

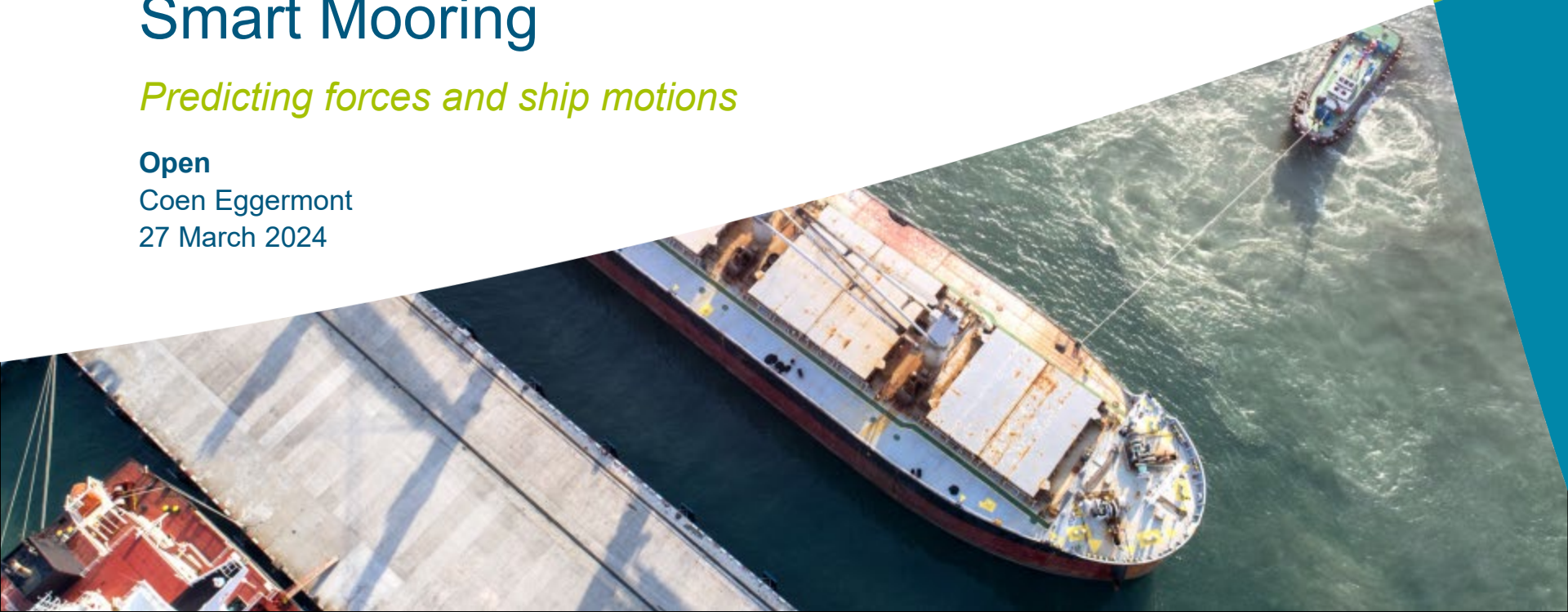
# Smart Mooring

*Predicting forces and ship motions*

Open

Coen Eggermont

27 March 2024



# Introduction



Captain Michael Magee  
Group Harbour Master  
RAK Ports



Coen Eggermont  
Product Owner Smart Mooring  
Royal HaskoningDHV

# Introduction RAK ports

- Ports in the group
- Location
- Cargo and ship sizes
- New development at Saqr Port
- Breakwater



# New Deep Water Terminal

- Mass concrete wall ACD +6m
- Orientation (N-S)
- Berth length, depth and catering for what vessels
- General Sea conditions
  - Monitoring
  - Effect on vessels
- Mitigation measures





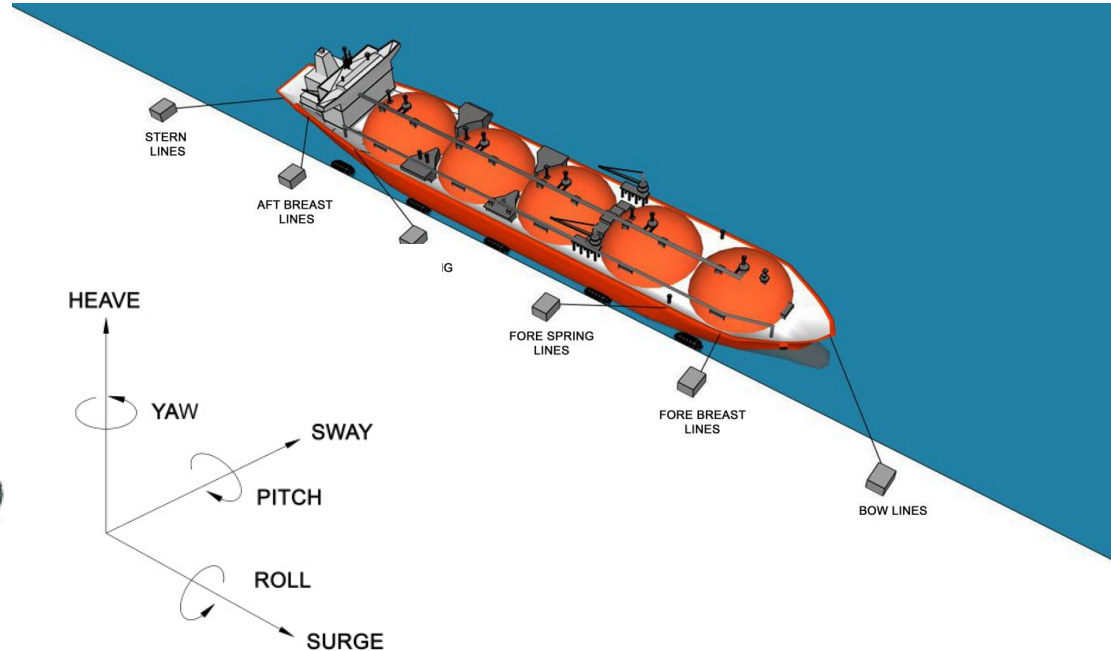
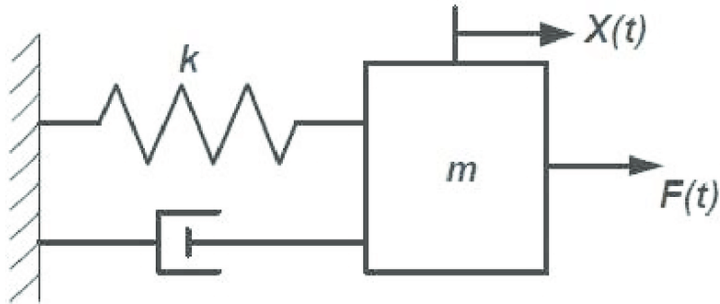
# Exposed bulk carriers

- Bulk carriers are sensitive to incoming waves
  - Waves also reflect from the closed concrete quay further worsening the vessel influence
  - Lines can be overloaded leading to snapping
  - Fenders can be overloaded leading to damage
  - Motions can be excessive leading to inability to operate
1. **When do wave influences become unacceptable?**
  2. **How do we avoid incidents in operations?**



# Theoretical background

- Moored ship in wind = forced mass-spring system in 6 degrees of freedom
  - Excited by waves in all degrees of freedom
- Force = waves
- Ship = mass
- Spring = lines & fenders



# Methodology: Software

- The difference between Static & Dynamic Mooring Analysis

- Static analysis can severely underestimate motions and forces of moored ships

- Applied software for DMA:

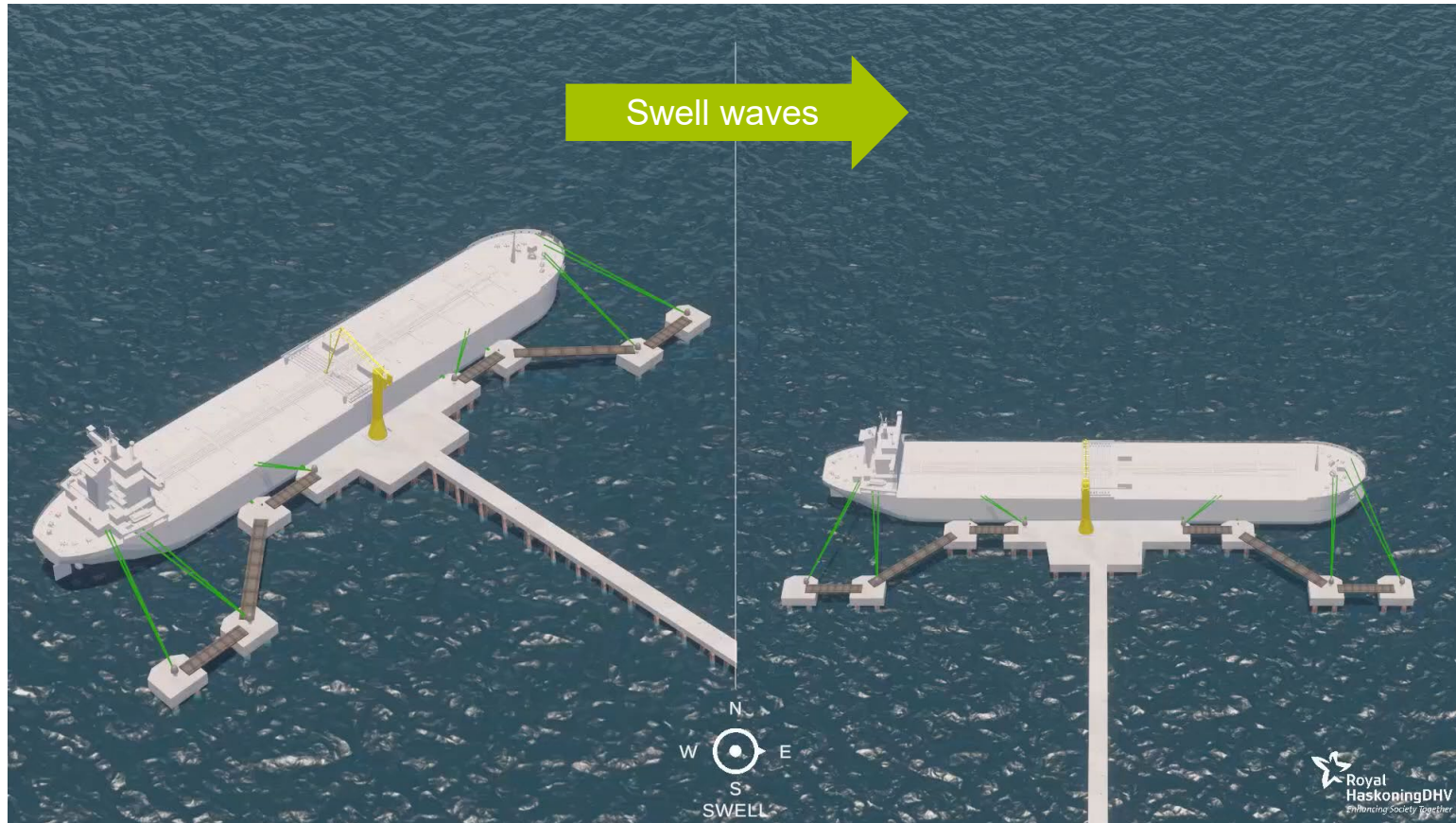
- aNySIM: To solve equations of motion in time domain
- Diffrac: To include hydromechanics

Both developed by Marin ([www.marin.nl](http://www.marin.nl))

$$((M + a_{nn}) \ddot{\bar{X}}) + (b_{nn} \dot{\bar{X}}) + (c_{nn} \bar{X}) = \bar{F}_{wave}(t)$$

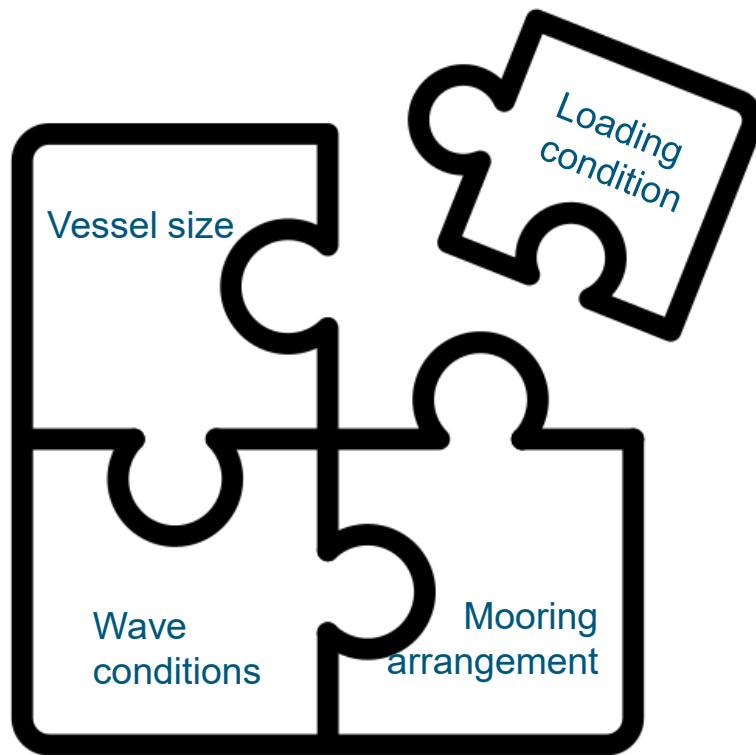


# Motions of vessel at a jetty





# Many different factors at play, how to apply in operations?



# Smart Mooring

- [Switch to live demo](#)

# Thank you for your attention



## Ensure safety, increase efficiency

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