## Material Durability for Off-Shore

# **SIM ICON SafeLife** – Lifetime prediction and management of fatigue loaded welded steel structures based on structural health monitoring

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## Fatigue lifetime prediction of complex welded structures **Kris Hectors**

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#### 1. Introduction

Lifetime assessment of dynamically loaded structures is essential towards decision support for quantification of lifetime extension and optimization of predictive maintenance. The core of our current research is the development of numerical tools for structural and fatigue analysis of welded steel structures.



## 3 2. Global structural analysis (FEA)

Shell + beam structure



## 4. Fatigue damage accumulation

A fatigue damage accumulation model is used to estimate the number of loading cycles to failure for multi-axial, variable amplitude loading.

**MaDurOS** 

S-N Curve



## 3. Detailed analysis (FEA)

- Submodel boundary conditions are S, S22 driven by the displacements (Avg: 75%) calculated in the global analysis
- C3D20R elements •
- Accurate stress field in • critical welds for lifetime calculations

Non-linear evolution of damage and block loading interaction effects are taken into account. Load cycle data





## 5. Lifetime assessment framework

90.00 79.17 68.33 57.50 46.67 35.83 25.00

14.17

3.33 -7.50

-18.33 -29.17 -40.00 -46.51









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**Clusters for Growth**