# EFFECT OF SUBSEA CONDITION MONITORING ON AVAILABILITY OF SUBSEA EQUIPMENT

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FORSYS SUBSEA

CONCEPT, DELIVERY AND BEYOND

An FMC Technologies and Technip Company

# OUTLINE

- What is Availability?
- Typical Subsea Control System Failure
- Why Do We Need Condition Monitoring? – Theoretical & Field Case Studies
- Subsea Data Processing and Analysis with Condition Monitoring
- Reactive to Proactive Maintenance
- Conclusion



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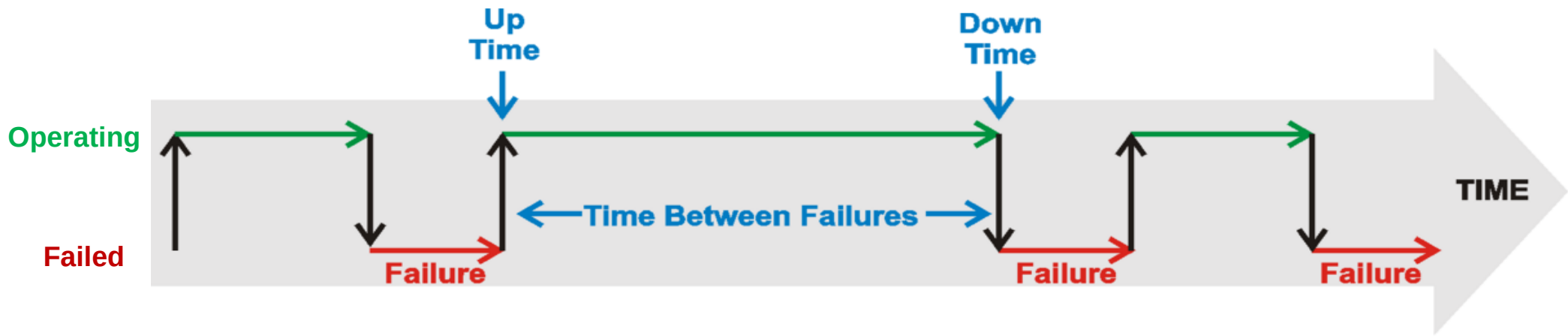
# WHAT IS AVAILABILITY?

- Probability that a product is performing it's intended function over a period of time in a stated operating condition (fraction of uptime over total operation time).

$$AVAILABILITY = \frac{UPTIME}{UPTIME + DOWNTIME}$$



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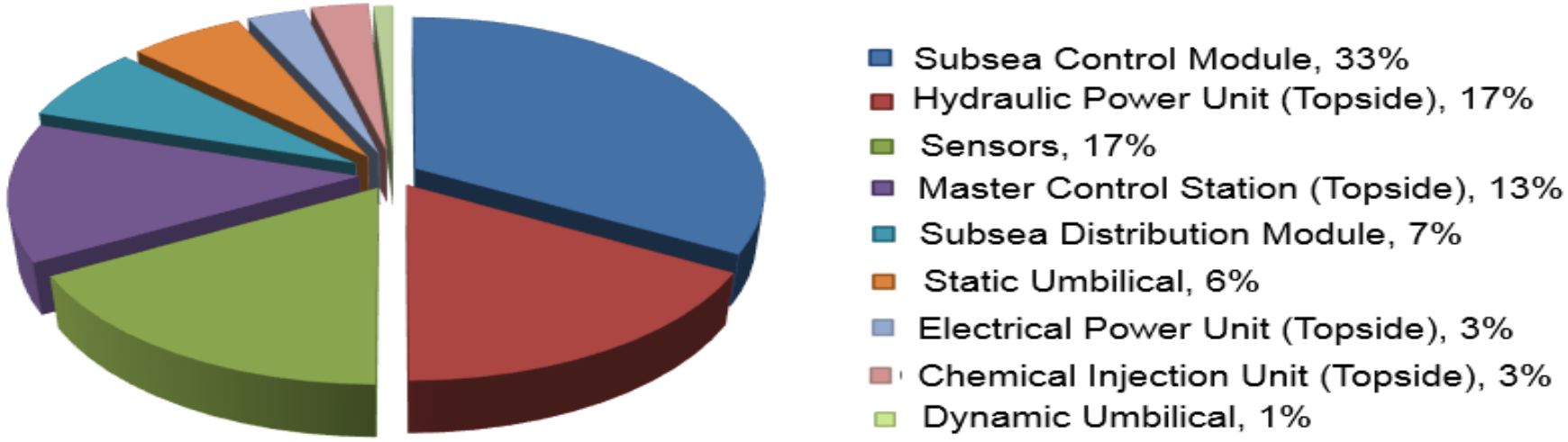
# TYPICAL SUBSEA CONTROL SYSTEM FAILURE

Approximately 70% of the subsea equipment failures are Controls System related failures:




Source: Offshore Reliability Data (OREDA), Version 5000.2.1

Field Recorder – subsea performance data collected to form a reliability database and with analysis by the Condition Monitoring system, converted to useful information that could maximize uptime and efficiency of the system.



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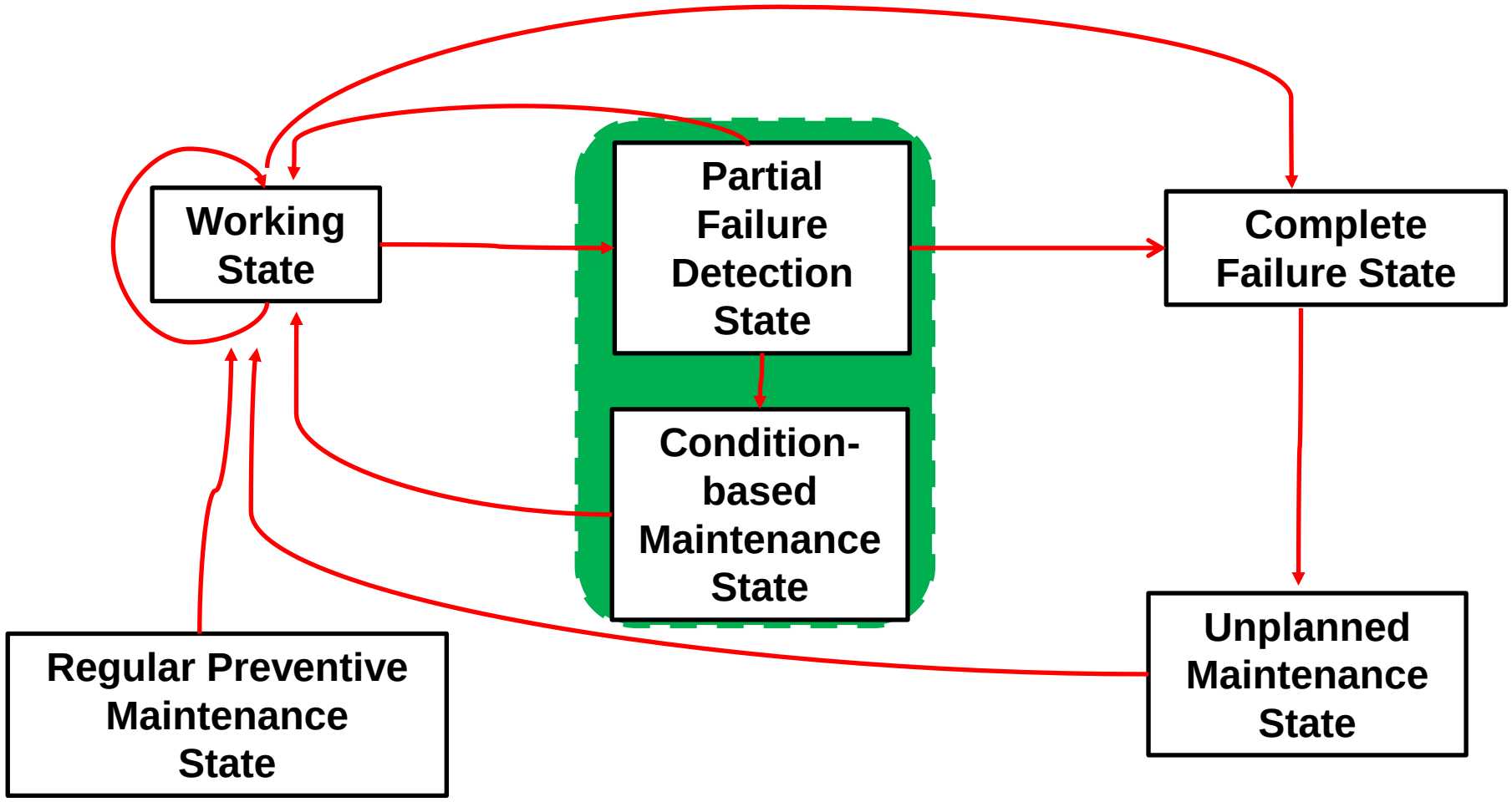
# THEORETICAL BASIS: WHY DO WE NEED CONDITION MONITORING?

Markov Chain Model: Preventive Maintenance + Condition Monitoring



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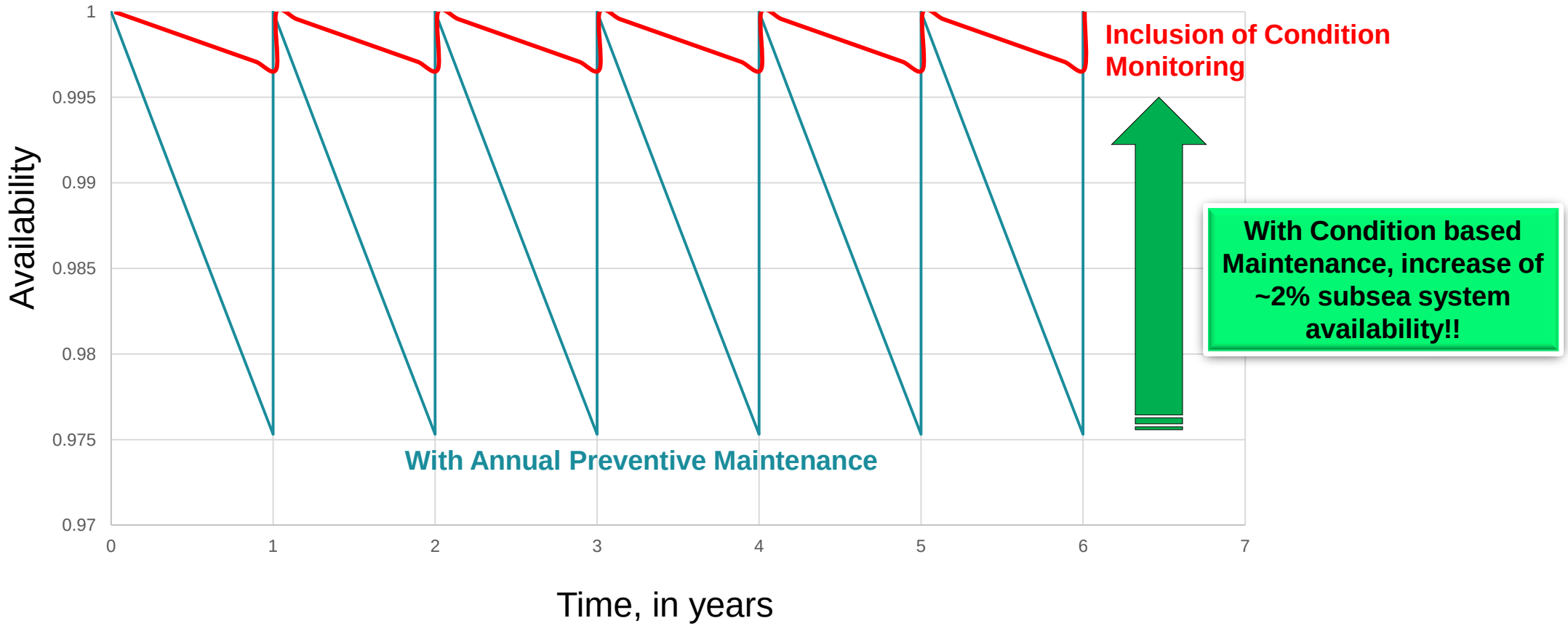
# THEORETICAL BASIS: WHY DO WE NEED CONDITION MONITORING?

Results from Markov Chain Analysis: ~2% Availability Increase!



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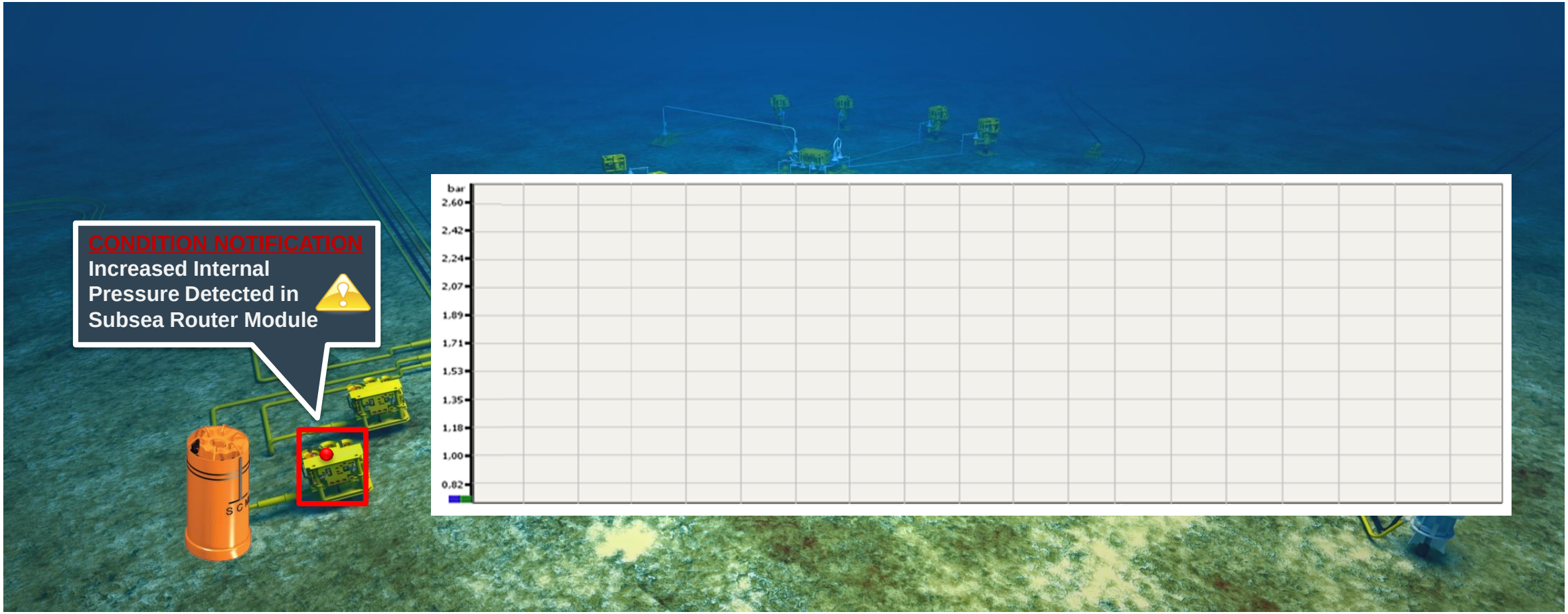
# FIELD CASE STUDY #1: REDUCED DOWNTIME

Subsea Router Module Leakage Detection



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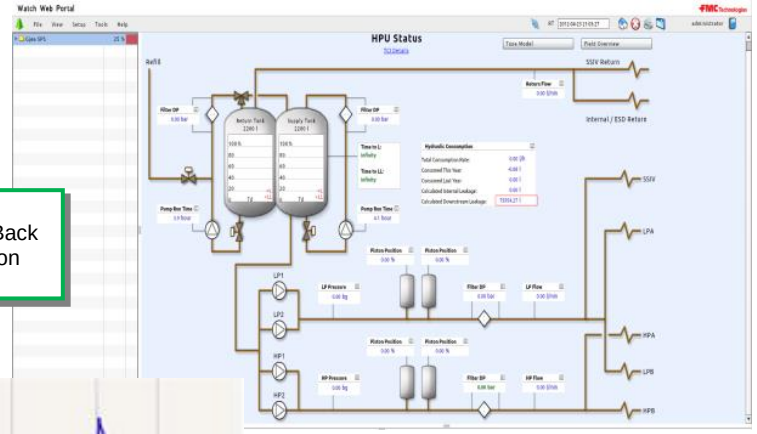
# FIELD CASE STUDY #2: BETTER DECISION

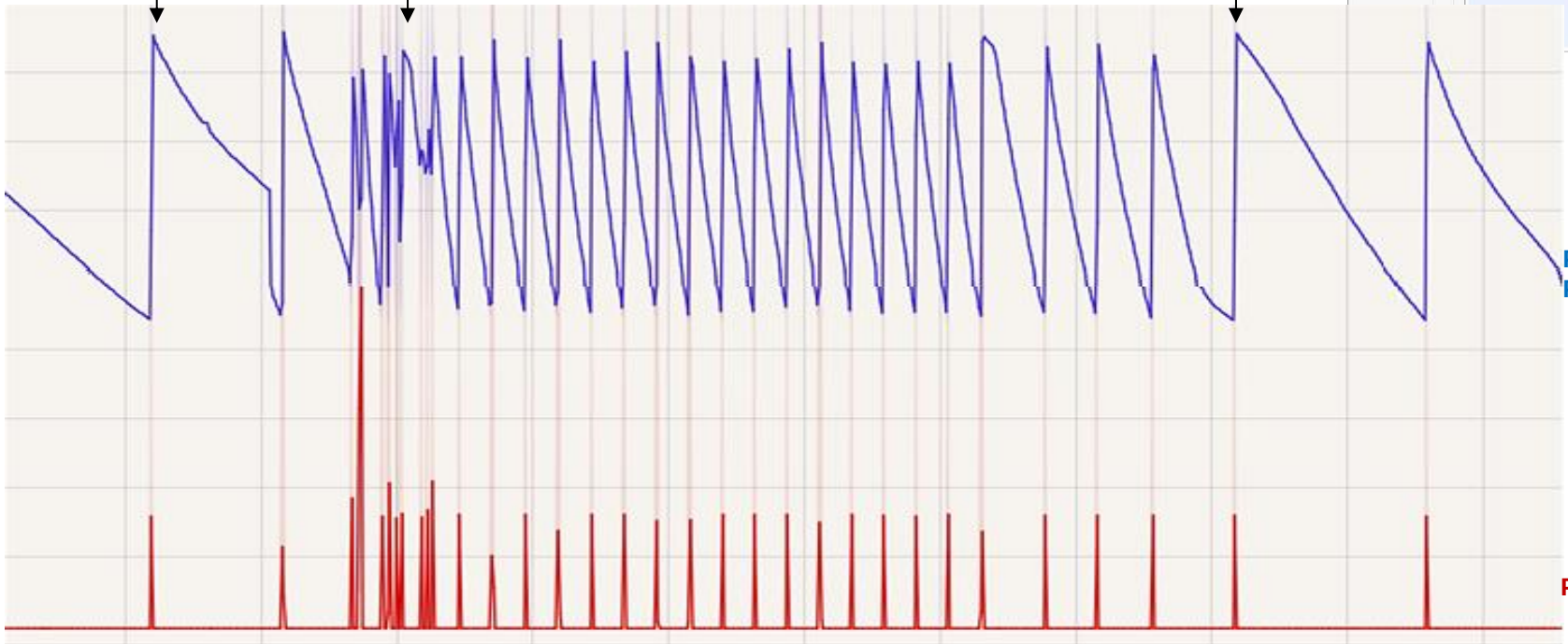
## Hydraulic Fluid Leakage Detection




Normal Pump Operation

Identified Pump Run Abnormalities

Resent valve command - Back to Normal Pump Operation



**Pump Supply Pressure**

**Pump Runtime**



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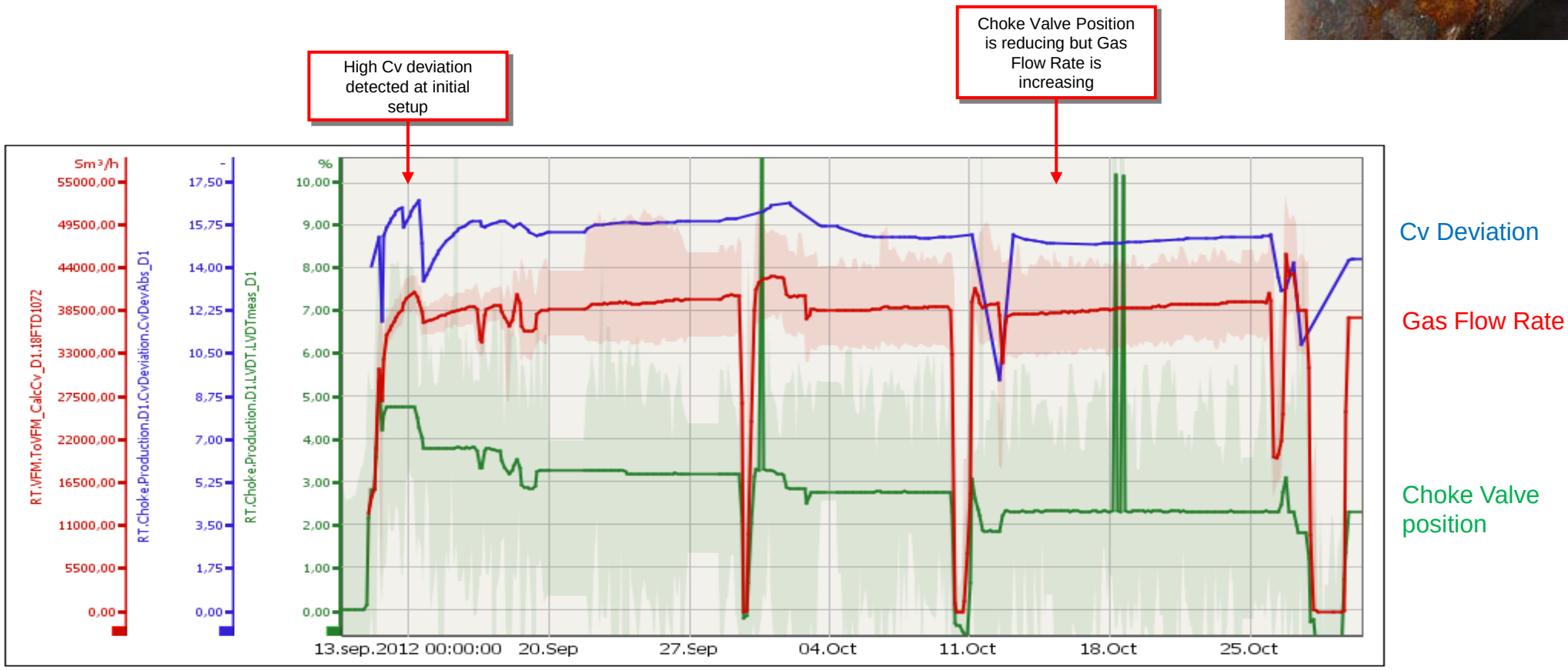
# FIELD CASE STUDY #3: INCREASED UPTIME

Subsea Choke Monitoring



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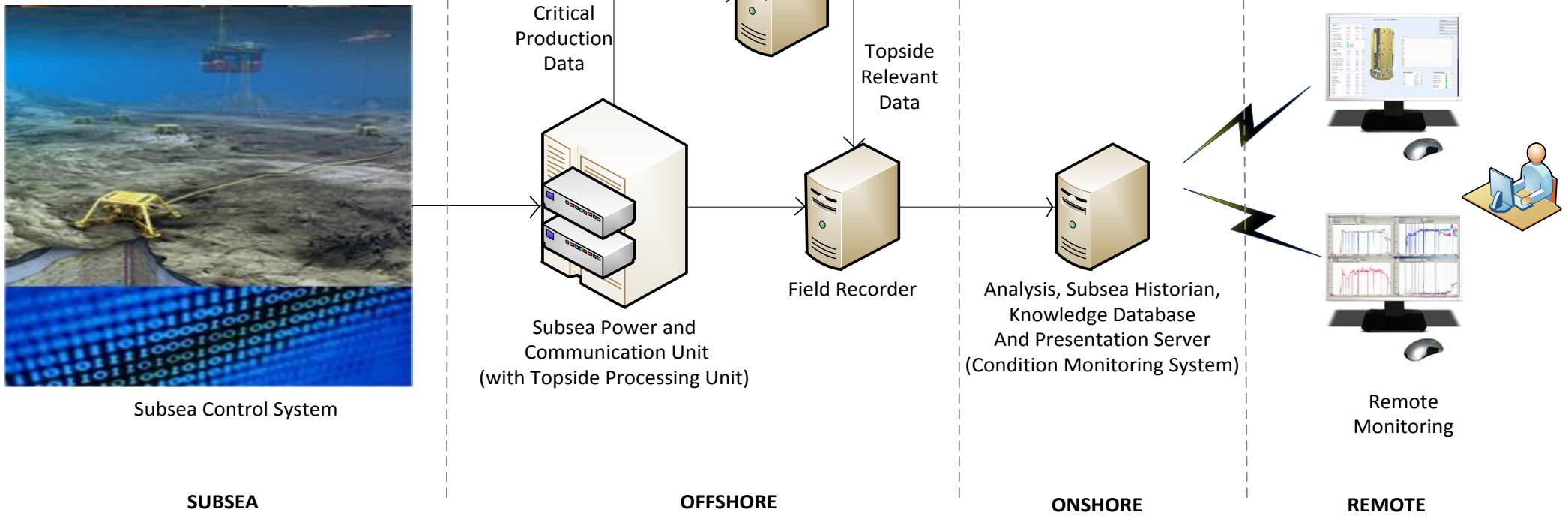
# DATA PROCESSING

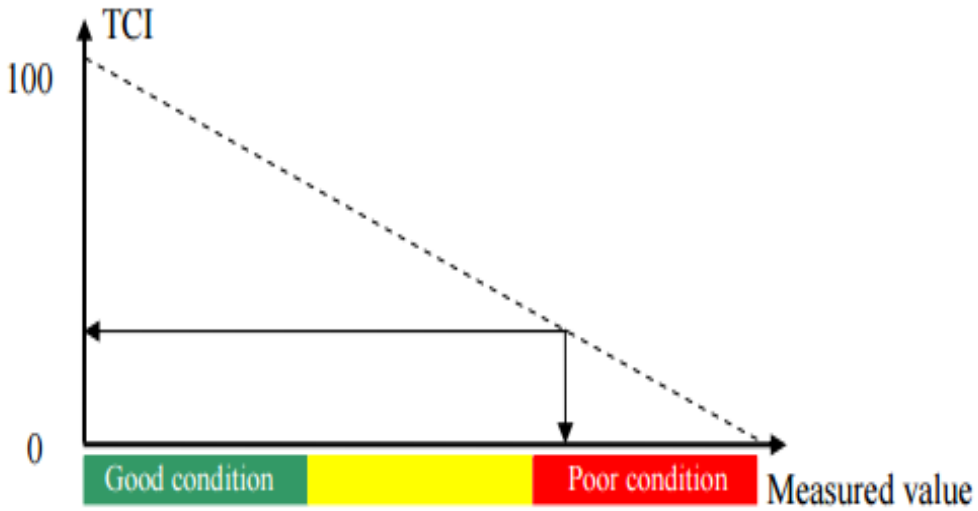
With Condition Monitoring System

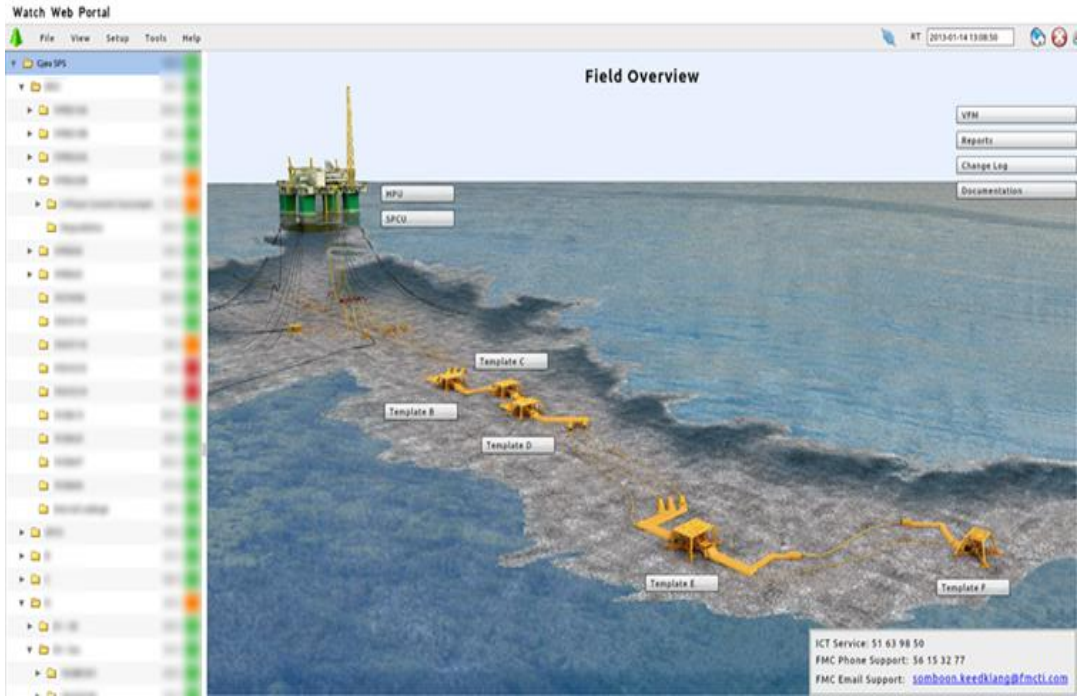


# SUBSEA DATA ANALYSIS WITH CONDITION MONITORING

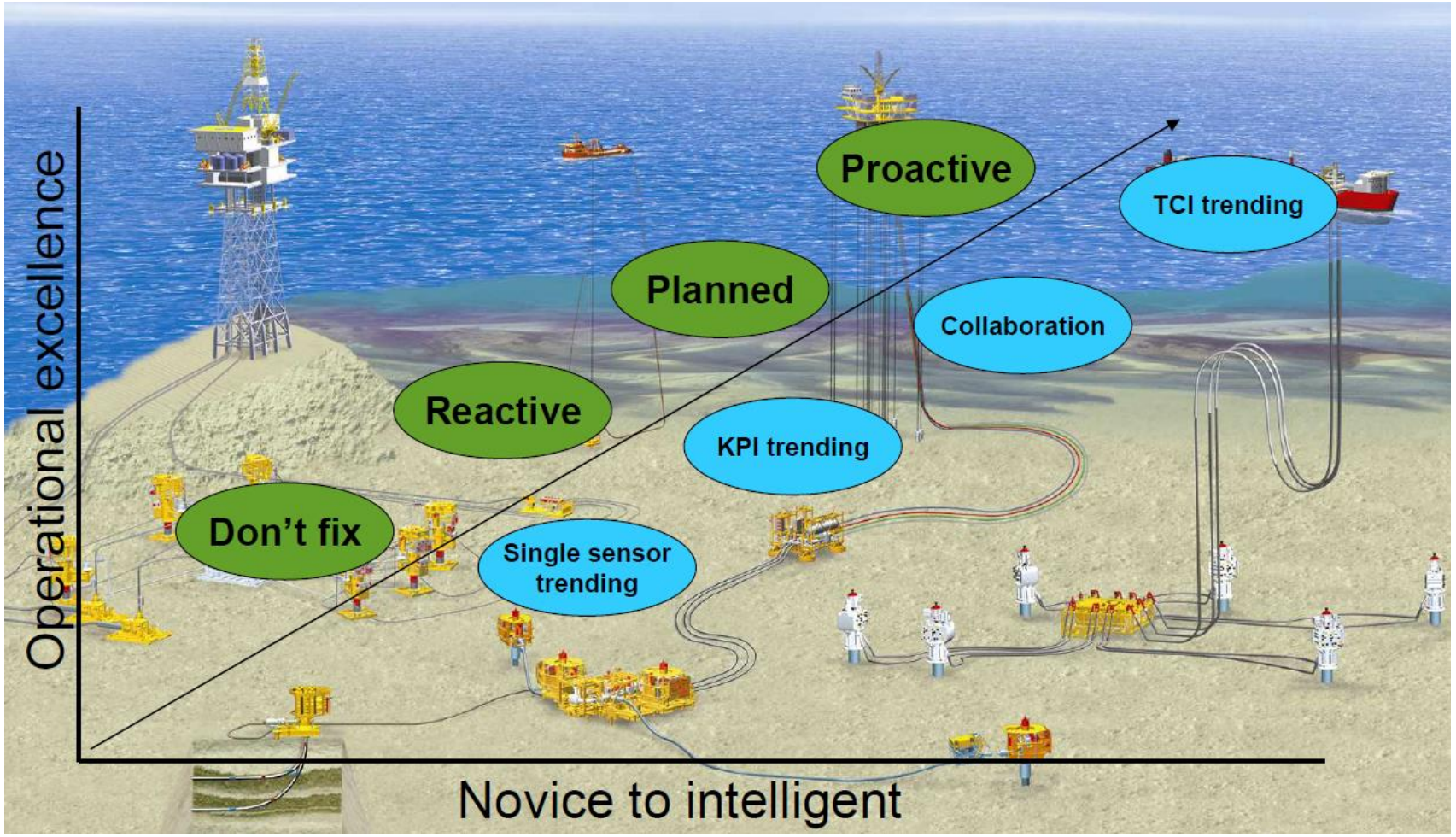
- Converts raw data to measurement of equipment condition, known as Technical Condition Index (TCI) scaled 0-100%

- TCI is calculated for state of an item or the whole assembly, and can be aggregated according to the operating conditions



# REACTIVE TO PROACTIVE MAINTENANCE



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# CONCLUSION

- ✓ Theoretically proven subsea condition monitoring complements preventive maintenance
- ✓ Field case studies shared to demonstrate subsea condition monitoring benefits:
  - Better decisions
  - Increased uptime
  - Reduced downtime
- ✓ Subsea condition monitoring system complements the subsea control system - enables proactive maintenance planning and increasing system availability
- ✓ ↑ Increase system availability by ↓ reducing downtime, ↑ increasing uptime



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# THANK YOU!

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