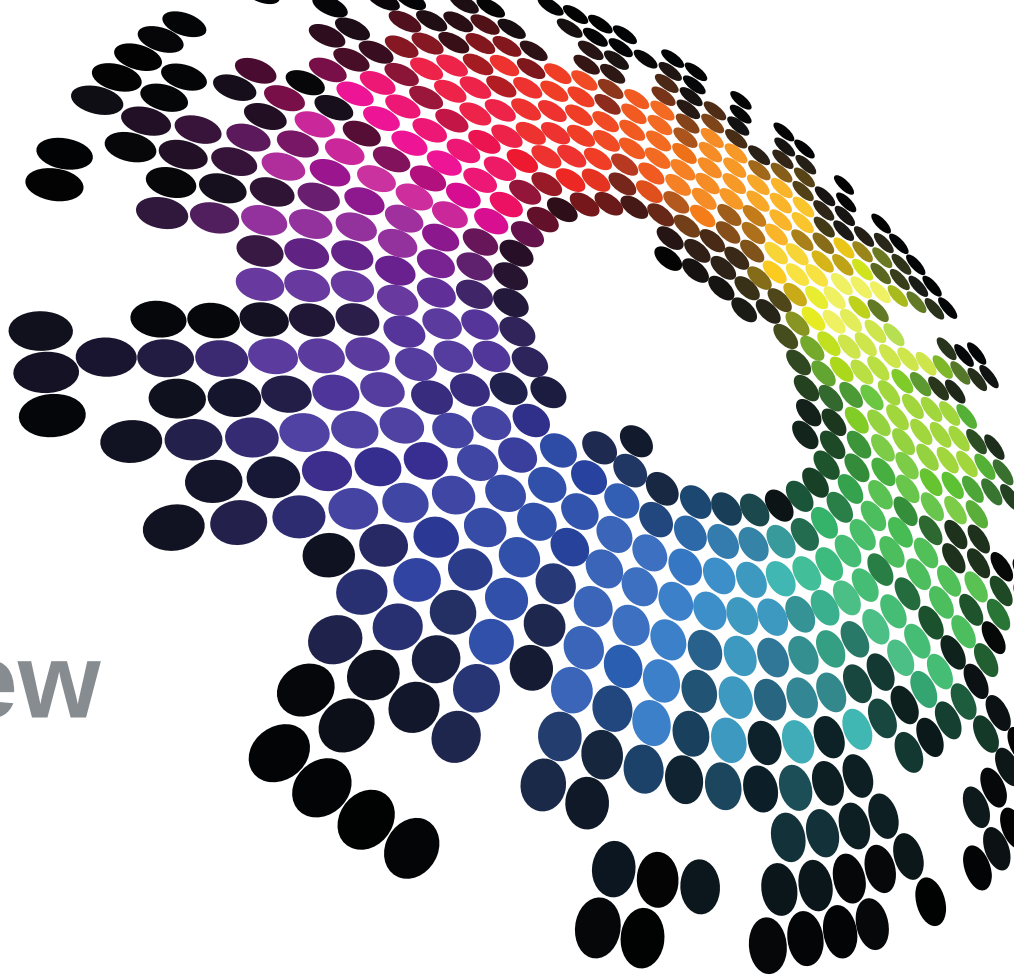


DECOFF overview

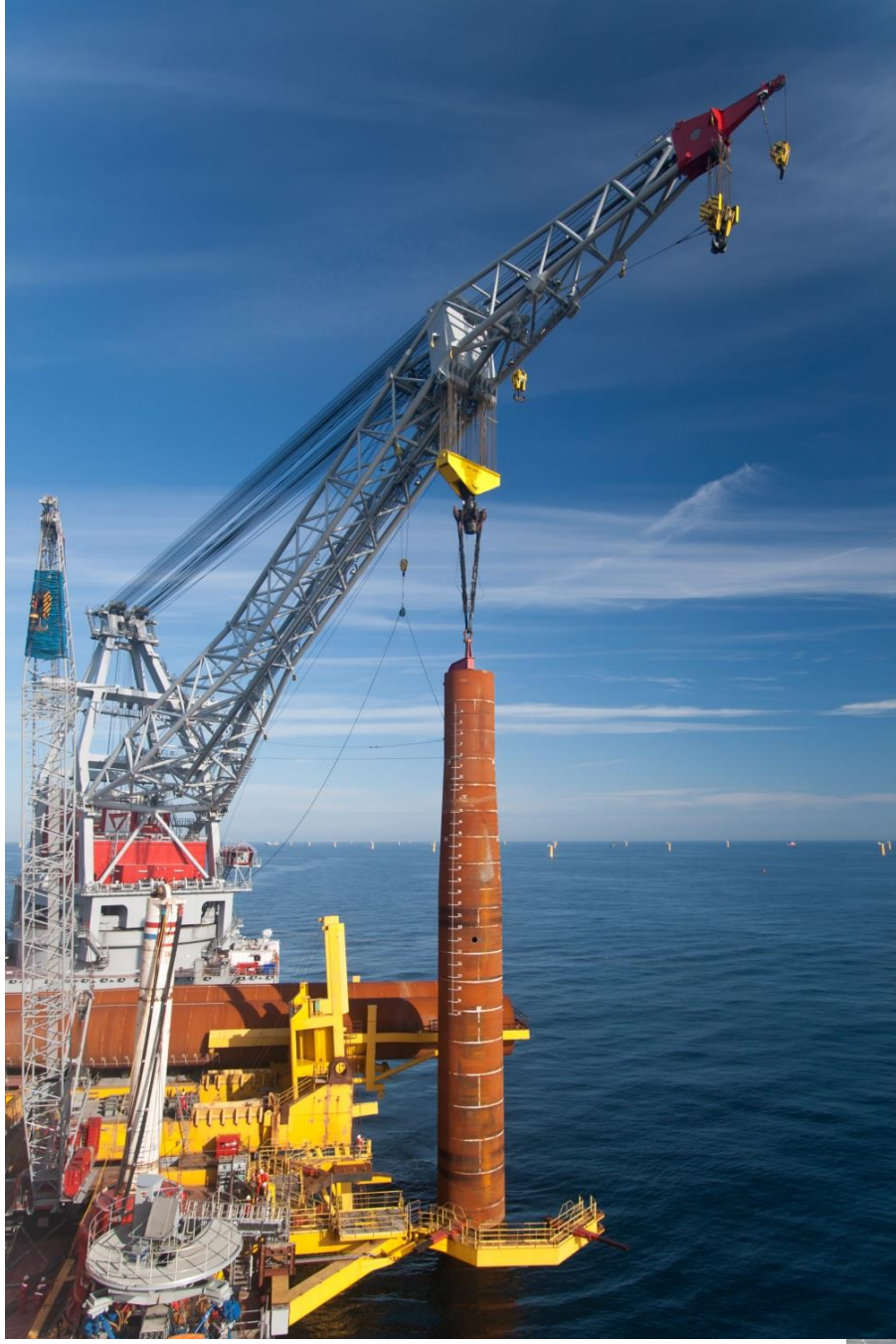
DECOFF workshop, August 2015

Yngve Heggelund

28.08.2015

Motivating problem

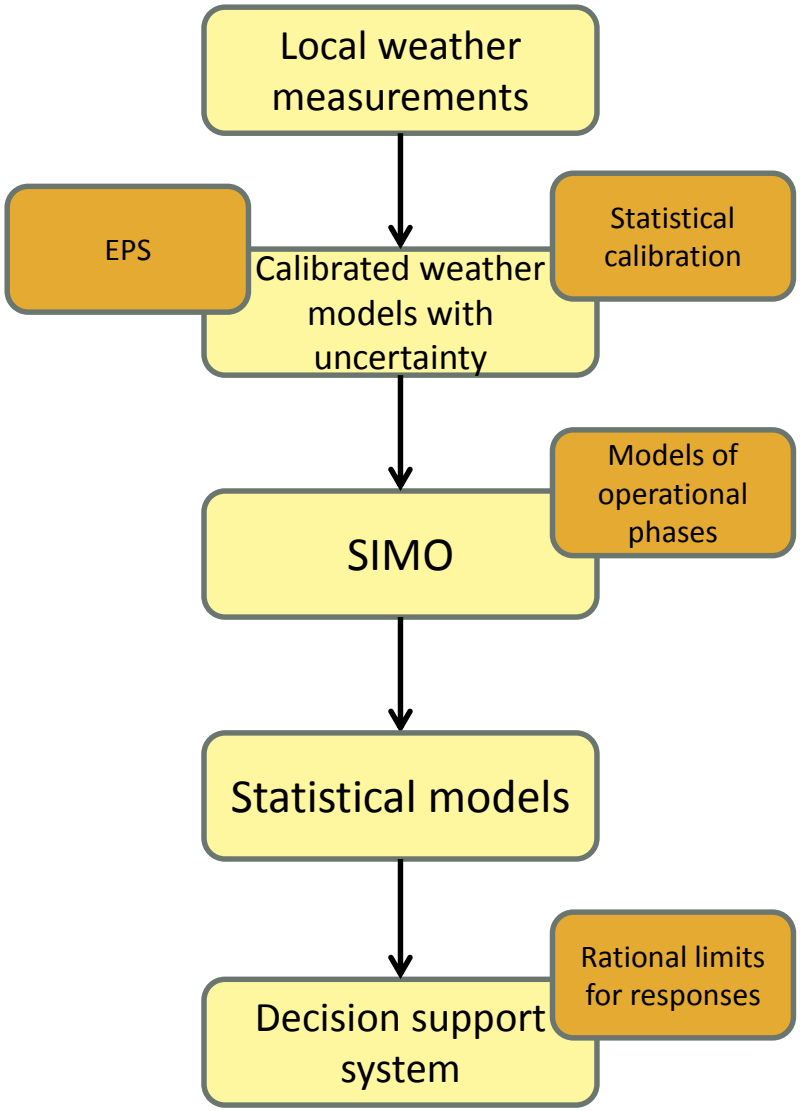
- The cost of installing offshore wind turbines must be distinctly reduced
- Waiting for weather windows is a significant cost contributor
- Criteria to commence installation operations are related to simple parameters
  - Significant wave height
  - Average wind velocity at reference height
- The physical limitation are however related to response parameters
  - Motions
  - Accelerations
  - Forces
- Uncertainties are currently not properly taken into account in the decision making



General project idea

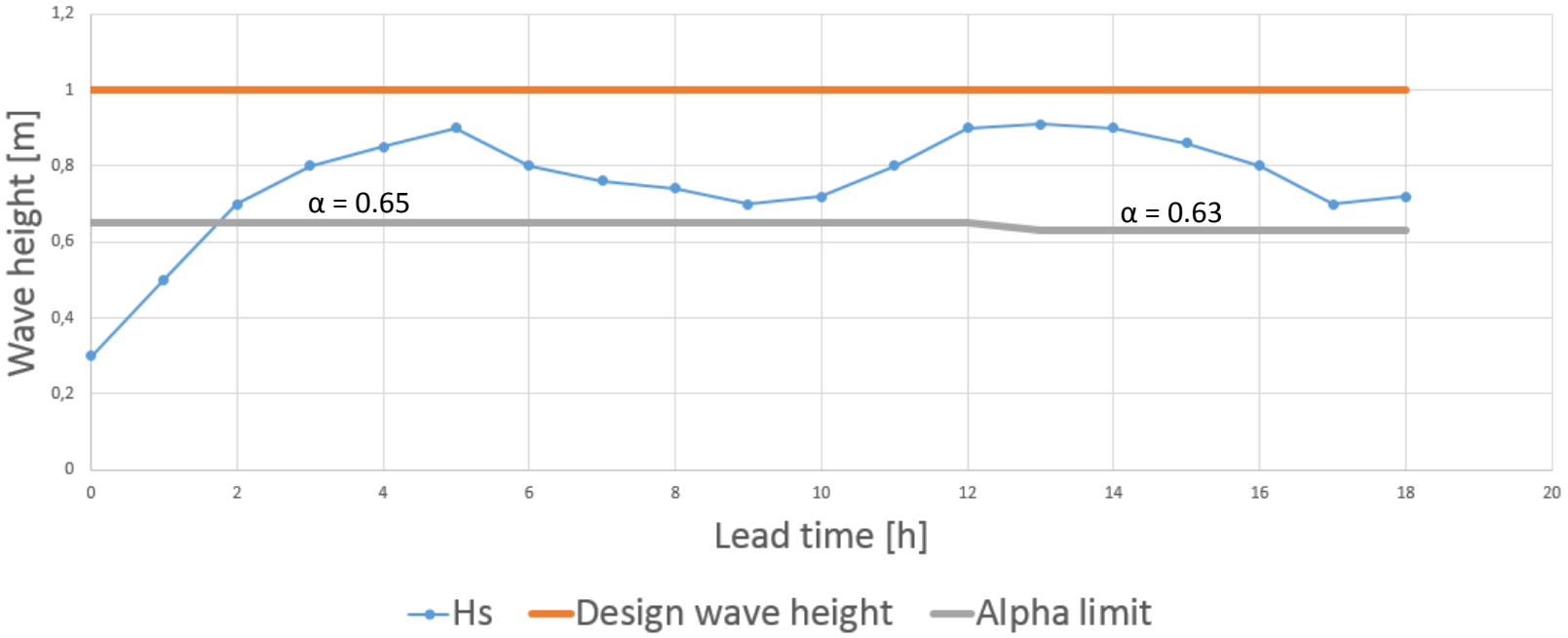
- Couple weather forecast models to an advanced dynamical model (SIMO) to obtain response parameters
- Improve local weather forecasts by utilizing local measurements
- Use statistical models to capture uncertainty of response characteristics
- Integrate the above into an online decision support system

- **Clear and informed view of the risks and potential costs of carrying out an operation in a given timeframe**



The alpha factor method

- Originated from the oil & gas industry
- Currently in use by the offshore wind industry



Project overview

Main tasks in the project

- Weather modelling (met.no, Uni Research, UiB)
  - Access to measurements
  - Downscaling
  - Calibration
- Response modelling in SIMO (MARINTEK)
- Statistical modelling of the probability of exceeding critical responses (AAU)
- Integration into a decision support system (CMR)

Two test cases

1. Installation of wind turbine rotor by floating crane vessel

2. Integrated installation of offshore wind turbines of gravity-base type

Virtual installation case

- We have defined a “virtual installation case” at FINO3
- FINO3 is a German research platform in the North Sea

- The project was given access to measurement data
  - Sept 2009 – Dec 2013
  - 10 min averages of 77 parameters

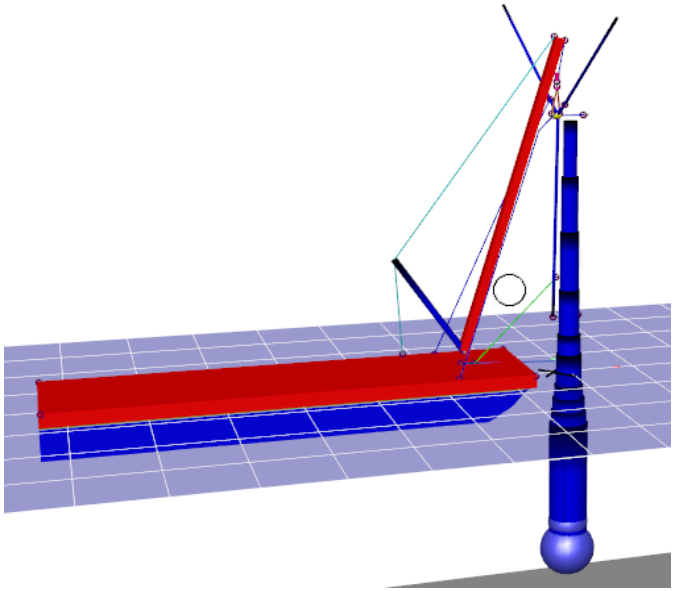
Weather forecasting (met.no, Uni Research, UiB)

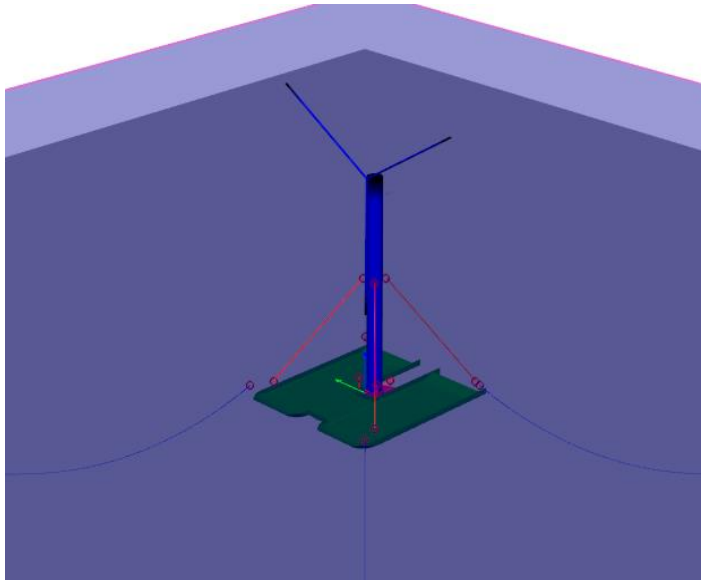
- Collection of measurement data

- Ensemble Prediction System (EPS) forecasts
  - Downscaling
  - Calibration of forecasts

Response modelling in SIMO (Marintek)

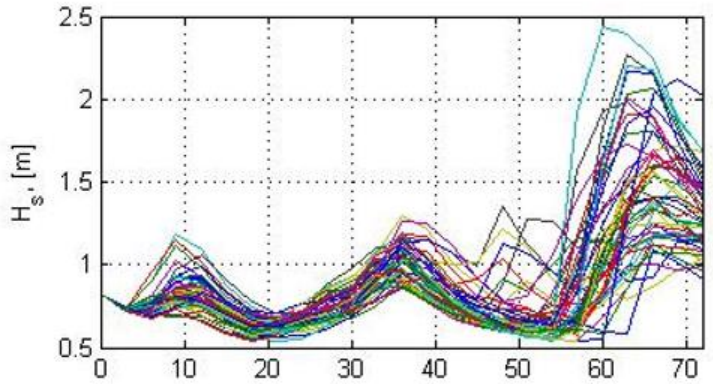
- SIMO: Simulation of Marine Operations
- Computer tool used for analysis of marine operations, made by MARINTEK
- Calculates the forces from the waves, wind and current on the structures and the forces on winches, lines and equipment



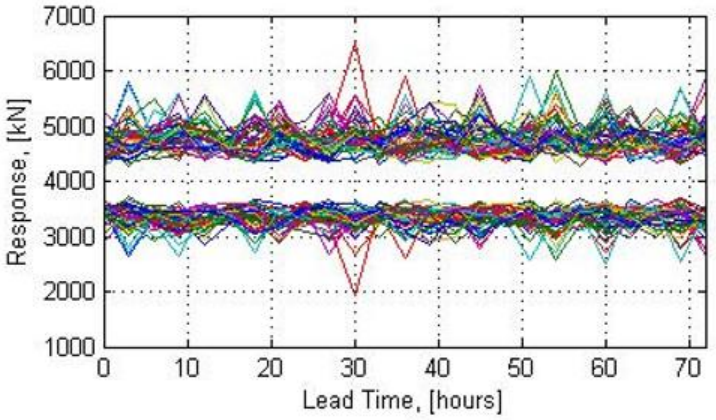


Input to SIMO

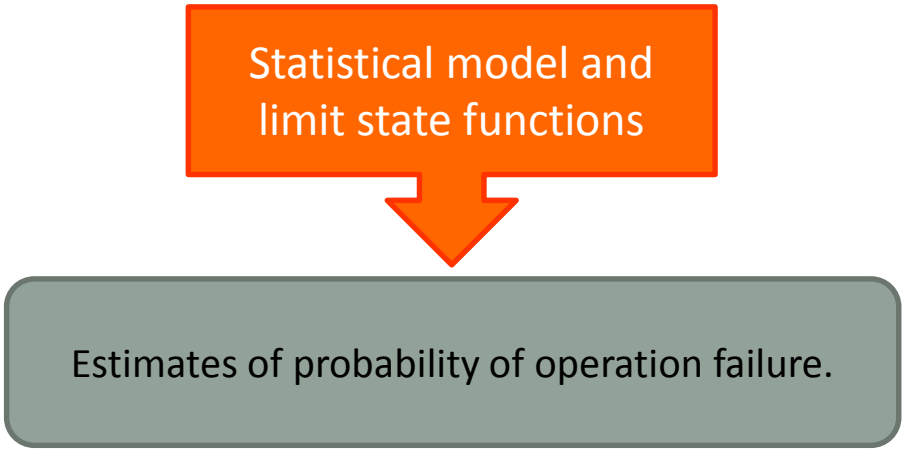
- The weather forecast data consist of statistical measures of the weather (average wind, turbulence, significant wave height, peak wave period, etc.)



- SIMO internally uses time series of wind and water motion
  - The weather forecasts are converted into time series realizations by SIMO



Statistical modelling (AAU)



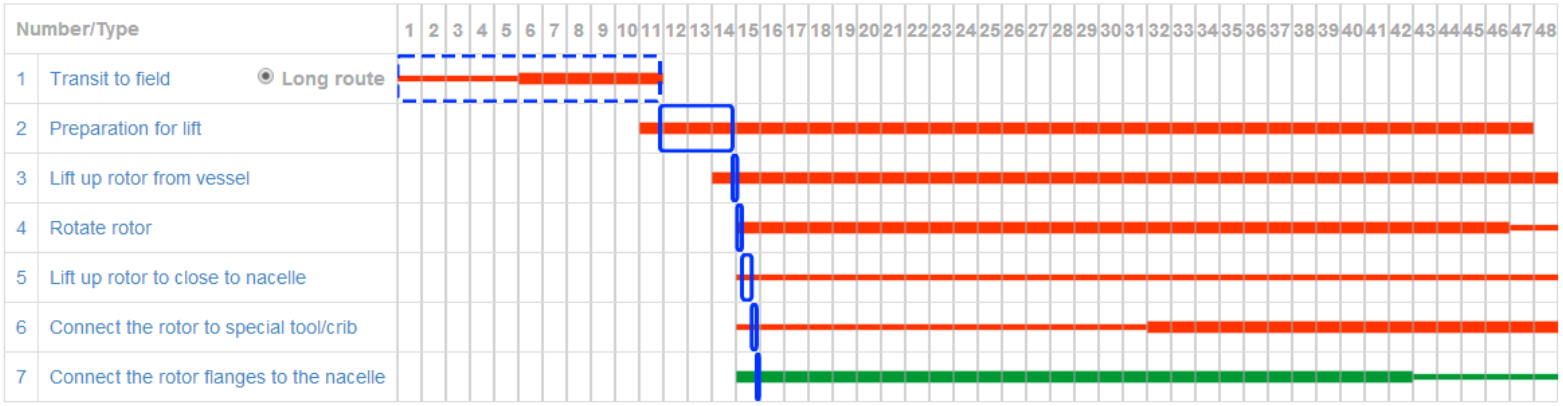
Decision support system (CMR)

DECOFF | Map | Wind farms | Operations | New Operation | Logout

Operation: Test operation 0.2614112771116197

Id: 5339683e6cda033a090114e9
Wind farm: WF a
Type: Operation test case 2
Description: Installation of wind turbine rotor from floating crane vessel
Name: Test operation 0.2614112771116197
Start time: 2014-03-31 16:00:00 +0200
End time: 2014-04-02 16:00:00 +0200
Created: 2014-03-31 15:06:06 +0200
Last update: 2014-03-31 15:10:59 +0200
Time spent: 292.9 seconds
Simulations done: 374 / 1314

Phases



Save | New transport phase

Summary

- Provide an objective foundation for decision support taking into account
  - The real physical limitations of the equipment being used
  - The uncertainties in the weather-dependent data
- Challenge the existing practice of using simple parameters such as significant wave height and average wind velocity
- Ideas and principles can also be applied to the operational phase and for oil & gas marine operations
- Main goal: Reduce the cost of installing offshore wind turbines


SENSE
VISUAL
CREATE
CHANGE
SAFETY FIRST
PEOPLE
designing the future