Integrated Operations - Parallels between Oil & Gas and Shipping

Recent developments in Oil & Gas industry collaborative decision making in Operation and Maintenance

Predicting the way forward in Ship Operation and Maintenance

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Outline

- Condition-based maintenance – why?

- Oil & Gas industry challenges and constraints
  - Integrated Operations / E-Field / Smart-Field
  - a convenient, high-profile enabler for improved maintenance
  - Center for Integrated Operations in the Petroleum Industry
  - a research initiative in Norway (CRI*)
  - Condition monitoring on static equipment
    - Separators, Heat exchangers, Safety critical valves, Chokes
  - Summary; Oil & Gas

- Shipping industry challenges and constraints
  - Shipping; Collaboration & Remote support - TOCC
  - Data communication, Technical Condition Indexing
  - Summary; Shipping

CRI – Centre for Research-based Innovation
Oil & Gas facilities

Challenges & constraints:

• Physical isolation
• Communication
• Weather / seasons
• Reliable condition monitoring data
• Data analysis and trending capability
• Maintenance not optimised
• Optimising production and overall recovery
• Maximising production availability
• Monitoring and KPI’s for continual improvement
• Up-turn in business
• Shortage of experienced competent staff
• Age profile of staff
• HSE
• Corporate image
• Profit
Oil & Gas; Operation & Maintenance

As is (and may become worse)
Maintenance

Too little of the right maintenance

Too much of the right maintenance

Continue with the same amount of the wrong maintenance

→ Maintenance Optimization
→ Critically assess Maintenance
→ Condition based maintenance
Why increase Condition-based Maintenance in oil and gas industry?

- **Unnecessary maintenance** leads to decreased regularity and increased maintenance costs
- **Lack of knowledge about the technical condition** of the components can make the maintenance period longer than planned
- ~50% of **personnel injuries** offshore occur in connection with maintenance (Petroleum Safety Authority Norway)
- To increase the **knowledge about the failure mechanisms** and prediction of remaining lifetime
- **Early Fault Detection** systems are dependent on reliable sensor data from condition monitoring
- Other onshore industries have good experience with condition based maintenance
Integrated Operations / E-field / Smart-field

- a convenient high-profile enabler for improved maintenance

...covers much more than just "operations"

To facilitate:
- communication of information
- between people and organisations (geographically spread)
- shared situational awareness
in order to achieve **better, faster decisions**.

It involves:
Man (People), Technology & Organisation (MTO)

Applicable to:
Oil and Gas, Medicine, Shipping, and much more .......
Centre for Integrated Operations in the Petroleum Industry  www.ntnu.no/iocenter

Conducts research, innovation and education within the IO field, to promote accelerated production, increased oil recovery, reduced operating costs and enhanced safety and environmental standards.

PROGRAM 1
Drilling and well construction

PROGRAM 2:
Reservoir management and production optimization

PROGRAM 3:
Operation and maintenance

PROGRAM 4:
Integration across disciplines

CRI – Centre for Research-based Innovation
RESEARCH CHALLENGES FOR INTEGRATED OPERATIONS

Smarter decisions

Visualization

Data processing

Sensor technology and automation

Geographically dispersed teams

Wearable computing
Condition Monitoring on Static Equipment

The situation today:
- The technical condition of static equipment is not monitored in the same way as for pumps and compressors
- Much information from the monitoring systems is not used
- The reliability of instrumentation & signals is questionable
- Time-based (RBI) insp & maintenance during shutdowns

Equipment types which warrant focus:
- Separators
- Heat exchangers
- Safety critical valves and chokes
Failure detection methods on static “Oil & Gas” equipment offshore

<table>
<thead>
<tr>
<th>Detection Method</th>
<th>% contribution to detection of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casual observation/ unknown</td>
<td>60-65 %</td>
</tr>
<tr>
<td>Periodic preventive maintenance</td>
<td>10-15%</td>
</tr>
<tr>
<td>Continuous condition monitoring</td>
<td>10-15%</td>
</tr>
<tr>
<td>Inspection</td>
<td>5%</td>
</tr>
<tr>
<td>Other (production interference, on demand, functional testing etc.)</td>
<td>5-10%</td>
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</tbody>
</table>
Safety Critical Valves; test rig
Separators; phase I laboratory set-up
Oil & Gas facilities: Operation & Maintenance

Overcoming some challenges & constraints:
• Physical isolation
• Communication
• Weather / seasons
• Reliable condition monitoring data
• Data analysis and trending capability
• Maintenance not optimised
• Optimising production and overall recovery
• Maximising production availability
• Monitoring and KPI’s for continual improvement
• Up-turn in business
• Shortage of experienced competent staff
• Age profile of staff
• HSE
• Corporate image
Summary – Oil & Gas

- Failure detection should be dominated by continuous or periodic condition monitoring, and not casual observations by personnel.

- Required Technology is available (and used on exception basis), but often still not specified in Philosophies / Tenders as required by company.

- Man and Organisation aspects are at least as challenging as Technology.

- Condition-based predictive maintenance must be promoted to decrease the number & frequency of shutdowns and increase the efficiency and lifetime of the equipment.

- Data sharing & remote decision support will lead to:
  - Increased safety & integrity
  - Increased lifetime of the equipment
  - Increased process regularity
  - Decreased maintenance costs

- The costs due to periodic shutdown and/or decreased efficiency should be emphasised and highlighted.
Shipping: Operation & Maintenance

Challenges & constraints:

• Physical isolation
• Communication
• Weather / seasons
• Reliable condition monitoring data
• Data analysis and trending capability
• Maintenance not optimised
• Optimise operational efficiency & fuel
• Maximise time at sea / Minimise off-hire
• Monitoring and KPI’s for continuous improvement
• Fluctuation in business
• Shortage of experienced competent staff
• Age profile of staff
• Health, Safety & Environmental impact
• Corporate image
• Profit
An example of “collaboration” in shipping

Improve competence and tools for utilisation of technical operational data in the maritime industry
Data communication:

- Fibre optic cable? Oil & Gas; real-time data in real time
- Satellite communication? Automatic data transmission as required
- Satellite communication? Periodic e-mail with .xml data files
TOCC project

- SHIP
- Feedback
- Registration
- OFFICE

Main engine performance
Auxiliary engine performance
Hull and propeller performance
Infrastructure
Support
User meetings
Management
Indexing fleet performance

Technical performance

Fleet Mgr.

Superintendent

Ship

Alarm
Alert
OK
TOCC procedure
Implementing Performance Measurement in the organisation

- Develop forms
- Input ship static data
- Send forms to ship

- Install forms
- Input measure data
- Form validate data
- Data sent to TOCC

- Receive xml/email
- Validate data
- Store data
- Analyze data
- Generate report
- Send report to ship
- Send report to office

- Receives report
- Maintenance
Keys to success

- Selection and maintenance of instrumentation
- Procedures for performance measurement
- Quality control of practise versus procedures
- Feedback and corrective actions to users/reporters
- Follow-up of deviations – responsibility and support
TOCC examples

- Improvement at fleet level
- Improvement at detail level where corrective action can be recognised
Fleet with less than 10 vessels
Fleet with approx. 20 vessels
Summary – Shipping

- Many of the Shipping challenges are similar to those in Oil & Gas
- The justification is apparent for a trend towards:
  - Remote monitoring, shared awareness, decision support, KPI’s
  - Shipping is more standardised than offshore, and may benefit more from operations support centre
- Failure detection should be dominated by continuous or periodic condition monitoring, and not casual observations by personnel
- Required Technology is available (and used on exception basis), but often still not specified in Philosophies / Tenders as required by company
- Man and Organisation aspects are at least as challenging as Technology
- Condition-based predictive maintenance must be promoted to decrease the number & frequency of shutdowns and increase the efficiency and lifetime of the equipment
- Data sharing and remote decision support will lead to:
  - Increased safety & integrity
  - Increased life time of the equipment
  - Increased process regularity (Maximise time at sea / Minimise off-hire)
  - decreased maintenance costs
- The costs due to periodic shutdown and/or decreased efficiency should be emphasised and highlighted