

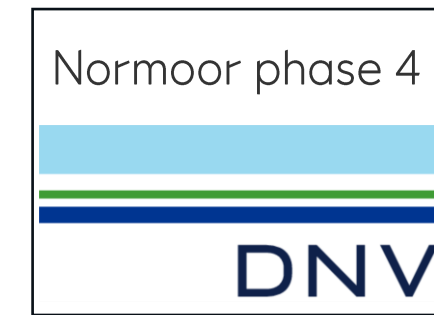


# FER JIP week ObjoCorr JIP - Objective Corrosion Assessment of Mooring Chains

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# Mooring chain fatigue – status so far

- KPN Lifemoor 2018-2022 achievements (++) + Normoor phase 3
  - Fatigue mean load dependency
  - Surface condition effect to fatigue capacity
    - Computer assisted surface corrosion condition assessment
  - 3D scanning requirements
  - Verified subsea 3D scanning
  - Re-assessment methodology
  - Increased fatigue mechanics understanding
  - Confirmed residual stresses
  - +++



Lone 1.1

$$\log N = 12.236 - \overset{\text{Mean load}}{0.0514 \cdot \lambda_m} - \overset{\text{Surface corrosion}}{0.0977 \cdot c} - 3.0 \cdot \log S$$

Limited to  
surface  
condition  
only

# New data – new knowledge – new development needs

- New full scale fatigue test sets with significant corrosion loss
  - Crown diameter reduction
  - Some larger pits
  - Preferential weld-line corrosion



Significant effect to fatigue capacity

- Test data includes:
  - Full test segment 3D scans
  - Breakage location details
  - Fatigue test results



Expand formula to include crown diameter loss

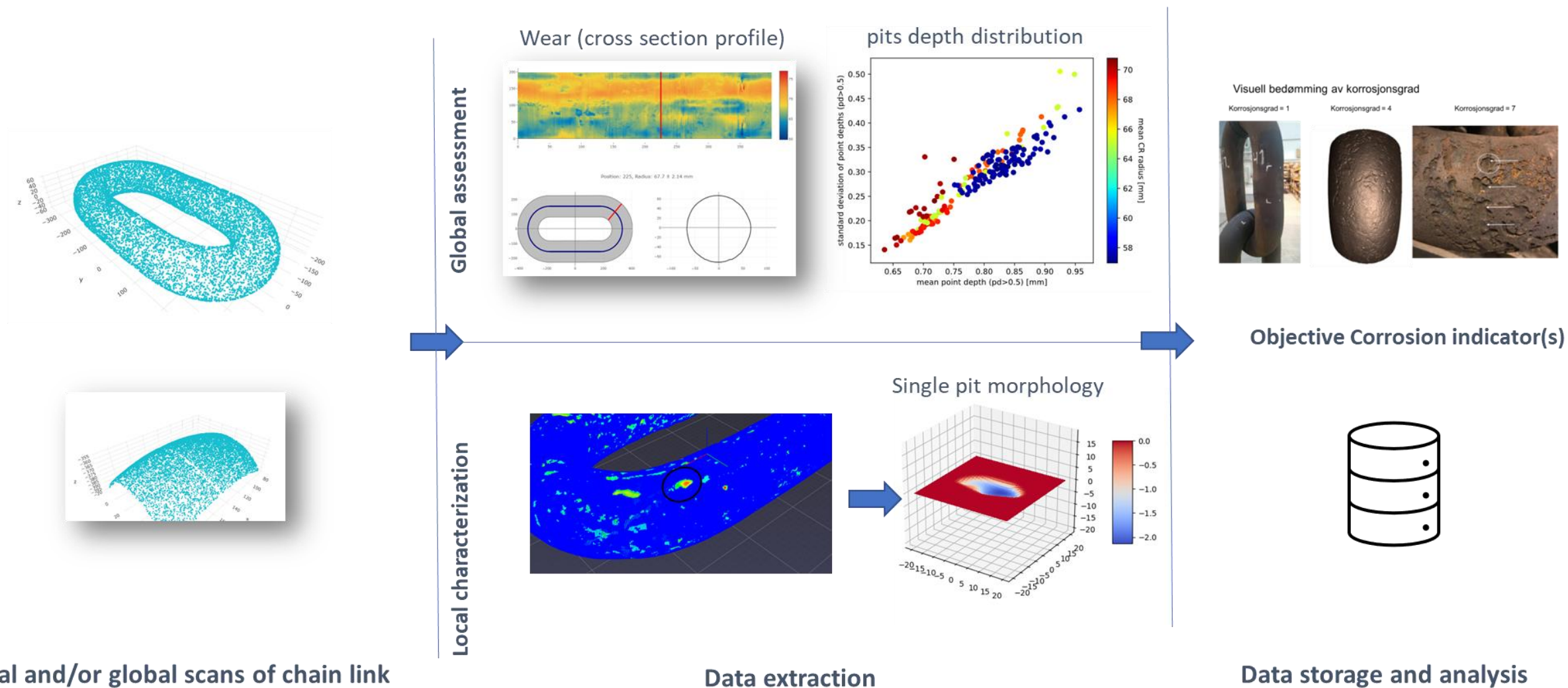
$$\log A(\sigma_m, c) = b_0 + b_1 \cdot g_1(\sigma_m) + b_2 \cdot g_2(c) + c_3 \cdot g_3(d)$$

Constant term  
(as in *time-invariant*)

Mean load effect

Corrosion effect  
(degradation with time)

# Chain condition assessment – post Lifemoor (surface condition/pits)



# ObjoCorr JIP

- Efficient post-processing for improved accuracy of corrosion assessment from high-resolution 3D laser scans.
- Updated SN formulation
- Updated database and web application to store scans and process corrosion grades.

Including diameter reduction

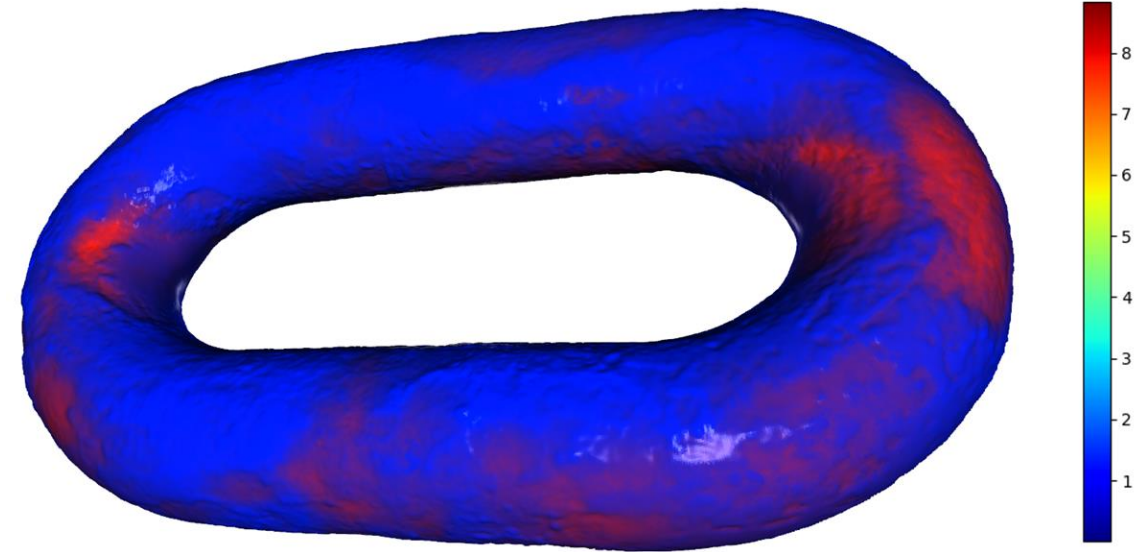
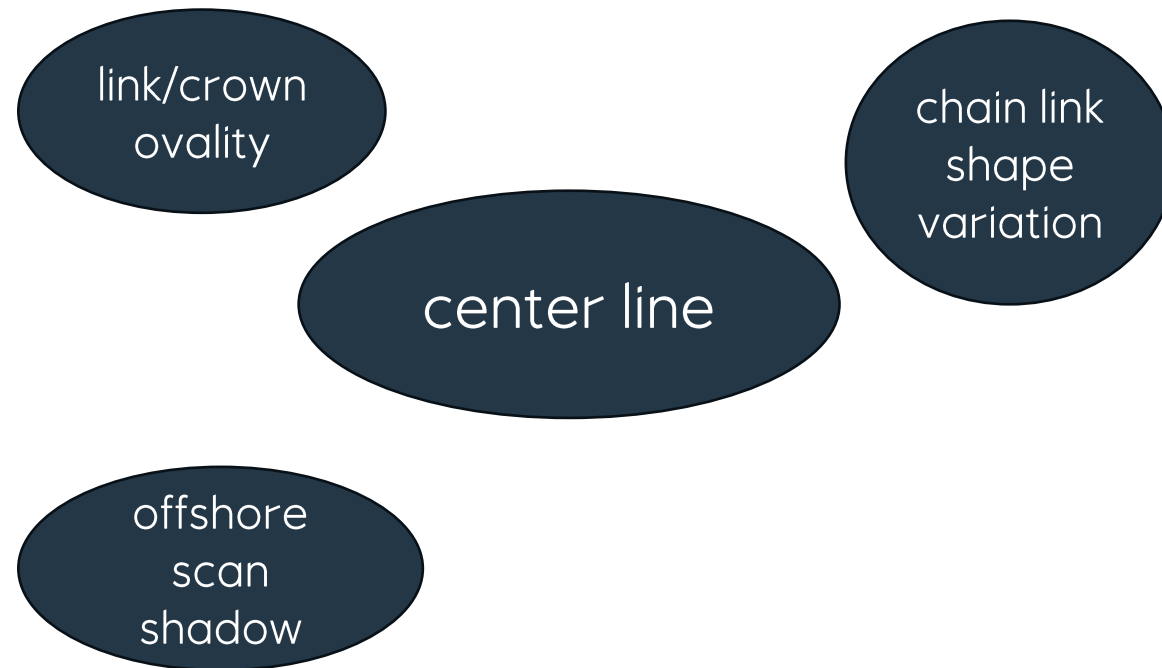
	first year (phase 1)				second year (phase 2)				third year (phase 3)				
Main activities / Quarters	Q1 2023	Q2	Q3	Q4	Q1 2024	Q2	Q3	Q4	Q1 2025	Q2	Q3	Q4	Q1 2026
<b>Inspection in Air conditions</b>													
A0- Corrosion indicators formulation			x	x									
A1- Improved and updated database	x	x	x										
A2- Calculated corrosion grades			x	x	x								
A3- Updated S-N formulation					x								
<b>Under water inspection/assessment</b>													
B0-Under water data acquisition					x	x							
B1-Under water scans data accuracy assessment					x	x	x						
B2-Efficient and representative underwater corrosion indicators					x	x	x	x	x				
<b>In-situ inspection/assessment</b>													
C0-In-situ data acquisition								x	x	x			
C1-In-situ scans data accuracy assessment									x	x			
C2-In-situ corrosion assessment tool									x	x	x	x	
GA- Meetings	x	x	x	x	x	x	x	x	x	x	x	x	x
Reporting					x				x				x

$$\log A(\sigma_m, c) = b_0 + b_1 \cdot g_1(\sigma_m) + b_2 \cdot g_2(c) + c_3 \cdot g_3(d)$$

Constant term  
(as in time-invariant)
Mean load effect
Corrosion effect  
(degradation with time)

# ObjoCorr – ongoing work

- Defining corrosion loss location on used chains
  - Full lab quality 3D scans -> Corrosion effect assessment
  - Offshore partial scans -> On-site criticality assessment
- Database improvement



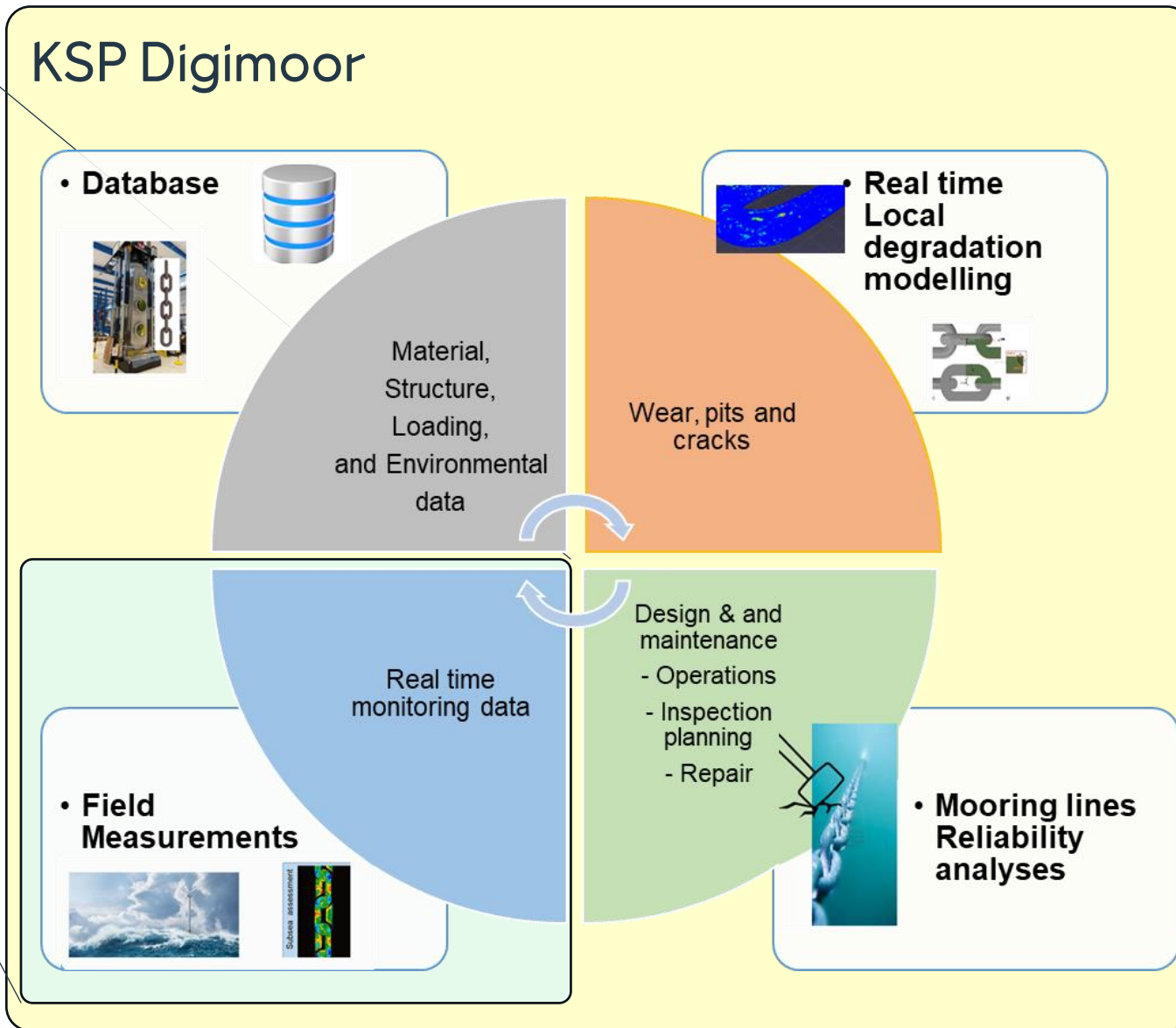
Work is including:

- 3D scans of corroded links
  - including "non-corroded" links from same chains
- 3D scans of new chains
- offshore 3D scans

ObjoCorr JIP

vs

KSP Digimoor



### Main goal:

Develop a digital twin framework for the design and the real time mooring system integrity monitoring accounting for local degradation mechanisms in mooring chains

### Research partners:

SINTEF Ocean  
SINTEF Industri  
NTNU Department of Marine Technology  
NTNU Department of Structural Engineering

### Industry partners:

Value chain industrials: from mooring chain manufacturers, suppliers to end-users e.g. energy companies

### Budget ≈

22 MNOK  
At least 20% funding from industry  
4 years  
2-3 PhDs



To join the ObjCorr JIP (or participate to release funding for Digimoor):

...or to ask questions!



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