Data Management and Digitalisation : Connecting Subsea Assets in the Digital Space

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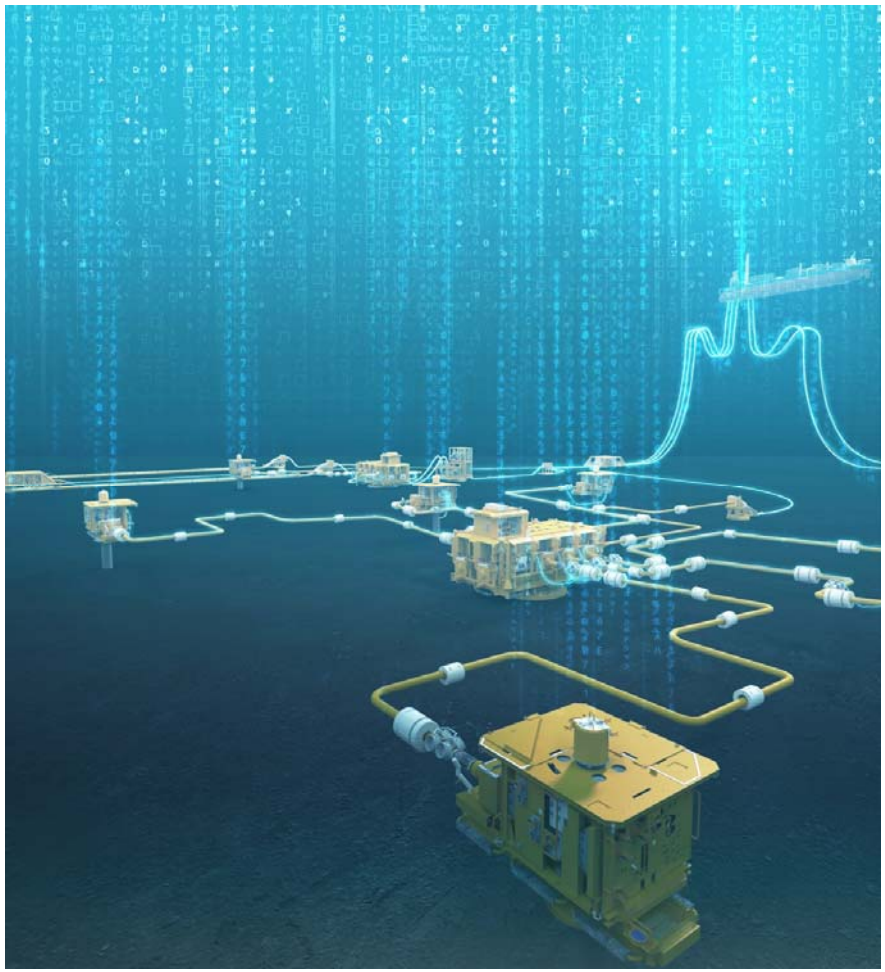
Introduction

- Subsea plants are less digitised than topside in certain domains
- Aerospace and airline industry is well advanced, oil & gas business is lagging behind
- Within oil&gas there are inherent differences between subsea and topside

Digitalisation theory / Big data

- Digitalisation has several definitions
- In this presentation we use the following:
- “Transforming our customer value proposition and internal processes by leveraging data and technology”

- Big Data is also vaguely defined, most commonly as data having
  - “Volume” = Large volumes of data
  - “Variety” = A variety of data sources
  - “Velocity” = Some data arrive at high sampling rate
  - “Veracity” = Quality of data



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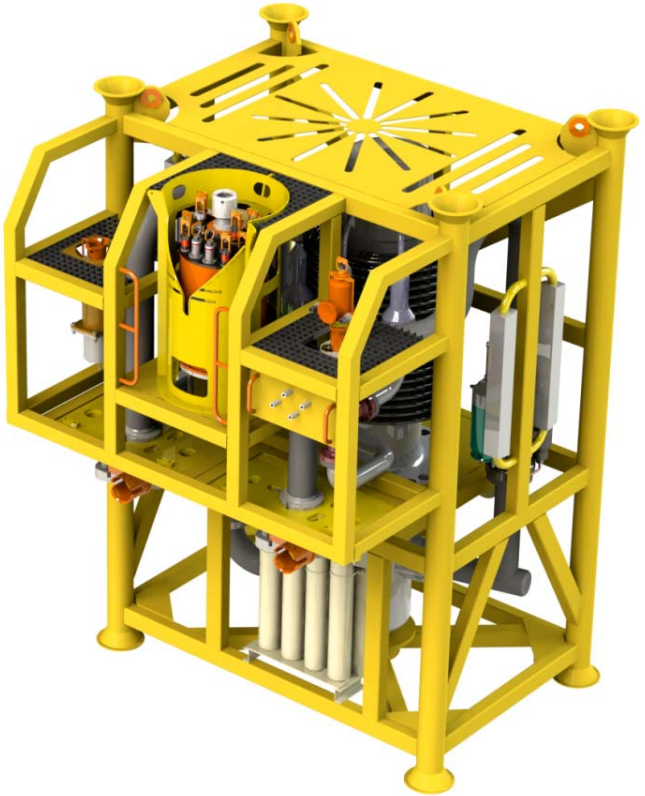
"Internet of things"

- All subsea devices are connected via control data networks to topside control systems
- Further links to the internet are sometimes used, but with severe restrictions (for IT security and other reasons)
- A few subsea devices communicate directly with each other when necessary, else all traffic is routed via topside controllers
- Traffic often allowed only in pre-defined routings
- So the term IOT is applicable to subsea systems only as an isolated island
- IT Security is very important before connecting anything to the Internet
  - Multiple firewalls normally used
  - Connection often only possible from client onshore office

Difference Subsea / Topside plants

- Topside plants are constantly changing
- Subsea plants are preferably untouched for 25 years+
- Subsea Maintenance mainly done by 100 ton module change-out (e.g. 3 MUSD, 1 month)
- Remote monitoring and control
- Intervention often only possible in summer
- 1 fault can thus give a long shutdown and a large production loss



Digitalisation Domains

- Digitalisation is applicable in several domains for a plant, e.g.
  - Design
  - Build
  - Operate
  - Maintain

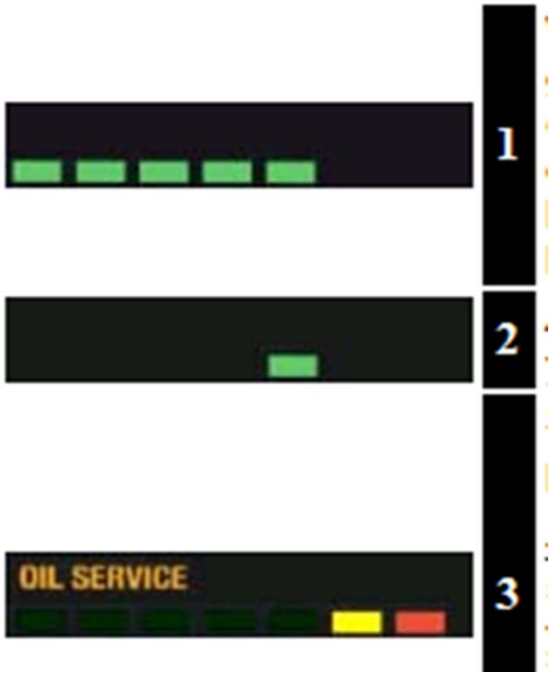
- The first two are similar for topside and subsea plants
- The latter two are discussed in this presentation

Operating Domain

- Tuning the process for max profitability
- Longer term monitoring by onshore personnel
  - Trends showing deterioration
  - Long term optimization (e.g. changing drainage strategy)
- Short term monitoring done in offshore control room
  - Providing alarms to operator to avoid breakdowns
    - e.g. reduce pump speed when vibration increases
- Avoid/postpone shutdowns

Maintenance Domain

- Condition Monitoring
  - Monitor deterioration of equipment
- Condition Based Maintenance
  - Planned maintenance instead of reactive maintenance
- Shown example from car
  - 1 : As new
  - 2 : Not much service time left
  - 3: Yellow light : Schedule maintenance asap
  - Red light : Shutdown imminent
- New tools enable us to do this better



Economic benefit of Condition Based Maintenance (example)

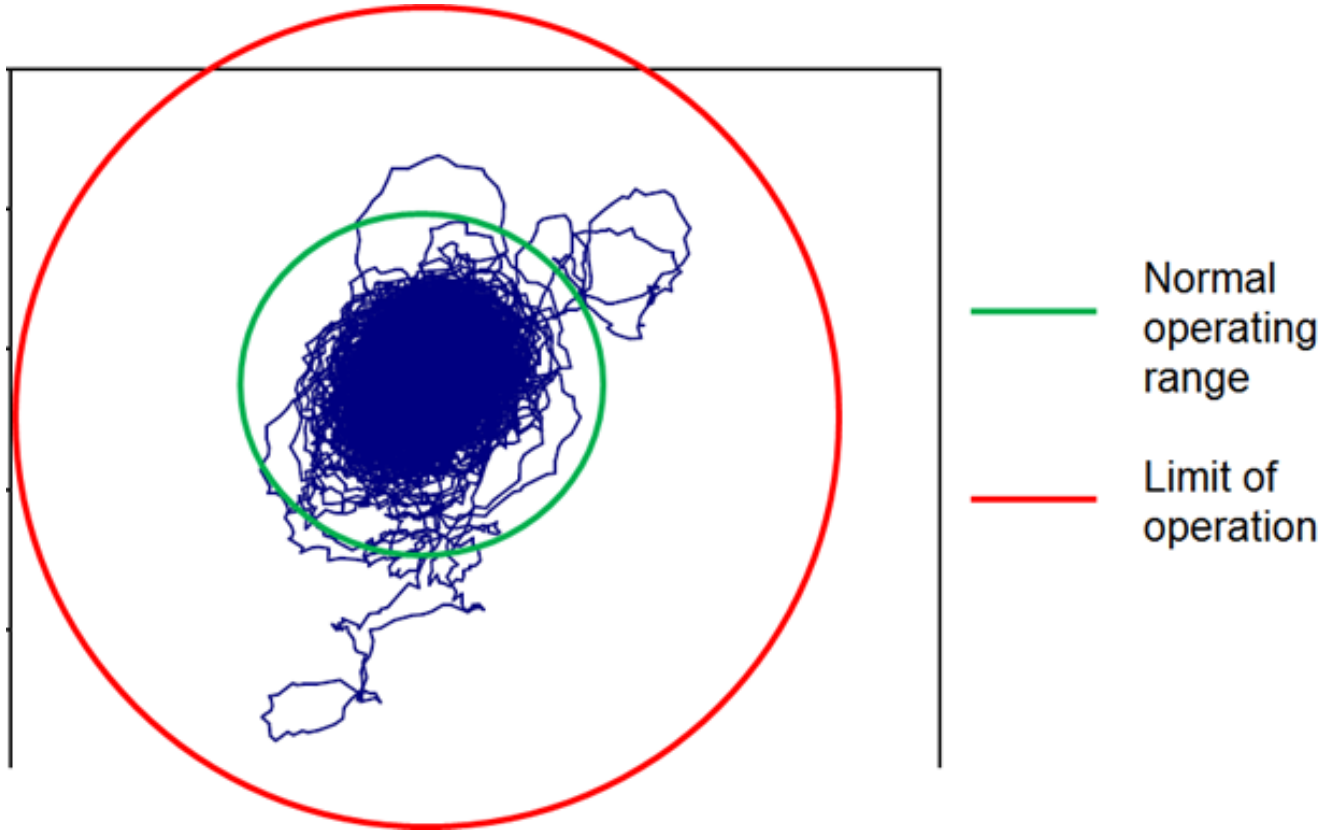
- A module change-out takes 24 hours and costs appr. 3 MUSD
- Preparing for a module change-out takes typ. 30 days
- The value of deferred production if a pump stops is e.g. 0.5 MUSD/day
- “Run until fail” thus costs 30 x 0.5 + 3 = 18 MUSD per fail
- If one can get 30 day advance warning, and do a planned intervention, the cost is 1 x 0.5 + 3 = 3.5 MUSD

- Each time one can detect an upcoming failure in advance, one can thus save 15 MUSD

Practical example 1 : Mag bearing

- A magnetic bearing is sometimes used in subsea compressors for longevity
- The rotating shaft is held in the centre of a 0.5 mm gap using magnetic forces
- If the shaft touches the wall, a backup bearing can hold the shaft for a very limited time (order of 15 s)
- It is thus of interest to determine how many times the shaft “hit the wall” e.g. monthly
- To check this, a huge volume of data needs to be sifted through (1 Tbyte/month)

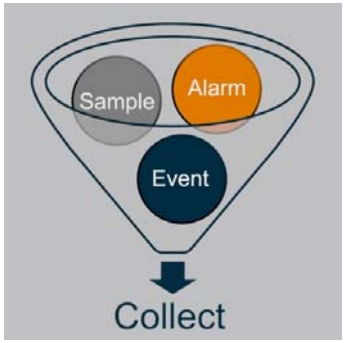
Practical example 1 : Mag bearing



- For each radial bearing, X and Y positions are logged at 14 kHz
- There are 3 radial bearings
- Each data point consists of 4 bytes
- To check if the shaft hit the wall during 1 month, one thus need to sift through
- 3 x 24 x 60 x 60 x 2 x 14 000 x 4 bytes or appr. 1 TByte of data
- So this is big data!

How we approach this

- New sensors provide further information
- More capable computing tools
- More access to operational data
- Improving / Self-Learning algorithms
- Service contracts to clients for
  - Data analysis
  - Aid to maintenance planning and pro-active service
  - Remote diagnostics and root-cause analysis
  - De-bottlenecking
  - Uptime guarantees



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Summary

- Digitalisation is emerging also for subsea plants
- Due to the in-accessibility of a subsea plant, there are differences in operating and maintenance domain
- Digitalisation provides benefits as follows:
- Operating Domain
- Better tuning of the plant
- Fewer unplanned shutdowns
- Maintenance Domain
- Condition Monitoring
- Condition Based Maintenance
- Planned intervention, less deferred production

Thank You ! / Questions

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