MARORKA
Data Management and Role of Big-data
in Maritime Situational Awareness

Jacob Wiegand Clausen
Marorka, Head of Advisory
jacob.clausen@marorka.com
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**MARORKA**

**Facts & Figures**

We are the **leading** global provider of **data-driven energy management solutions** for the **maritime** industry.

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**Established in:** 2002

**Head office:** Reykjavik, (IS)

**Global presence:**
- Copenhagen (DK)
- Hamburg (DE)
- Athens (GR)
- Singapore (SG)
- Dubai (AE)
- Busan (KOR)

Planning to open offices in Shanghai and Houston in 2016/2017.

**No. of Data Systems installed:** > 500 (since 2002)
HYPE CYCLE FOR EMERGING TECHNOLOGIES
- BIG DATA IS ON EDGE OF INFLATED EXPECTATIONS ...

Source: Gartner (August 2014)
New Maersk boss: Big data is the next revolution

Every month, the fleets at Maersk collect massive amounts of data. Big data will be the next big revolution in shipping, says Paolo Tonon, new head of Maersk Maritime Technology to ShippingWatch.

BY KATRINE GRØNVALD RAUN
Published 10.04.15 at 10:43

International shipping finally gets its big data revolution
WHAT IS BIG DATA AND HOW DOES IT LOOK IN THE SHIPPING INDUSTRY?

Development in using and analysing data

- **1970 - 1985**: Use of data analysis to support decision making
- **1980 - 1990**: Focus on data analysis for decisions by senior executives
- **1990 - 2000**: Software for analyzing multidimensional data tables
- **2005 - 2010**: Focus on statistical and mathematical analysis for decisions
- **2010 - Very**: Large, unstructured or fast-moving data

Performance data in shipping

- **Performance data = Big Data?**
  - Shipping industry started collecting data within Performance Management. The solutions has developed from simple noon reports to become realtime auto-logged data.

**Volume**
- Too large to store and analyze using traditional databases
- Noon-report: 20-50 tags, 10-100 kb/day
- Auto-logged: 20-100 tags, 1-8 MB/day

**Velocity**
- Real-time or fast-moving data need to be analyzed quickly
- Noon-report: Daily report 24 h
- Auto-logged: Onboard 5-15 s, On shore 15 min

**Variety**
- Different types of structured and unstructured data
- Noon-report: Manual entries
- Auto-logged: Automation systems, Sensors, Equipment

Sources: Davenport (2014) and IBM Institute for Business Value and the Said Business School at the University of Oxford (2012)
DATA AND ANALYTICS
.. is key for becoming leader in the maritime business

Real-time data management & analytics are becoming an indispensable prerequisite for maritime businesses to remain competitive under tightening market conditions.
DATA DRIVEN ENERGY MANAGEMENT
What is it all about?

Efficient machinery operation

Propeller performance

Speed profile optimization

Hull performance

Optimized bunker, ROB and emissions control

Trim optimization

Key benefits:
✓ Reduce energy/fuel consumption
✓ Bring down cost & waste
✓ Increase productivity,
✓ Improve profitability
✓ Enhance competitiveness.

ENERGY MANAGEMENT encompasses all measures, processes and tools to improve energy efficiency of shipping operation
MARORKA SOLUTION
Data, analytics and decision support

MARORKA INFRASTRUCTURE

ENERGY MANAGEMENT SOLUTIONS
- Data and analysis
- Fuel manager
- Voyages
- Trim
- Machinery

The Marorka infrastructure provides reliable data to crew and onshore personnel. It can be extended with powerful performance optimization applications and analytics.
DATA FLOW
From sensor data to Marorka Online via Marorka Onboard

MARORKA ONBOARD
- MARORKA SPM
- REMOTE CONNECTION
- SHIPS SAT-COM
- MARORKA SERVER
- DATA AQUISITION UNITS
  Automation System, Bridge System, Loading Computer, ECDIS, shaft meter, anemometer, speed log, etc.

MARORKA ONLINE
- HOSTING PARTNER
- DASHBOARD + WALLBOARD
- MARORKA ONLINE ODATA API
- MARORKA ONLINE SERVER

DATA FLOW Diagram: Sensor data flows from DATA AQUISITION UNITS to MARORKA ONBOARD, then remotely connected to SHIPS SAT-COM and MARORKA SERVER. From there, data is sent via ODATA API to MARORKA ONLINE, resulting in a dashboard and wallboard for monitoring and analysis.
DATA INTEGRITY
Building knowledge from data

Performance System
Systems and processes must be in place for proper data collection and monitoring

Governance and leadership
Clear ownership, roles and responsibilities to ensure accountability for data quality

People and skills
Train people so they have appropriate knowledge and competencies for their role

Provide feedback from the data
Focus on data usage by providing value from good data and feedback from bad data
ONBOARD OPTIMIZATION APPLICATIONS
Enhancing onboard decision to reduce emissions

Speed, Trim and Auxiliary optimization

Propulsion optimization

Voyages optimization

Engine optimization
Marorka Voyages identifies speed profiles that result in minimized voyage costs for given routes and ETAs, making voyage planning simpler and the voyage more economical.

Voyages optimizes planning by continuously calculating the most efficient speed of the ship during the sea passage.

The ship’s officers can then use the proposed speed profile to reduce fuel consumption.
SPEED MANAGEMENT
Optimizing speed profile for a given route, weather and sea state

Speed management involves the following objectives:

- **Decreasing Speed Volatility:** Minimize speed volatility by staying as close as possible to target speed and thereby reducing speed fluctuations.

- **Speed Profile Planning:** Reducing speed on a given route when environmental loads (wind, waves, swells and currents) are high and increased again during favourable conditions to make up for lost time.

**Marorka Voyages** enables planning and execution of energy efficient voyage based on mathematical models and forecasts for weather and sea state. The fuel consumption and harmful emissions are consequently minimized.
PROPULSION MODELLING
Using speed-power model for optimizing speed profile

Creating speed-power model based on well-known marine engineering expressions
\[ P_{\text{model}} = \frac{R_{\text{tot}} V}{\eta}, \quad R_{\text{tot}} = f(V, \text{wind}, \text{wave}, \text{draught}, \text{depth}, ...) \]

Statistical methods used to tune resistance components with collected data and test records
\[ \min \left( \sum_{i=1}^{n} \text{ABS}(P_{i,\text{model}} - P_{i,\text{data}}) \right), \quad P_{i,\text{model}} = f(V, \text{wind}, \text{wave}, \text{draught}, \text{depth}, ...) \]

Optimizing fuel consumption over speed profile
\[ \min \left( \sum_{i=1}^{n} FC(t_i) \right), \quad FC(t_i) = f(V, \text{wind}, \text{wave}, \text{draught}, \text{depth}, ...) \]
\[ t_{\text{ETA}} = \sum_{i=1}^{n} \frac{\text{Dist}_i}{V_i} \]

Using speed-power model fitted to actual data will provide most accurate decision support recommendation and real picture of fuel saving potential
PROPULSION MODELLING
Model fit and resistance breakdown

Still water: 92.3%
Wind: 6.1%
Wave: 1.6%
SPEED MANAGEMENT
Example: Sprint-loitering

<table>
<thead>
<tr>
<th>Actual speed</th>
<th>Optimal speed</th>
<th>Potential savings</th>
<th>Ship</th>
<th>Date</th>
<th>Distance</th>
<th>Draft</th>
</tr>
</thead>
<tbody>
<tr>
<td>345.6 MT</td>
<td>324.4 MT</td>
<td>21.2 MT</td>
<td>Container</td>
<td>Feb 2015</td>
<td>2,271 nm</td>
<td>8.5 m</td>
</tr>
<tr>
<td>58.1 MT/24h</td>
<td>54.5 MT/24h</td>
<td>3.6 MT/24h</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Potential savings: 6%
REGULATORY COMPLIANCE OVERVIEW
Past, present and future challenges

- SEEMP & EEDI
- ECA NOx
- ECA SOx
- EU SOx
- Global SOx
- MRV
- EEDI 10%
- EEDI 20%
- EEDI 30%
- MBM ?

MONITORING, REPORTING AND VERIFYING
On voyages to, between and from EU ports after 2018

- MRV is a EU regulation on the **monitoring**, **reporting** and **verification** of carbon dioxide emissions from maritime transport within the European Union
- Implemented in steps, submit monitoring plan in 2017 and first submitted verified report for 2018
MRV is a EU regulation to vessels* (larger than 5000 GT) on voyage to, between or from ports in the EU.

Shipping companies need to:
- Submit a monitoring plan describing procedures and methods for measuring CO₂ emissions.
- Monitor CO₂ emissions on voyage and annual basis according monitoring plan.
- Report emissions on annual basis. This should include information on ship particulars and also performance data and CO₂ emissions on each voyage departing and/or arriving at a port in EU member state and each EU port stay.

Verifiers need to:
- Approve shipping company’s monitoring plan
- Verify annual emission report

* excluding dredging, ice-breaking, pipe laying or offshore installation activities
## METHODS FOR MONITORING CO₂ EMISSIONS
Four monitoring methods approved by EU

<table>
<thead>
<tr>
<th>Method</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bunker Fuel Delivery Note and periodic stocktakes of fuel tanks</td>
<td>No hardware investment costs or meter installation efforts.</td>
<td>Administration cost and over reporting of emissions.</td>
</tr>
<tr>
<td>2. Tank sounding on board</td>
<td>No investment costs or meter installation efforts.</td>
<td>Administration cost and over reporting of emissions.</td>
</tr>
<tr>
<td>3. Flow meters for applicable combustion processes</td>
<td>Automated monitoring and reporting.</td>
<td>Investment costs and installation efforts.</td>
</tr>
<tr>
<td>4. Direct CO₂ emissions measurements</td>
<td>High accuracy</td>
<td>High investment cost. Frequent calibration and unreliable equipment</td>
</tr>
</tbody>
</table>

### Method
- 1. Bunker Delivery Notes (within EU)
- 2. Tank Soundings
- 3. Flow Meters
- 4. Direction Emissions Measurements

### Accuracy
- 1. Bunker Delivery Notes (within EU)
- 2. Tank Soundings
- 3. Flow Meters
- 4. Direction Emissions Measurements
EU MRV COMPLIANCE OPTIONS
Noon reports vs. auto-logged data

Noon reports
- Monitoring plan made in-house or via consultant.
- Monitoring is based on BDN and bunker fuel tank monitoring.
- Emissions report is constructed from noon reports in-house or via consultant.

Auto-logged data
- Monitoring plan integrated in solution and ready for verifier.
- Monitoring is based on flow meters and bunker fuel tank monitoring.
- Emissions report is ready for verifier approval and electronic template.

High transparency and awareness for energy consumption and efficiency.
Low transparency and awareness for energy consumption and efficiency.
MARORKA ODATA API
Enabling sharing of data across organizations

Marorka Online OData API provides standardized method to access data from Marorka Online from various software tools.
MARORKA PERFORMANCE CENTER
Developing performance management as a service

Service coverage

- Dedicated team to monitoring performance and provide relevant feedback to your fleet on daily basis
- Get immediate benefit through increased operational efficiency, reduced operating costs and enhanced reliability of your assets
TECHNOLOGY OUTLOOK
Developing tomorrows data-driven solutions

Go-Green Project
Marorka is partnering with Kongsberg to deliver fully autonomous speed pilot for UASC Ultra Large Container Carrier in order for vessels to autonomously follow optimal speed profile ensuring that energy savings are realized.

Maritime Unmanned Navigation through Intelligence in Networks
Marorka has been selected to participate in the MUNIN project, an EU-funded initiative lead by Fraunhofer which is investigating the possibility of using unmanned ocean-going ships for transportation.
Thank you for your attention!