter changes the serial bus to Ethernet. EcoMAIN can record all standard telegrams up to a baud rate of 19,200. User-defined telegrams can also be handled by the driver.
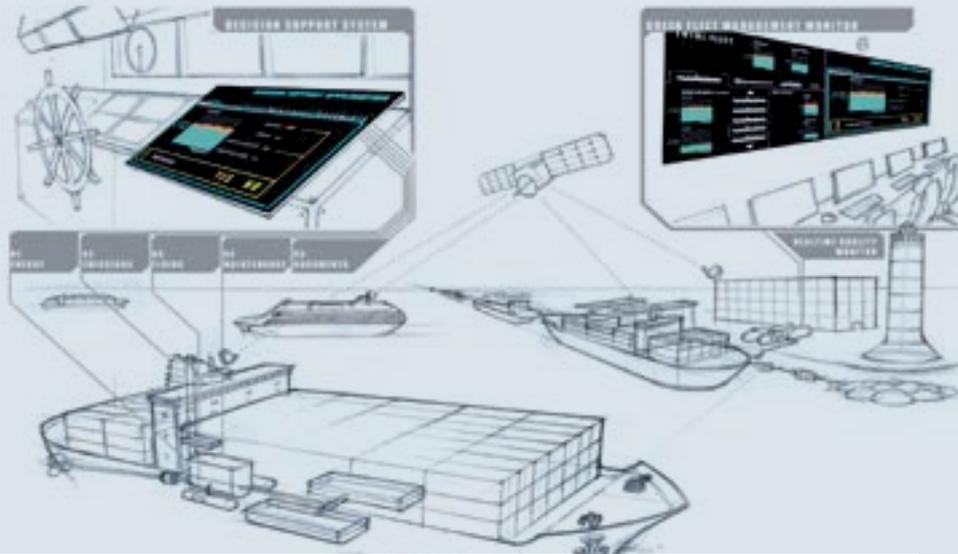
EcoMAIN onshore –
Your fleet in your hands

EcoMAIN fleet management provides a full operational overview and possible engagement of the fleet manager with all connected ships.

EcoMAIN fleet management enables the operator head-quarters of a fleet to gain online access to any onboard EcoMAIN system for insight into onboard operations. In addition, it is possible to compare and analyze defined sets of data from different ships to discover optimization potential for the entire fleet.

Either existing communication channels provided by the customer or channels provided by Siemens can be used to establish data communication between ships and the land-based EcoMAIN fleet management system. Data security is ensured by the use of firewalls, VPN tunnels, and binary data encryption.

Redundant data storage of the land-based EcoMAIN fleet management system can be provided by the customer (customer computing center) or by Siemens based on Cloud computing.

The graphical user interface – the door to EcoMAIN

The EcoMAIN graphical user interface allows you to access your vessel via a tablet PC such as an iPad from anywhere in the world.

EcoMAIN, on board and onshore, is a user-friendly system with an easy-to-operate graphical user interface (GUI). The graphical user interface shows all applications in a unique layout that includes third-party applications. All important information is accessible from the home page, which provides a quick overview of the installed EcoMAIN system.

The EcoMAIN GUI is based on web technology that supports multiple operating platforms. This graphical user interface is installation-free and can be used on the following supported browsers:

• Google Chrome

• Internet Explorer

Other browsers that support HTML5 protocol can also be used on request.

The operating philosophy

The layout of the graphical user interface is oriented to the new Metro style used in Windows 8. Each user has an individual login providing individual user rights. These user rights may assign certain access or tasks to certain operators. For example, some operators may use navigation decision support applications, while others may use only machinery-based applications. Superusers may get full access.

The graphical user interface is provided with a day mode and night mode, permitting operation of EcoMAIN from the bridge. The brightness of the GUI is switched to a low level at night. Special monitors are not required. Third-party applications with their own user interface which may not be based on compatible web technology can also be integrated into the EcoMAIN GUI. This is realized by using a special remote desktop connection.

EcoMAIN – Applications

EcoMAIN applications give a wide range of optimization opportunities, adapted and specific to your solution.

Applications

Waste Heat Recovery	Fluid Monitoring	Maintenance	Reporting	Electronic Logbook	SEEMP
Data Explorer	Energy Efficiency	Service	Documen-tation	Knowledge	Emissions

The unique concept of EcoMAIN is its integral approach to collecting and consolidating operational ship data from different system suppliers and in heterogeneous data formats in order to supply superior applications via a simple and standardized interface.

EcoMAIN allows data exchange between different proprietary applications. Each application can return output data to the EcoMAIN database via the standard interface, which can be an input for other applications if needed. The applications represent real customer value by optimizing ship operation and saving operational costs.

These applications also become an integrated part of EcoMAIN even if they are third-party products.
The flexible EcoMAIN data platform allows the customer to install several applications by minimizing installation costs.

The EcoMAIN principle allows an open and modular system that encourages customer input for future applications.

The following applications are available; others can be integrated on request.

• Data Explorer
• Service (Remote Diagnostic and Remote OS)
• Energy Efficiency – Trim/Speed Decision
  Support Cooperation with Marorka
• Energy Efficiency – Waste Heat Recovery Decision Support
• Ship Energy Efficiency Management Plan (SEEMP)
• Recording of fuel oil consumption and CO_2 emission
• Ready for Monitoring, Reporting & Verification (MRV)
• Electronic Logbook – Cooperation with NAPA
• Reporting
• E-Documentation
• SISHIP SiPOD Condition-Based Monitoring (CBM)

Data Explorer –
an easy tool for your data analysis
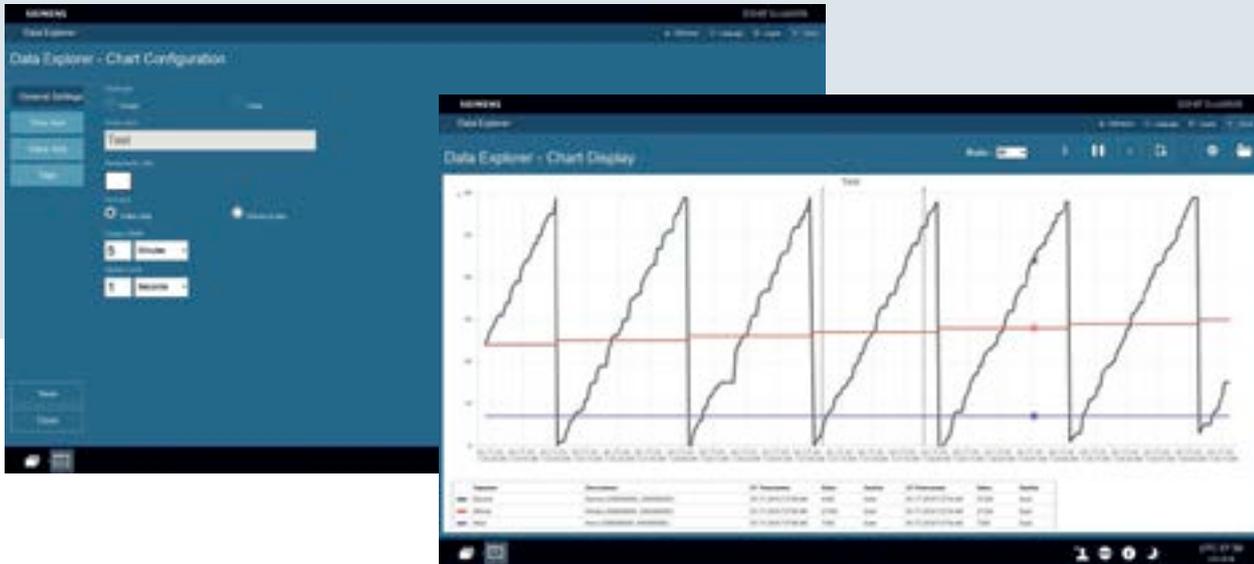
The Data Explorer tool offers easy data analysis, allowing the operator to compare data in a graphical manner. An intuitive configuration dialog box can be used to set up this data tool according to individual needs. Chart configurations can be saved in the EcoMAIN system and reopened at any time, whenever needed. Data charts can be individually created by each user and also made public to all users. Data Explorer shows actual online data as well as historical data.

Eight data points can be configured for each display chart, and an individual time axis can be selected for each data point. Therefore, up to eight individual time axes are possible. This allows the operator to compare the same data point at different times, and performance indicators can be compared in different situations. Use Data Explorer as the first step in analyzing the situation on board and drawing conclusions from this analysis.

Analog or binary data points can be displayed in one chart. The value axis can be automatically scaled by the EcoMAIN system or by the operator.
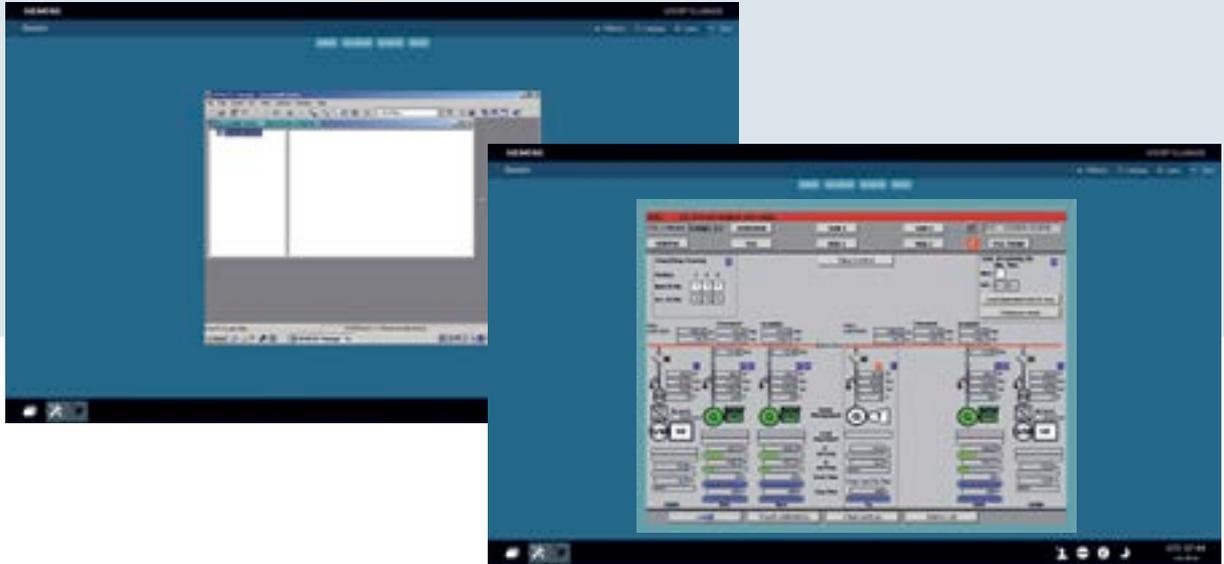
The operator is informed about the status of the displayed data points via appropriate messages. This means that the operator can see if a value is in an invalid state due to a sensor fault, for example.

On request by the operator, a displayed chart can be printed to a network printer or stored as a PDF file.

Data charts can also be exported from the EcoMAIN system to a CSV file. These files can be sent ashore to headquarters, where experts are able to investigate incidents in greater detail using common office tools.

Remote access to SIMATIC panel for power management system

The major problem in service issues today is lack of
knowledge about the actual status of the technical equip-
ment on board. This is not only a problem for regular
service interventions, but also during actual fault scenarios.
The EcoMAIN service application helps the crew avoid
such problems.

Scope of the Service application
The EcoMAIN service application can be scaled to the
customer's needs. Tools for the service application fulfill
a wide range of required functionalities to decrease the
cost of onboard services and allow technicians to analyze
the status of the onboard systems. Using a dedicated
communication bandwidth between the vessels and the
onshore EcoMAIN fleet management system, a land-based
service technician can perform the analysis remotely and
advise the onboard crew in how to fix the problem.

Service application tools
The following tools can be provided for the Service
application:

• SIMATIC manager

• SPS analyzer

• Versiondog

• Remote Operator Station (OS)

SIMATIC Manager
With this tool all connected SIMATIC-based control systems
can be monitored and analyzed. Hardware and software
fault diagnostics can be performed down to the module
level.

SPS Analyzer
The SPS analyzer records a freely selectable volume of
analog and digital signals of a connected SIMATIC PLC.
These records allow troubleshooting in real time by
analyzing the timely behavior of certain signals.

Versiondog
Versiondog is a version management system that checks
the correct software of the connected PLCs. The correct
software as well as older software versions are stored
in the Versiondog tool. Changes are checked and docu-
mented. Using SIMATIC manager and the installed SIMATIC
packages, the service engineer can always find the correct
PLC software and the appropriate engineering tools.

Remote Operator Station
This tool makes it possible to monitor systems remotely
via the EcoMAIN GUI. The GUI can be an operator station
of the automation system or local screens consisting of
SIMATIC panels. By using this tool from the fleet manage-
ment system the service engineer can assist the operator
on board a vessels.

Energy Efficiency application –

an integrated and proven solution from Marorka
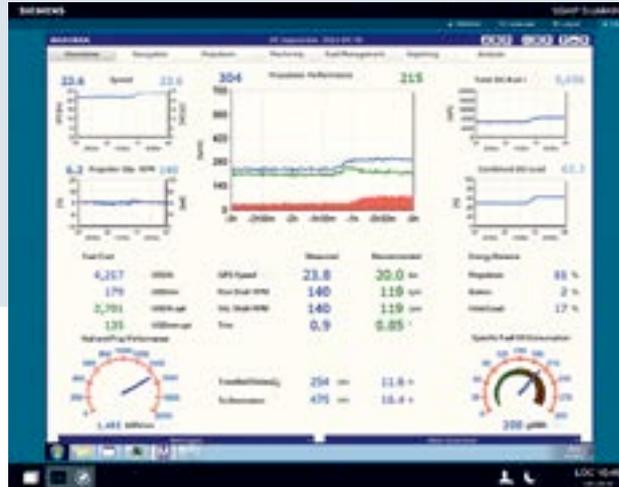
The MAREN Energy Efficiency application is powered by our partner company Marorka. MAREN fulfills a wide range of energy efficiency tasks and is integrated into the EcoMAIN system.

All necessary data points from onboard systems that are needed for these applications are obtained via the EcoMAIN API (application programming interface). Decision support messages and calculated figures are also returned to the EcoMAIN database using the EcoMAIN API. MAREN is integrated into the EcoMAIN graphical user interface (GUI) and can be operated via web pages provided by the EcoMAIN system.

The Maren software is a modular solution and can be scaled to the customer's needs. A wide range of modules is available to fulfill the energy efficiency tasks on board a vessel. The modules interact with one another as needed, as well with other EcoMAIN applications, to give the operator the optimal decision support.

The following modules are available:
• Marorka voyages
• Marorka navigation
• Marorka propulsion
• Marorka power plant
• Marorka trim
• Marorka boiler/steam
• Marorka refrigeration
• Marorka deck machinery

The MAREN functionality is based on a complex simulation of parts of the onboard equipment. MAREN compares the simulated values with the actual measured values and provides decision support messages to the operator for how to achieve the best performance.

Contact Marorka
Detailed information is available on request. Siemens will put you in contact with Marorka.
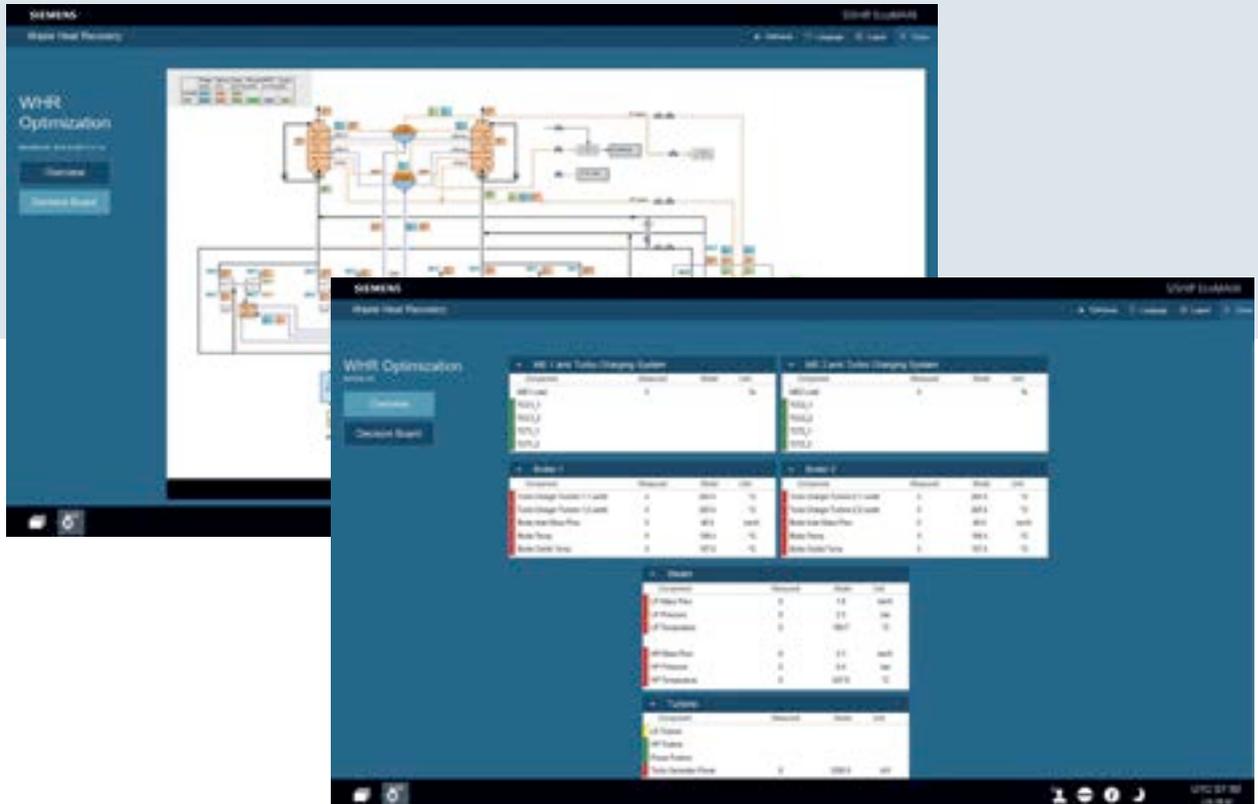
The EcoMAIN WHR system optimization application provides decision support in order to optimizing waste heat recovery from the exhaust gas of the main engine.

One of the most difficult tasks in operating a waste heat recovery system is selecting the optimal process parameters for variables such as exhaust gas temperature, heat flow rate, steam pressure, and temperature. These parameters need to be continuously adapted to the actual operating conditions of the main engine.

To assist the operator in running the WHR system in the most efficient way, Siemens provides a WHR optimization application. Actual process parameters are compared with parameters generated by a process simulation. Clear supporting texts are derived from this comparison, giving advice to the operator for how to achieve the most efficient operation of the waste heat recovery system.

Via the EcoMAIN fleet management the WHR KPIs can be compared to achieve fleet-wide optimization of the installed waste heat recovery systems.

SEEMP –

an application that helps ensure compliance with regulations

2013	2015	2020	2025	2030	2050
Regulations go into force for over 90% of fleets worldwide	EEDI requires new ships to meet agreed-upon efficiency targets	New ships must improve efficiency by 10%	New ships must improve efficiency by up to 20%	New ships must improve efficiency by 30%	
Ship Energy Efficiency Management Plan (SEEMP): mandatory implementation for all ships		20% CO_2 reduction per tonne/km (industry goal)			50% CO_2 reduction per tonne/km (industry goal)

The IMO resolution MEPC.213 covering the ship energy efficiency management plan (SEEMP) became mandatory for ship operators in 2013.

EcoMAIN provides a SEEMP application that helps ensure compliance with the IMO resolution. This application assists in the creation, continual planning, maintenance, and analysis of a fleet-wide SEEMP.

The EcoMAIN SEEMP provides:
• Scheduling of energy efficiency targets, measures, projects, and presentation at a glance for the entire fleet
• Online data from the ship's EcoMAIN databases and special reports, enabling continuous evaluation and improvement
• All SEEMP data securely stored in a centralized place in the EcoMAIN fleet management

Targets
Setting targets for meeting the IMO guidelines is voluntary. After a baseline analysis is performed based on historical data from the EcoMAIN ship databases, targets can be determined and entered in text form into the SEEMP.

All ship entries are centralized in the EcoMAIN Fleet Management, where all targets can be monitored and verified. Targets can be communicated between the EcoMAIN fleet management and the EcoMAIN systems onboard.

Measures
EcoMAIN SEEMP also helps manage various energy efficiency measures such as those listed above. EcoMAIN can provide energy efficiency applications including third-party modules to realize these measures.

IMO SEEMP Article 3.13 in MEPC.1/Circ.683 turned into reality by EcoMAIN:

"It should be noted that whatever measurement tools are used, continuous and consistent data collection is the foundation of monitoring ..."
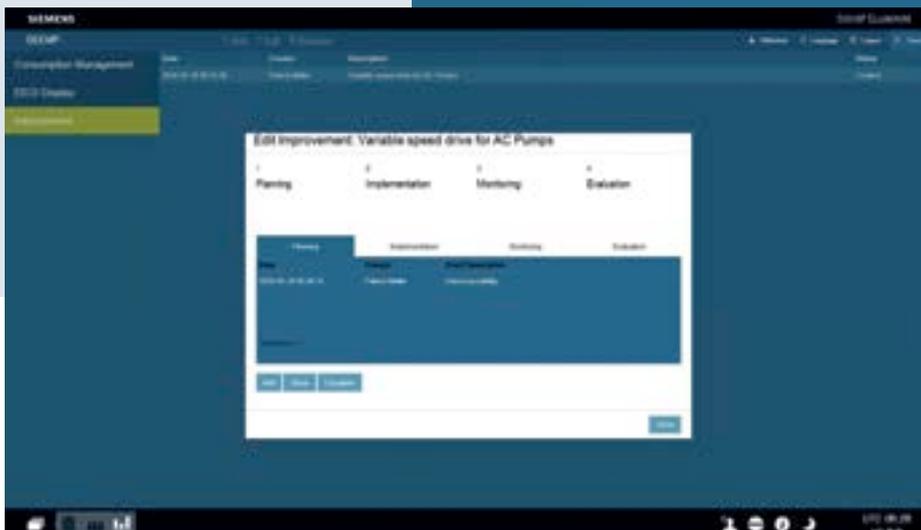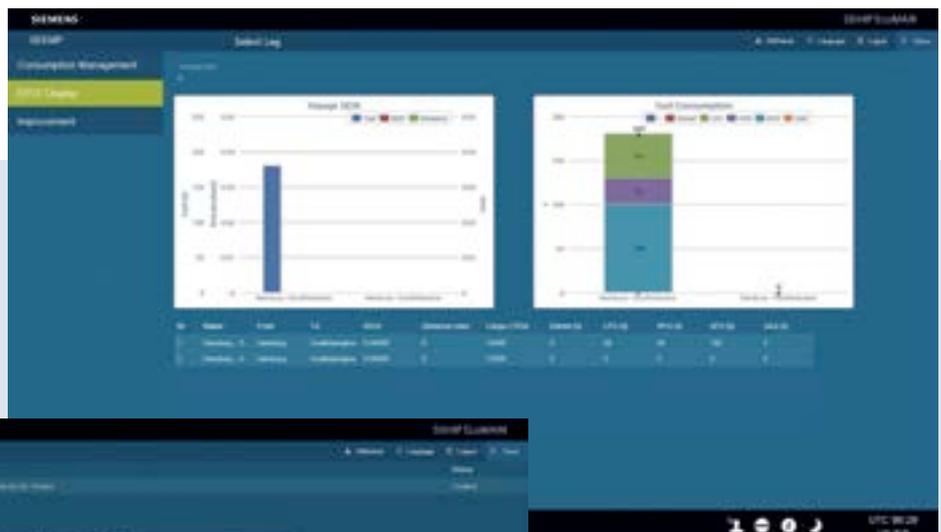
Recording of fuel oil consumption –

ready for monitoring, reporting, and verification (MRV).

The EU resolution 2015/757 requires CO_2 monitoring, reporting, and verification (MRV) for all seagoing ships beginning in 2018.

For representing CO_2 emission the regulation offers four different recording methods. One common method has to be implemented for the entire fleet.

1) Fuel oil consumption measurement on each consumer (e.g. main engine, auxiliary engines, incinerators, oil-fired boilers etc.)
2) Bunker measurement
3) Fuel oil tank sounding
4) Online CO_2 emission measurement

Siemens is able to provide a leading sensor technology for all four alternatives.

Fuel oil consumption measurement on each consumer
Siemens provides high-quality sensor system in combination with an EcoMAIN system to measure and report the fuel oil consumption for each main consumer, such as the main engine, auxiliary engines, incinerators, oil fired boilers etc.

SITRANS FC, the lightest and most compact Coriolis flow system worldwide, measures both liquids and gases. In addition to mass flow, the Coriolis flowmeter provides information on media density, fraction, and temperature. The density measurement determines the percentage of air/gas content in liquids and is therefore ideal for optimum monitoring of fuel oil consumption.

The measurement values are recorded in the EcoMAIN, where tailor-made reports are automatically generated to comply with the MRV regulation.
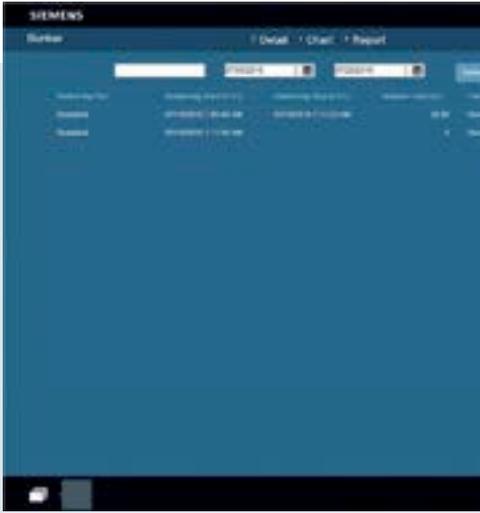
Bunker measurement

Siemens provides high-quality sensor system in combination with an EcoMAIN system to measure the amount of fuel oil during the bunker process.

SITRANS FC, the lightest and most compact Coriolis flow system worldwide, measures both liquids and gases. In addition to mass flow, the Coriolis flowmeter provides information on media density, fraction, and temperature. The density measurement determines the percentage of air/gas content in liquids and is therefore ideal for optimum monitoring and billing of bunker fuel oil.

Based on this measurement technology EcoMAIN provides a tailor-made bunker report application which is state of the art and easy to handle and complies with the MRV regulation.

Online CO_2 emission measurement

Siemens provides a high-quality sensor system in combination with an EcoMAIN system by means of an online CO_2 measurement directly in the funnels.

The EcoMAIN emissions application provides analysis of emissions compounds such as CO_2, SO_x, and NO_x. A hardware package consisting of exhaust gas probes in situ and extractive gas analyzers can be provided, including an EcoMAIN software application that gives an overview of the actual and historical emissions at a glance. Emissions reports can be generated to be stored electronically or printed out.

Siemens exhaust gas probes and analyzer hardware is already introduced in land-based power plants. This technology has already been adapted to the maritime environment and installation on ships.
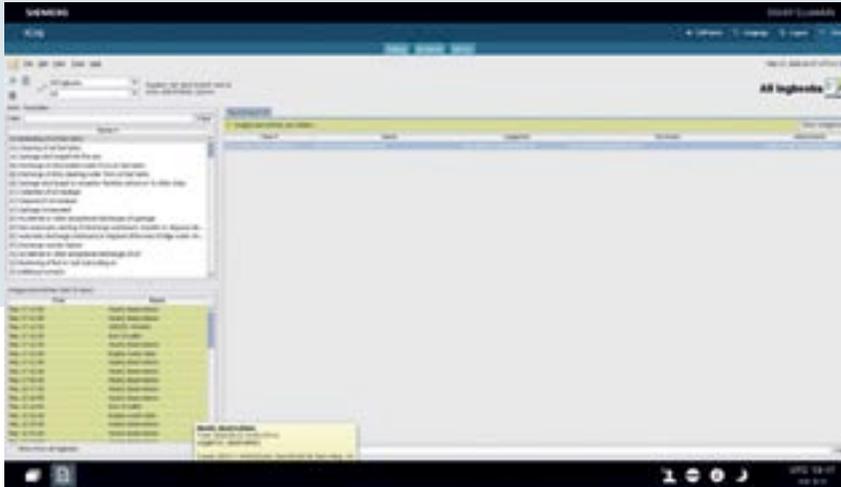
The Electronic Logbook is a special kind of reporting that fulfills the requirements of the flag state of the allocated vessel. This application replaces the paper version of the necessary logbooks on a vessel such as the engine log, radio log, and navigation log. Electronic logbooks are stored redundantly in order to avoid any data losses. The reports of the electronic logbook can be released by an e-Signature. User identification for the EcoMAIN system can be provided by a smart card or RFID card identification system.

The Electronic Logbook is powered by our partner company NAPA. Other applications from NAPA could be integrated into EcoMAIN on request in the same manner.

Contact NAPA
Detailed information is available on request.
Siemens will put you in contact with NAPA.

Having all information, measurements, and status information available in a system is not sufficient to gain a full overview of your business. It is necessary to make important information visible to the operator in an understandable format. This can be achieved by the Reporting application of the EcoMAIN system. The Reporting application is structured in two parts: standard reports and user-defined reports.

General functionality
Reports can be generated for a defined event. An event may be defined by a process signal, e.g. the starting of a motor, or a preset time, e.g. each hour, noon, or midnight. The operator can open any report via the EcoMAIN graphical user interface. Reports can be printed to a file or on a printer. Automatic report printouts at a specified time or based on a specified event are also possible. In general, reports cannot be modified after they have been generated, except output fields designed for manual input.

Created reports are stored in an unchangeable format and can be transmitted to the onshore EcoMAIN fleet management system.

Standard reports
Standard reports are customer-defined fixed templates such as a bunker report or daily report. These templates cannot be modified or deleted by the onboard operator.

User-defined reports
User-defined reports can be created, modified, and also deleted by onboard operators according to a defined user administration. This functionality can be used for debugging or special reports, depending on operator needs.

Documentation application –
overall availability of the actual technical documentation of the entire fleet
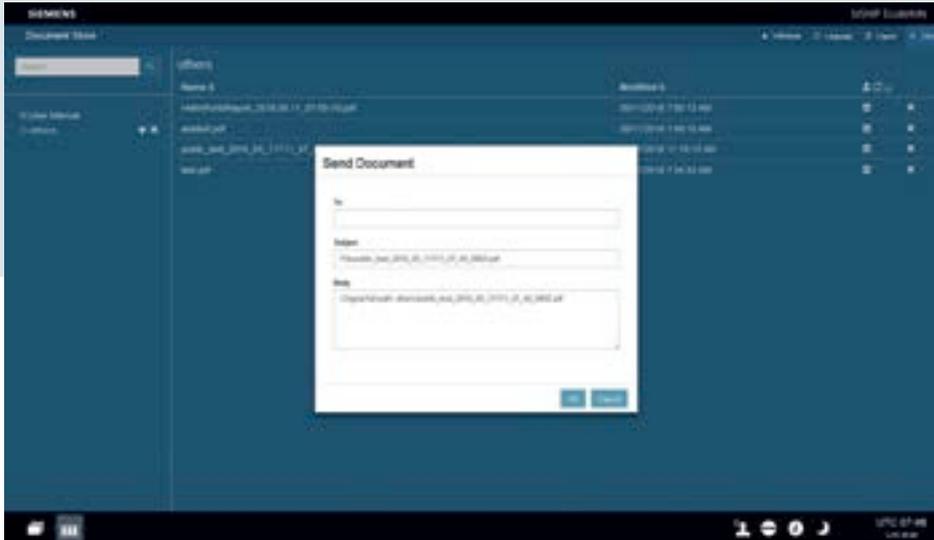
Today, technical documentation is mostly available in paper form on board individual vessels. Finding a particular needed document can be difficult, and fleet-wide documentation updates are becoming a challenge. The EcoMAIN Documentation application is the solution to this problem, also considering the lifecycle history of a vessel.

Functionality of the Documentation application
A land-based fleet management database holds all relevant documentation for the entire fleet. The onboard EcoMAIN database of each vessel holds the ship-relevant documentation. The ship-based database can be synchronized with the land-based database and vice versa. The synchronizing rate can be adjusted individually. Usually any update event, onshore or on board, triggers a synchronization. This synchronizing mechanism allows updated documents to be uploaded anywhere in the fleet. The entire fleet documentation can be manually or automatically updated, precisely and cost-effectively.

Each document is stored in a common and secured format. In addition, a reference to the allocated system including the plant identification number is saved. Multiple references for one document are possible.

A comfortable and easy-to-use user interface helps the operator find the right document. On board a vessel the operator has the option of using a keyword or a plant identification number search. A document explorer is also available. The onshore fleet management user interface for the Documentation application has the same functionality for searching documents, with the extended capacity to browse data for different vessels.

All documents can be opened in PDF format and printed out. The operator can also export the displayed document to a local file system, e.g. to the hard disk of the EcoMAIN web client being used.
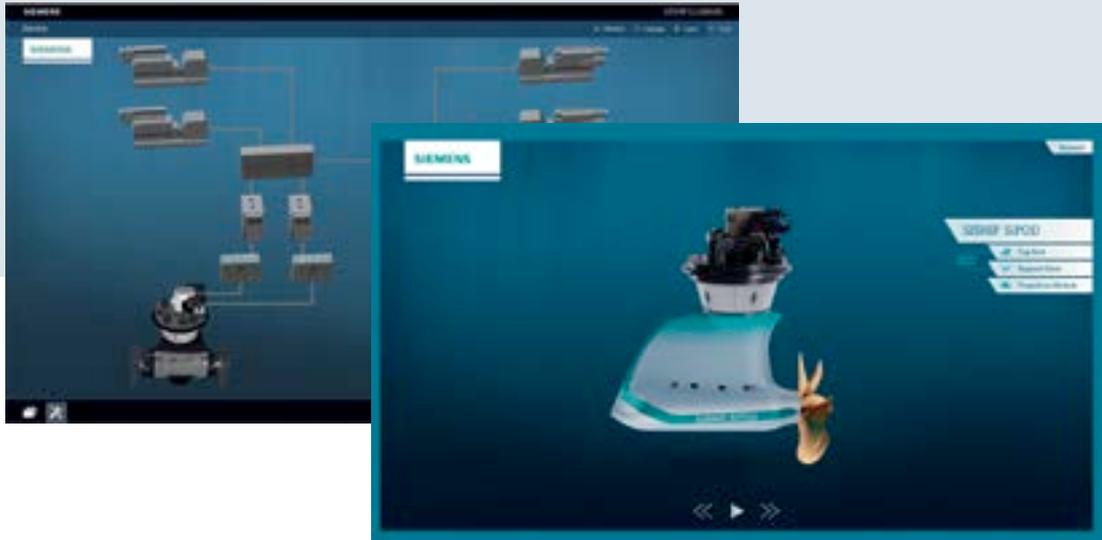
Nowadays, maintenance is one major field that provides opportunities for high potential cost saving. Condition monitoring systems will come more and more into focus for ship operators.

A short history of maintenance

EcoMAIN provides an answer regarding this requirement with the SISHIP SiPOD Condition-Based Monitoring application. This application gives the operator on board an overview of all relevant measurements of the system, from the generators to the switchboard to the transformer, converter, and all components of the SISHIP SiPOD.

Via tailor-made reports an overview of the important KPIs are available. Besides this visualization of current measurements the SISHIP SiPOD CBM application analyzes the current condition of all components. This is performed by using the given sensor system and additionally integrated sensors, e.g. vibration sensors. Via traffic lights and condition monitoring, the operator on board gets dedicated reports and detailed information.
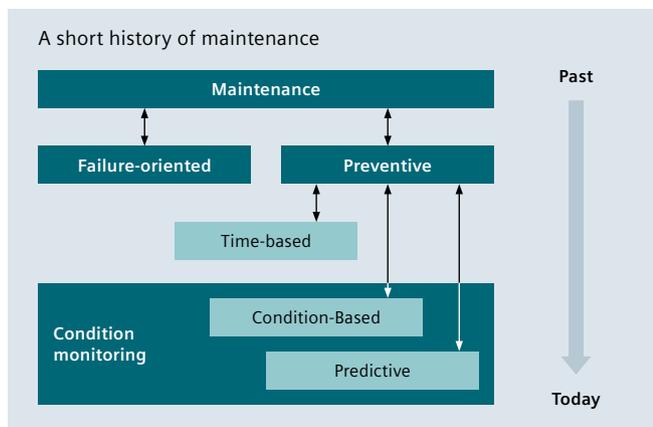
In addition, this application could combine all relevant measurements of a SISHIP SiPOD into periodic tailor-made reports. These reports would be sent in time intervals automatically to a SISHIP SiPOD specialist, who analyzes the reported data and returns with a qualified CBM analysis report. This report indicates the actual status of the propulsion motor including the auxiliaries (e.g. operation without restrictions, maintenance required, immediate action necessary).

Detailed recommendations are included in this CBM report.