CSL's Fleet Management
Successful Journey through Advanced Analytics and towards AI

Frederic Lavoie, Senior Manager | Operational Efficiency, CSL
Remi Duquette, Vice-President | Industrial AI, Maya HTT
Better Engineering for Industry 4.0

- Composites
- Product Lifecycle Management
- Process Simulation
- AI & Big Data Analytics
- IIoT and Digital Twin
- Manufacturing Simulation
- Cloud Applications
- Custom Engineering Applications
- Optimization Services (Automation, Standardization & Compliancy)

Maya HTT

mayahhtt.com/ai

- 40+ Software solutions developed & maintained
- 12+ Years Partnership with AVEVA™ PI System
- 75% Engineers & Scientists
- 22% PhDs
Create a backlog of business challenges & move forward in an agile way

What are your top business challenges?

- Improve Product Quality
- Increase Operational Efficiency
- Reduce Maintenance Costs
- Reduce Compliance Breaches
- Enhance Forecasting
- Reduce Fuel Consumption

What data is needed?

What sensors & networks?

How clean is your data?

- Diagnostic stage
  - Why did it happen?

- Descriptive stage
  - What is happening?

- Predictive stage
  - What will happen?

- Prescriptive stage
  - How to control?

Digitalisation.

Advanced Analytics.

Machine Learning.

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### Benefits

<table>
<thead>
<tr>
<th>Compliance / Process Digitalization</th>
<th>Energy Management</th>
<th>Asset Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="whale" /> 10% of benefits</td>
<td><img src="image" alt="fuel" /> 50% of benefits</td>
<td><img src="image" alt="engine" /> 40% of benefits</td>
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</table>

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<thead>
<tr>
<th>Compliance / Process Digitalization</th>
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</thead>
<tbody>
<tr>
<td>Automatic Infringement detection – Pre-warning reduces infringements</td>
<td>One Example based on the 2022 speed optimization trial:</td>
<td>Potential failure avoidance:</td>
</tr>
<tr>
<td>Automatic reporting – reduces manual reporting time from hours to minutes</td>
<td>~3 - 5% fuel saving per vessel per year = Fuel for ~210 cars for a year (8 vessels)</td>
<td>133 Failure Avoidance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>68 Downtime Avoidance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significant Value or projected savings</td>
</tr>
</tbody>
</table>

Maya HTT | CSL | AVEVA
The AVEVA™ PI System at CSL

PI Vision

DMZ

Pi Data Archive Pi SQL db for AF Server Pi AF Server Pi Analytics and Notification Server

01101100 01101111 01110110 01100101

01101100 01101111 01110110 01100101

Maya HTT | CSL
O2 is a data information system. It must translate into human actions at some point to produce benefits. Crew & Office.
O2 Vessel Dashboard

- OWS
- Effluents
- Energy Management
- Pilotage

- Speed Limit
- SUL Safety
- ETA
- Voyage Information

- Bridge Condition
- Fuel Sounding
- Cargo Uplift
- Mini Historian
- Smart Clocks

Operational Tips
Aural Cues

Maya HTT | CSL | AVEVA
## Process digitalization

<table>
<thead>
<tr>
<th>SEASON</th>
<th>PILOTAGE TRIPS</th>
<th>FUEL SOUNDINGS</th>
<th>CARGO UPLIFT</th>
<th>ETAs</th>
<th>NAVIGATIONAL TIPS</th>
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<tr>
<td>2020</td>
<td>12,989</td>
<td>7,834</td>
<td>89</td>
<td>959</td>
<td>3,500</td>
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<tr>
<td>2021</td>
<td>11,407</td>
<td>5,774</td>
<td>512</td>
<td>1,785</td>
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<td>2022</td>
<td>10,942</td>
<td>3,637</td>
<td>500</td>
<td>2,798</td>
<td>5,026</td>
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</table>

Valuable business processes that were manual, tedious, error prone
- Strong adoption by the crew
- Easy, intuitive, saves time
- High level of data quality and consistency
- Single source of truth in O2, real-time access by subscribers

Navigational Tips
- Automatic
- Triggered by geofencing
Office Interfaces using the Power of AVEVA PI Vision
Where the AVEVA™ PI System becomes CSL’s O2

Anomaly Detection & the AVEVA™ PI System

Supervision

Using the PI System for easy bulk deployment at scale
• Countless Attributes
• Close to 6000 PI analysis to make
• 960 Indicators for Asset Performance
• 166 Indicators for Operational Efficiency
• 51 Indicators for Compliance

Combine with expert knowledge
• Monitors all ships across the globe 24/7
  • 40 Main Engines
  • Over 100 Generator
  • Over 30 Steering Gears
  • Over 25 SUL’s
  • ... and a lot more assets

Notification

Using the PI System for Automated PI Notification
Most notifications are filtered by the shore team
False Alarm rate exceptionally good

• Failure avoidance without the SPAM!

Where CSL’s Wisdom, Maya’s Skills & AVEVA’s PI System combines
## Assets, Smart Indicators, Anomaly Detection

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Indicators</td>
<td>998</td>
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<tr>
<td>Anomaly Detection</td>
<td>98</td>
</tr>
<tr>
<td>Repaired</td>
<td>83</td>
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<tr>
<td>Under Investigation</td>
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</tbody>
</table>

### Assets Monitored by O2

<table>
<thead>
<tr>
<th>Asset Types</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>ME</td>
<td>29</td>
</tr>
<tr>
<td>AE</td>
<td>84</td>
</tr>
<tr>
<td>CPP</td>
<td>10</td>
</tr>
<tr>
<td>SUL</td>
<td>22</td>
</tr>
<tr>
<td>Thrusters</td>
<td>23</td>
</tr>
<tr>
<td>Steering Gear</td>
<td>12</td>
</tr>
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<tr>
<td>AE</td>
<td>30</td>
</tr>
<tr>
<td>CPP</td>
<td>10</td>
</tr>
<tr>
<td>SUL</td>
<td>9</td>
</tr>
<tr>
<td>Thrusters</td>
<td>14</td>
</tr>
<tr>
<td>Steering Gear</td>
<td>10</td>
</tr>
</tbody>
</table>
Anomaly Detection – AVEVA™ PI Vision KPI Dashboard
Anomaly Detection – Shaft Earthing Device
Anomaly Detection – Shaft Earthing Device

Good day,

O2 detected a below abnormal trend relating to ME shaft earthing device. Please confirm the receipt of this notification and revert with the actual findings. If you have any questions, please feel free to contact 3SC.

**Anomaly Detection Details**

The ME shaft earthing device’s mV trend has gradually increased and exceeded 100 mV for the last few days. (Normal range: Within +/- 80 mV)

**Possible Root Causes**

- Poor contact or spring tension between the silver band and carbon brushes
- Dirty silver band and carbon brushes
- Poor cable connections
- Rust builds up behind the silver band

**Attachment**

- Shaft earthing device trends (last 8 days)
- Shaft earthing device trends (Last 2 months)

Thank You!

**Standards, Systems, and Support Center**

Maya HTT | CSL | AVEVA
Anomaly Detection – Shaft Earthing Device: Potential Major Crankshaft Damages

Good day,

Thanks for sharing the inspection results and pics.
As shown in the below, mV trends returned to normal after the repair. We will close this notification case.

Attachment
- Shaft earthing device trends (Last 7 days)
Anomaly Detection – ME Exhaust Turbo High Temperature

Good day,

O2 detected a below abnormal trend relating to ME Exhaust Turbo inlet temperature on May 29th. Temperature keeps increasing at steady load. Please confirm the receipt of this notification and revert with the actual findings.

If you have any questions, please feel free to contact [SIC].

**Anomaly Detection Details**

ME Exhaust Turbo inlet temperature has gradually increased and shown abnormal trends.

**Possible Root Causes**

- Fuel type / quality
- Scavenge air too hot
- Faulty fuel injector(s)
- Fuel injection pump(s) malfunction (internal leakage, fuel rack position error)
- Exhaust valve(s) leakage
- Faulty sensor

**Attachment**

- Last 7 days trend

Thank You!

**Standards, Systems, and Support Center**

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[Company Logos]
Sheila Ann - Before

Kg/hr – About 15% delta

Sheila Ann - After

Kg/hr – No delta

Propeller Power vs SFOC

Anomaly Detection – ME Exhaust Turbo High Temperature – 1,000 MT of CO₂ Saved

1,000 MT of CO₂ Saved
**Compliance**

**Effluents Management**
Using the power of geofencing and business logic, the complex environmental rules were coded in O2, making it easy and reliable for the crew and office.

**Reporting**
O2 data, stamped with time and geolocations, automates reports with high quality information.

**Speed Limits**
A simple problem, yet complex to solve. O2 displays actual speed limits, even the dynamic ones that vary with water levels and marine protected areas.
Compliance – Template for Auto-Generated E-Mail with PI Notification

Dear Officers,

OWS discharge allowance is **not permitted** based on Regulatory or mandatory Company Best Practices.

The OWS System is **currently discharging overboard**.

Kindly take action as per the SMS procedures.

Vessel information:
- Current Regulatory Area: Vessel Outside Prohibited Area
- Country - State: Canada - Ontario
- Vessel Distance to shore: 18.63 nm
- Vessel Speed: 5.9 knot

Do not hesitate to contact your O2 Fleet Support Center if you need assistance.
SUL Safety Alarms Feature

➢ O2 SUL Safety alarms feature aims to assist the crew in automatically recording each time a safety switch, emergency stop or shutdown is activated.

➢ O2 displays the latest activation date and consequently the appropriate color with the longest standing alarm activation by default on the main dashboard.

➢ The color of an indicator displays the elapsed period since its activation:
  • **Green** < 60 days
  • **Yellow** > 60 days
  • **Red** > 90 days
  • **Gray** – Unavailable or ignored

![SUL Safety Table](image-url)
SUL SAFETY

Sept 2022

- **260 Safeties - 4 Trillium SUL**
  - Sep 2022: 119 red
  - Nov 2022: 0 red (waiting parts, RA in place)
  - 4 Forebodies ECD April 2023

- **788 Safeties - 9 vessels**
  - Commissioning in progress, ECD April 2023
  - Metis ECD June 2023

- **291 Safeties - Adelie, Elanora, Reliance, Donnacona**
  - Commissioning in progress, ECD April 2023
  - Cement ships safeties – not many - lower priority

Nov 2022

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### Vessel Operations Dashboard

<table>
<thead>
<tr>
<th>Vessel</th>
<th>Since</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baie Comeau</td>
<td>10/9/2023 11:00:00 AM</td>
<td>Green</td>
</tr>
<tr>
<td>Baie St. Paul</td>
<td>9/27/2023 4:30:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>Thunder Bay</td>
<td>8/25/2023 10:30:00 AM</td>
<td>Green</td>
</tr>
<tr>
<td>Whitefish Bay</td>
<td>10/6/2023 1:30:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Assiniboine</td>
<td>8/28/2023 4:45:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Laurentien</td>
<td>8/23/2023 9:15:00 AM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Niagara</td>
<td>9/15/2023 5:45:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>Hon. Paul Martin</td>
<td>10/16/2023 9:15:00 AM</td>
<td>Green</td>
</tr>
<tr>
<td>Nukumi</td>
<td>9/8/2023 2:01:00 PM</td>
<td>Green</td>
</tr>
</tbody>
</table>

### Vessel Operations Dashboard

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</thead>
<tbody>
<tr>
<td>Rt Hon Paul E Martin</td>
<td>10/16/2023 12:45:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Tacoma</td>
<td>10/16/2023 9:00:00 AM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Tarantau</td>
<td>10/15/2023 2:30:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Tecumseh</td>
<td>10/2/2023 2:15:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>Sheila Ann</td>
<td>10/15/2023 4:15:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Spirit</td>
<td>10/12/2023 6:45:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Kajika</td>
<td>10/11/2023 3:00:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Koasek</td>
<td>10/14/2023 6:00:00 PM</td>
<td>Green</td>
</tr>
<tr>
<td>CSL Frontier</td>
<td>10/10/2023 2:00:00 PM</td>
<td>Green</td>
</tr>
</tbody>
</table>
In 2022, 8 Canadian vessels trialed and sailed **219 days** in open water

**299 MT** of fuel was saved, equivalent to **956 MT** of CO₂ reduction

No negative side impact on the business due to fuel savings
Office Interfaces using the Power of AVEVA™ PI Vision

Global Fleet Operations Dashboard
One-stop link page to access all O2 dashboards.

Vessel Operations Dashboard (VOD)
- VOD L1
- VOD L2
- VOD L3

Fleet Overview Dashboards
- Overview
- Fleet Map
- Fuel ROB

Key Initiatives Fleet Dashboards
- Compliance
- Speed Optimization
- Engine SFOC
- Anomaly Detection

IT/OT Dashboards
- Manual Entries
- Custom Message
- HMI Remote Ctrl

Global Fleet Overview & KPI Dashboards
- Engine SFOC
- SUL Safety
- HMI Connectivity
- Opt.Speed Entry
- OT Connectivity
- Flow Meter
Office Interfaces

Global Fleet Operations Dashboard
One-stop link page to access all O2 dashboards.
CSL Reduces fuel consumption by ~3-5% per trial vessel per year & achieves asset failure avoidance goals

Challenge
- Improving operations has always been a Primary Drive of CSL, and remains a Key Business Priority
- Regulations are complex (there are no street signs on waterways)
- Lots of manual entries & paperwork for the crew
- Vessels are operating worldwide

Solution
- Deployed AVEVA™ PI System™ to streamline data collection, access, analysis, and reporting

Results
- Estimated 3-5% fuel saved & 120 MT of CO2 per vessel per year – validated with trial on 8 vessels
- Equipment failure avoidance by applying 133+ preventive corrective actions thus far
- Countless automated reports
Q&A

Speaker Info

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Scan for Access to White Paper Maya HTT
ABOUT AVEVA

AVEVA is a world leader in industrial software, providing engineering and operational solutions across multiple industries, including oil and gas, chemical, pharmaceutical, power and utilities, marine, renewables, and food and beverage. Our agnostic and open architecture helps organizations design, build, operate, maintain and optimize the complete lifecycle of complex industrial assets, from production plants and offshore platforms to manufactured consumer goods.

Over 20,000 enterprises in over 100 countries rely on AVEVA to help them deliver life’s essentials: safe and reliable energy, food, medicines, infrastructure and more. By connecting people with trusted information and AI-enriched insights, AVEVA enables teams to engineer efficiently and optimize operations, driving growth and sustainability.

Named as one of the world’s most innovative companies, AVEVA supports customers with open solutions and the expertise of more than 6,400 employees, 5,000 partners and 5,700 certified developers. The company is headquartered in Cambridge, UK.

Learn more at www.aveva.com