VTT Operation and Maintenance

27/01/2020  VTT – beyond the obvious
VTT is one of the leading research, development and innovation organizations in Europe. We help our customers and society to grow and renew through applied research. The business sector and the entire society get the best benefit from VTT when we solve challenges that require world-class know-how together and translate them into business opportunities.

Our vision
A brighter future is created through science-based innovations.

Our mission
Customers and society grow and renew through applied research.

Strategy
Impact through scientific and technological excellence.

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Established in
1942

Net turnover and other operating income (VTT Group 2018)
268 M€

Total of personnel (VTT Group 31.12.2018)
2,049

Nonprofit
Owned by Ministry of Economic Affairs and Employment

Doctorates and Licentiates (VTT Group 2018)
31%

From the net turnover abroad (VTT Group 2018)
44%
VTT - customized CBM solutions for production assets usage

Measuring (sensors) – Transfer (data) – Store (information) – Analyse (act)

NEED
- Production systems are ever more complex, new methods are necessary for effective operation and maintenance.
- Uninterrupted production.

APPROACH
- Knowledge driven analytics customized to fit specific challenges.

BENEFIT

Economy
- New Business models.
- Remote operation and monitoring of multi site systems.

Optimized
- Operation & Maintenance.

Increased
- Performance
- Availability
- Quality
- Reliability
- Safety
Data Acquisition, Management and Analytics

Data Acquisition

Data Management Solutions

- Critical operations
- Critical processes
- Critical components
- Critical materials

Data Management

Data Management Solutions

- Health Assessment
- Remaining Useful Life
- Advisory Generation

Tailored Condition Monitoring Solutions

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The Goal and Impact for VTT

- Develop **completely automatic condition based system** that increases OEE
- In addition enables **enormous savings in maintenance costs**

**With Using:**
- Low-cost and automatic connecting sensors
- Automatic **self-developed diagnostics and prognostics** based to the ISO-13374-1 and 2
- The **competition is based on** comparison of **OEE**

**Next Steps:**
- Autonomous CBM

Overall Equipment Effectiveness (OEE).
Light Remote Solutions for O&M

The goal is to provide easily exploitable methods and technologies related to operation and maintenance that can be implemented for lightweight and cost-effective solutions for a range of services to implement. For Example:

- Fault and usage history of the equipments
  - Gear and bearing faults and fault history of the components
- Safety tracking
  - Load situation and other wanted alarms concerning safety
Heavy Remote Solutions for CBM

- Global Asset Management (GAM): Highlights
- The selected Internet-of-Things (IoT) platform for GAM platform development
  - Microsoft Azure Intelligent Systems Service
  - IoT framework consisting of MS products & services
- Condition Based Maintenance (CBM) Phase 1, Demo:
  - Example of E-maintenance Network and Modern Integrated Control System in Mobile Machinery
We can bring together a large variety of competences according to the case at hand

- Extreme conditions
- Material performance & mechanical degradation
- Material modelling
- Risk management
- Wear and corrosion respective preventive methods
- Failure mechanisms
- Fuels and burning
- Wide variety of applications
- Process optimization
- Data-analytics
- and many more…
Is your plant lifecycle fully optimised?

Does your current data analytics provide comprehensive support for decision making?

Could you improve productivity through more advanced maintenance practices?
First touch with MIMOSA in 2005

Deploying MIMOSA ever since

DYNAMITE: EU: FP6-2004-IST-NMP-2
MIMOSA OSA-CBM and Raspberry PI3

Mantis: EU: H2020-EU.2.1.1.7. - ECSEL
The overall SERENA system architecture:

EDGE device Raspberry Pi3 with MEMS sensor

SERENA: EU: H2020-FOF-2017
Technical approach

Communication between analytics module and data repositories:

Information from metadata repository (arrow A) consist of e.g.
- Measurement names, explanation information, units
- Analysis configuration data
- Analytics results

Information from measurement data repository (arrow B) consist of e.g.
- Vibration acceleration data
- Acoustic emission data
- Sound measurements

SERENA: EU: H2020-FOF-2017
Serena WP3 – Use Case Automatic Diagnostics

SERENA: EU: H2020-FOF-2017
Serena WP3 – Use Case Automatic Diagnostics

1. Maintenance Engineer
2. Web Client Factory Laptop
3. Microsoft Azure Cloud
4. EDGE/Gateway Rasberry Preprocessing

- **Start Decision Support**
  - Activate Decision Support
  - Request Prognostics
  - Remaining Useful Life
    - Request Advice
    - O&M Advisories
  - Advisory Generation
    - Selected actions
    - Generate work order
    - Work order

- **Recommendation of actions**
  - Selection of actions

SERENA: EU: H2020-FOF-2017
VTT Python O&M Analytics toolbox: Continuous improvement

Data from the whole fleet

Feature extraction
State identification
Prognostics

Continuous refining of computational models

Maintenance plan optimization

Exploratory data analysis to gain new insight

Service data
Decades of background and knowledge from VTT O&M Analytics

Measurement methods
- Data acquisition and transmission
- Signal processing
- Diagnostics methods
- Prognostics

Increased efficiency

- Interaction of components
- Data acquisition and transmission
- Measurement methods
- Use and load profiles

Data import
- Data preparation
- Feature extraction
- State recognition
- Load profiles
- Anomaly detection
- Analysis of causality
- Time-frequency analysis
- Analysis of bearings and gearboxes
- Decision support

Temperature
- Vibrations (0 - 10 kHz)
- Acoustic emission (80 - 120 kHz)
- Spectrometry (SOAP)
- Wear particles, etc

Use and load profiles
- Cutting
- Lifting
- Moving
- Pothole
- Time

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Arrowhead Framework and MIMOSA OSA-EAI

Production sites

Local Cloud

Cloud

Edge e.g. WRM 24/7
- local processing
- light analytics

C

Edge e.g. Arduino
- local processing
- light analytics

C

Edge e.g. Raspberry Pi
- local processing
- light analytics

C

Gateway e.g. PC / Raspberry Pi

Arrowhead Framework
- Analytics services:

P

MIMOSA MariaDB

C

P is Arrowhead service provider
C is Arrowhead service consumer

Advanced Services

MIMOSA MariaDB

Productive4.0
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