The Digital Twin in action

Smart Maintenance Conference, 2019, ETHZ
WinGD has its headquarter in Winterthur Switzerland, one of the earliest exponents of the Diesel engine technology.

It started with the development of internal combustion engine in 1898 under the “Sulzer” name and continues to develop power solutions.
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1. Digitalization at WinGD
2. The engine diagnostic system (EDS): the digital twin in action
   - Data analysis
   - Consolidation and Orchestration
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3. Value for the ship operators
Digitalization at WinGD

A tool to better support our customers

**Collect**
- Display trend of ship and engine data
- Transfer of engine data ashore
- Store data in a secured environment

**Predict**
- Prediction and diagnosis of component malfunction
- Extension of maintenance intervals

**Support**
- Troubleshoot abnormalities
- Steps to fix the malfunction
- Remote support

**Analyze**
- Intelligently diagnose the engine status
- Engine performance and components behaviour

**Support**
- Troubleshoot abnormalities
- Steps to fix the malfunction
- Remote support
A common goal: to support our customer

WiDE for a better collaboration between WinGD, engine builders and service provider

- Engine continuous diagnostic
- Predictive maintenance
- Troubleshooting support
- Access to spare parts

WinGD
Engine Builders
Service providers

WiDE

High Engine availability

DATA

Shipping company/ operators
WinGD engines go on line
A closer customer relationship

On board:
- Data collection
- Data Analysis

Onshore/online:
- Data Storage
- Remote support

Customer

WinGD server
The Engine Diagnostic System
The WinGD’s main Engine Digital Twin

Advanced engine simulation and data analysis for:

1. Engine Performance
2. Engine components

- Condition Based Maintenance
- Engine Health management
- Energy efficiency
- Safe operations
- Fleet management
- Remote support
Engine data analysis process

A combination of advanced analyses to closely simulate the engine reality

1. Thermodynamic analysis
2. Engine subsystem diagnostics
3. Machine learning
Thermodynamic analysis

A sophisticated model customized for each engine

A thermodynamic model is created for each engine, using the specific:

- Geometry
- Settings
- Controls Data
- Shop tests data

This is the thermodynamic “Digital Twin”
Engine subsystem diagnostics

Algorithms based on WinGD core know-how

The following engine components are monitored and analyzed:

- Fuel injection system
- Gas admission system (for dual fuel engines)
- Servo oil system
- Piston running
- Scavenge air system & Exhaust gas system
- Engine control & automation system

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<th>WinGD core know-how</th>
<th>Failure modes</th>
<th>Root cause analysis</th>
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<td>Cause - Effects on the components</td>
<td>Reference Value</td>
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<td>Trace of the fault-influenced parameters</td>
<td>Tolerance and thresholds</td>
<td>Rule sets</td>
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Reference Value

Tolerance and thresholds

Rule sets
Machine learning for the engine diagnostic

Data analytics combining expertise with operational data

Analysis steps

• Use historical data & expert’s knowledge to train the Machine Learning algorithm

• Apply the trained algorithm to predict future events
Consolidation & Orchestration

Consolidate the analyses and make them actionable

- Consolidation of findings of the Analysis part from various methods of analysis
- Orchestration of actions to follow:
  - Troubleshooting
  - Maintenance tasks/events
  - Spare parts
# The valuable outcome of the analyses

Troubleshooting, maintenance and spare parts

<table>
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<tr>
<th>TROUBLESHOOTING</th>
<th>MAINTENANCE</th>
<th>SPARE PARTS</th>
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<tr>
<td>Provides a list of possible causes for detected faults &amp; core relevant parameters</td>
<td>Condition-based maintenance based on asset usage &amp; status</td>
<td>Automatic creation of relevant spare part list for each maintenance task identified</td>
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<td>Presents a set of corrective actions for each possible cause based on:</td>
<td>This allows operator to extend or advance overhauling/maintenance event</td>
<td>Spare parts drawings</td>
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<td>Digital spare part code book</td>
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A tool for a stronger customer relationship

We speak with customer the language of data

1. Warning

2a. Troubleshooting

2b. Request for remote support

3. Solution
   - Actions
   - Operating manual
   - Maintenance plan
   - Spare parts identifications
Value for the ship operators

- Engine failure prediction
  Predictive maintenance and real time component diagnostic

- Full access to all engine data

- Saving fuel cost
  Real time engine performance monitoring with a digital twin

- Advanced Troubleshooting
  Digital expert and remote support on board and on shore

- Easy access to spare part, documents and updates

- Dynamic maintenance plan
  Based on the engine conditions
Thanks!