# CONDITION MONITORING

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## FOR ENGINES AND ROTATING EQUIPMENT

KONGSBERG Condition Monitoring (CM) solutions for engines and rotating equipment are built on our strong knowledge within sensor technology, secure data handling and high speed processing technology. The embedded functionalities include information on operational status, advice for decision support and input for predictive maintenance. With KONGSBERG CM optimal performance of your assets is ensured and critical functionality is retained until planned service can be conducted.

**Functional Description**

KONGSBERG uses advanced sensor technology for vibration, acoustics, pressure, temperature and electrical readings. This data is time stamped with information from automation & navigation system; such as vessel speed, weather conditions and other relevant information. Online data from sensors is sent to the software, where extremely fast analysis is performed depending on the criteria set by the operator. KONGSBERG CM applies self-learning Big Data analysis tools for continuous updates and improvements. This results in accurate prognosis and diagnostics for your equipment reliability and general asset health.

Results from analysis can be presented or visualised for quick and optimal use of information. This provides a unique decision support tool to understand how the process can be optimised.

## YOUR BENEFITS

- Asset availability will be increased
- Maintenance cost will be reduced
- Performance will be improved
- Operation of your assets will be safer
- OPEX will be reduced

KONGSBERG provides a holistic view of current condition including Remaining Useful Life (RUL) calculation. Planned maintenance can be evaulated and presented locally or as fleet wide comparison, allowing benchmarking of your assets through secure network and cloud solutions.

Automatic reports and online KPIs are the basis for creating plans for efficient operation of your assets, prioritising maintenance needs and identifying faults before breakdowns, thus providing a basis for your Condition Based Maintenance (CBM) ambitions.

# BUILDING BLOCKS

### Data Collection
KONGSBERG manufactures high end sensors for vibration, temperature, pressure, and electrical readings. Our experienced engineers will provide guidance on type of sensors and location for all types of machinery in order to achieve results.

### Bearing Monitoring
Temperature monitoring is, in addition to vibration, a key factor for detecting damage or wear in bearings. KONGSBERG provides wireless temperature sensors for cross and crank bearing as well as Bearing Wear Condition Monitoring for two stroke engines.

By monitoring these parameters it is possible to avoid expensive and time consuming open-up inspections of bearings.
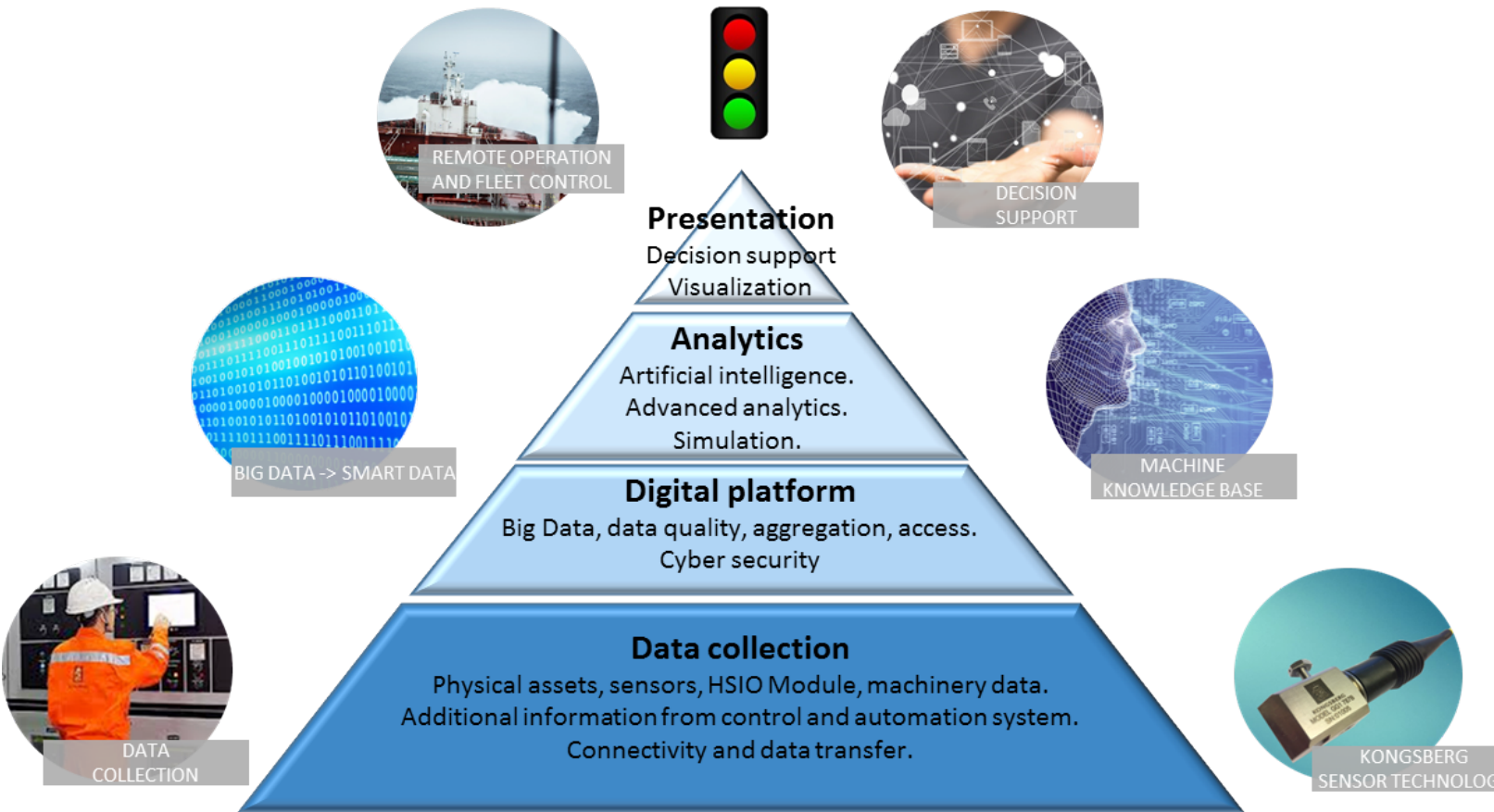
### HSIO Module
The KONGSBERG High Speed I/O module has market leading specifications for acquiring and processing high frequency signals like vibration and acoustics.

Traditionally, these kinds of readings are converted to FFT spectrums and stored on portable media for later manual analysis. KONGSBERG uses raw signal and applies enveloping and other analysis tools directly allowing the best possible resolution and valid status indication.

### Digital Platform
The new KONGSBERG digital platform is an open and collaborative platform for Merchant, Offshore and Renewable & Utility market applications.

The Platform is specially developed for big data analysis and immediate access to large amounts of both historical and real-time information. Visualisation & Global system tools for customised views and reporting as well as solutions for application development and API Management are also available.

### Advanced Analytics
Big Data processing is becoming faster and faster, and requires more and more advanced methods. KONGSBERG uses a unique combination of physical and data driven smart algorithms in order to establish the normal working baseline. The software is self learning and continues to reduce false alarms. This results in an improving knowledge base and accuracy of calculations.

## Presentation
Decision support
Visualization

## Analytics
Artificial intelligence.
Advanced analytics.
Simulation.

## Digital platform
Big Data, data quality, aggregation, access.
Cyber security

## Data collection
Physical assets, sensors, HSIO Module, machinery data.
Additional information from control and automation system.
Connectivity and data transfer.

REMOTE OPERATION AND FLEET CONTROL

DECISION SUPPORT

BIG DATA -> SMART DATA

MACHINE KNOWLEDGE BASE

DATA COLLECTION

KONGSBERG SENSOR TECHNOLOGY

### System hierarchy
Data collection founds the basis for the validity of the Digital platform. Through advanced analytics KPIs are created and presented to the operator in form a traffic light for instant decision making.

### RUL and Predictive Maintenance
KONGSBERG uses real-time analysis of sensor values with imidiate access to an immense machine knowledge base. System HMI and reports are always kept updated with the current condition of your machinery as well as expected Remaining Useful Life (RUL).

Comparing the operation of identical equipment on different vessels can advise proactive maintenance measures and increased predictability. Presenting results in a simple holistic view will help you to prioritise service resources and maximise your yield.

### Machine Knowledge Base
KONGSBERG has over time built up a extensive machine knowledge base with known fault patterns, expected asset degradation and data on how external factors affect the measured raw signals. This knowledge base is continuously updated utilizing deep-learning software.

### Intergration and Ownership of Data
The KONGSBERG solution solves the increasing challenge that each sub-supplier needs their own data and communication infrastructure. The system unites all data logging and communication into a single, secure and maintainable solution. It gives the fleet owner control of the information flow and security. It is a common solution for all roles in the owner and 3rd party supplier organisations enabling collaboration and improved decision processes.

Choosing KONGSBERG as your partner for Condition Monitoring ensures a seamless integration between all systems onboard.

### Condition Based Maintenance CBM
The KONGSBERG CM application is being developed in close cooperation with class societies and will be a catalyst for changing from interval based to condition based maintenance. With KONGSBERG as a partner and in dialogue with class society our customers are able to migrate to a reliable and cost efficient maintenance program for their assets.

### Traffic Light
KONGSBERG online processing and data quality assurance, certified by DNV, provides a simple traffic light indication for equipment status. If no abnormality is detected, a green light appears and operation continues or maintenance intervals can be extended.

When a malfunction is detected the CM application will advise on slowdown/shutdown of machinery. Additional detailed reports can be created for further analysis.

### Engine Condition Monitoring Since 2007
KONGSBERG is in cooperation with AVL List GmbH developing advanced diagnostics tools using relevant engine data as basis. KONGSBERG provides online diagnostics for two and four stroke engines including advisory for balancing and servicing the engine.
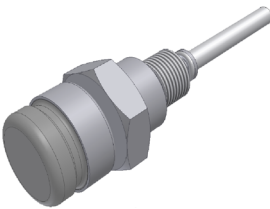
This enables engines to run more efficiently, saving fuel, minimising risk of seizure and increasing expected lifetime.
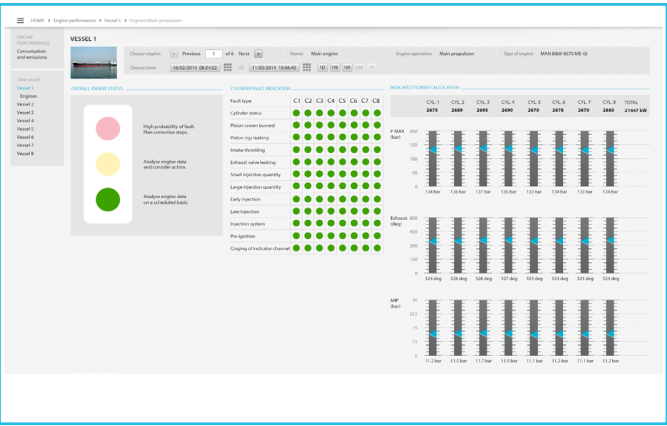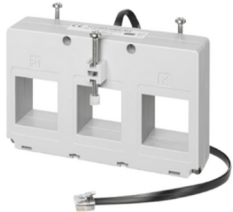
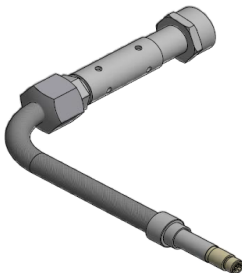*Engine condition monitoring screenshot*
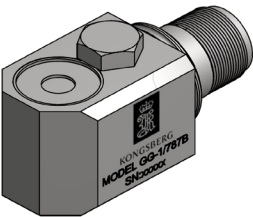
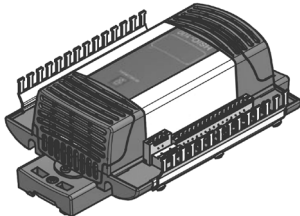Accelerometer | Wireless temperator sensor | Speed ref. sensor | Electrical meas. transformer | Combustion pressure sensor | High speed I/O module | KONGSBERG condition monitor server

**Secure & Remote Networking**

KONGSBERG is a world leading companyin IT security and remote services for marine and processing industries utilising physical security, account management, security updates, network segregation including firewall and malware protection

KONGSBERG Remote Services is a tool for certified engineers worldwide to connect to an installation upon customer request and provide remote support. Our follow the sun concept ensure 24/7 available remote technical support around the globe.

**Applications Areas**

KONGSBERG CM solution is applicable for any rotating equipment including:

- Diesel and dual fuel engines
- Generator sets
- Compressors
- Thrusters
- Pumps
- Fans
- Gears and Bearings

## WHY CHOOSING KONGSBERG?

KONGSBERG is market leader in marine automation offering unmatched technical expertise backed up by an extensive, world wide service network. KONGSBERG is your preferred partner and providing a cost efficient, high quality, Full Picture delivery for Condition Monitoring. Through our core values; Determination, Innovation, Collaboration and Reliability we always put the customer in focus to ensure your projects are a success.

## TOPOLOGY

Sensor input from you assets is processed in modern, high speed IOs and results are made available on board via the KONGSBERG OS and/or sent to your on-shore office.
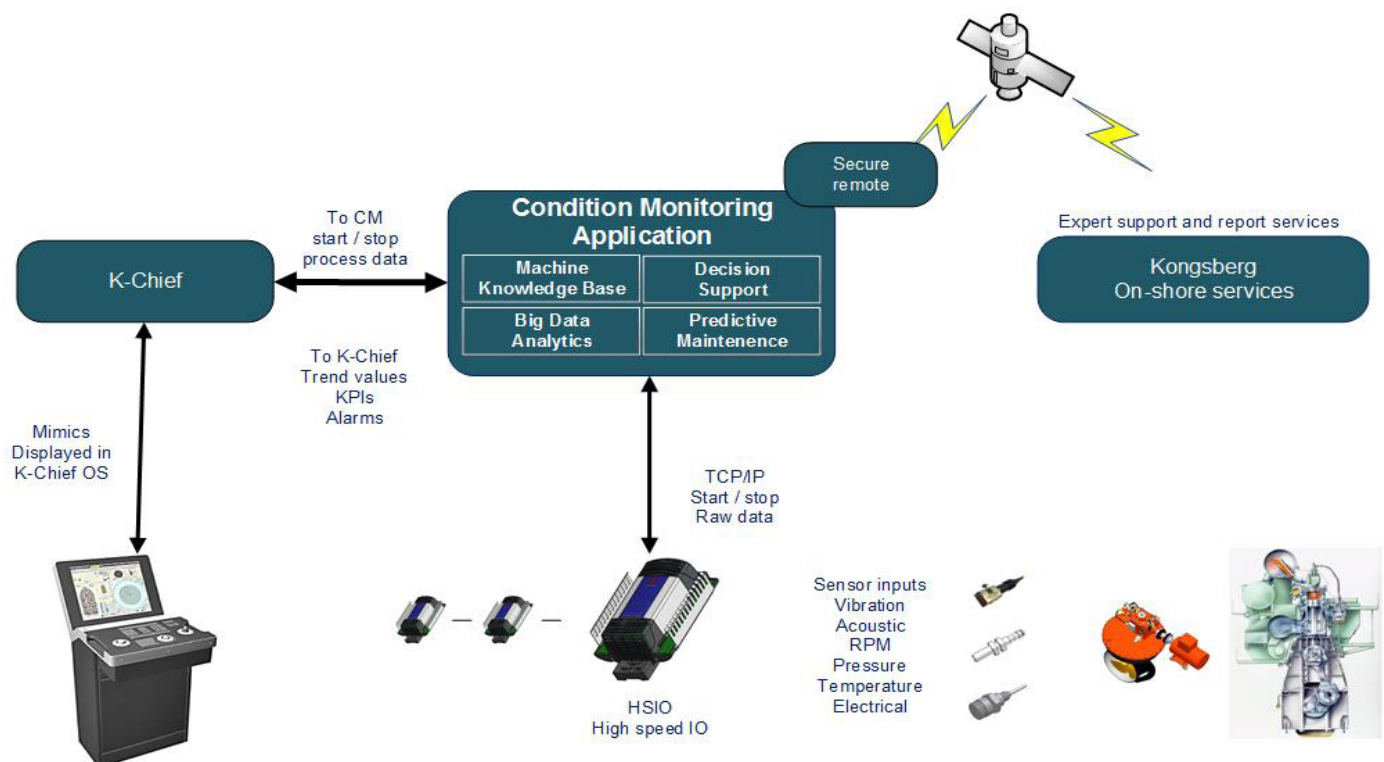


*Specifications subject to change without any further notice.*

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