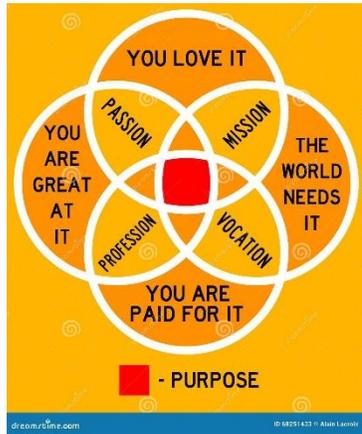


# GBMS

REDUCING CONTAINER LOSS



# OUTLINE



# PURPOSE



REPORTAGE de Volkskrant 11 december 2022

# Waar komen al die duizenden tuinkabouters op het Amelandse strand vandaan?

Op 9 februari 2006 was de Mondriaan van het Britse Southampton onderweg naar de haven van het Duitse Hamburg toen het rond 6 uur 's avonds zo'n 15 kilometer boven Terschelling in de problemen kwam. Het was slecht weer waardoor er volgens de kustwacht 58 grote containers (40 voet lengte) overboord gingen.



Schiermonnikoog January 2019



Sri Lanka February 2022



Spain December 2023



Denmark December 2023



# 3000+ TEU yearly lost at sea



# CONSEQUENCES

- Environmental damage
- Economic damage > 200 mln/year
- Degradation of Brand Image
- Pressure from government
- Lawsuits



# DOES THE WORLD NEED A SOLUTION?



*Tuchtcollege voor de scheepvaart:*

Installeer een computersysteem dat de sterkte van het sjorsysteem toetst in gevallen waarbij de individuele gewichten in de stacks afwijken van de container lashing plans. Het zou de controle op de naleving van het CSM een stuk eenvoudiger maken indien containerschepen daarmee wel worden uitgerust.

*Dutch Safety Board & Bunderstelle für Seeunfallursuchung*

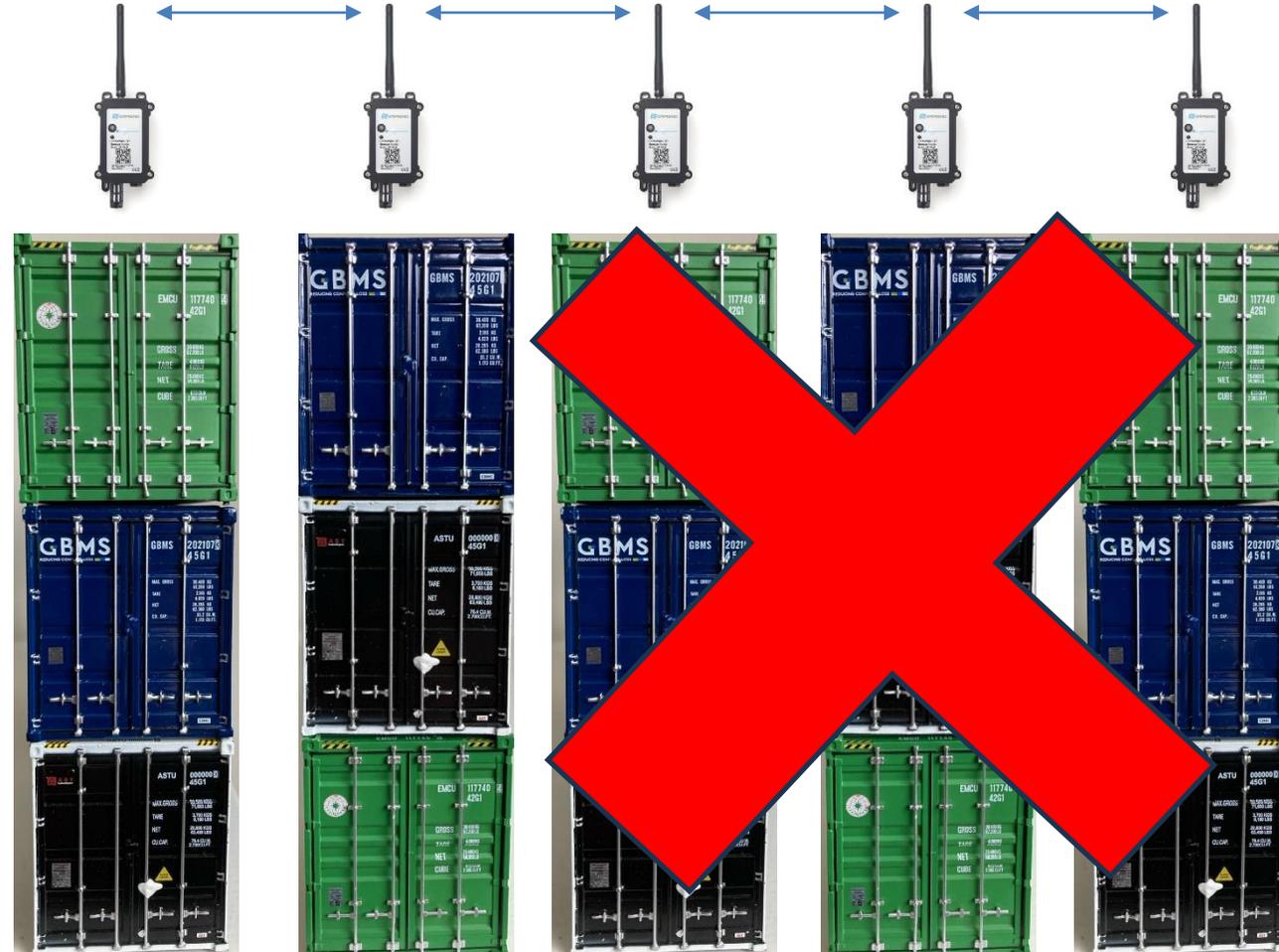
Generate an obligation on all container ships

1.2.1 to install electronic inclinometers or similar (inertia) systems to measure and display this information in real-time to the captain/crew

1.2.2 to install sensors on critical locations on the ship in order to measure accelerations and to provide this information in real-time to the captain/crew in order to allow them to monitor these;

1.2.3 and for ships with mandatory equipped VDR to record actual roll angle, roll period and accelerations for the purpose of safety investigations.

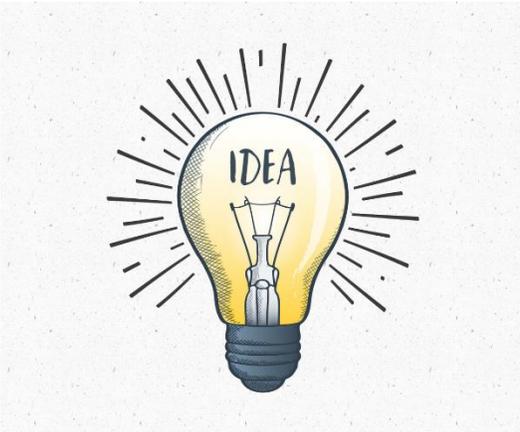
# TECHNICAL SOLUTION (1)



# TECHNICAL SOLUTION (2)



# TECHNICAL SOLUTION (3)



- Intranet server for UI and real time calculations
- Primary ship motion sensor
- Optional ship motion sensors

# NETWORK



A2B-online



BETTER SHIPS, BLUE OCEANS



# FUNDING



- Own savings...
- Ontwikkelingsmaatschappijen
- VC
- Corporate VC
- Angels
- Subsidies (MIT/WBSO)
- Loans (Rabobank investeringslening)

# KNOWLEDGE



(PhD)  
**MICHEL  
GUNGING**  
CEO  
[m.gunging@gbms.nl](mailto:m.gunging@gbms.nl)



(MSc)  
**JORIS  
BROUWER**  
CTO  
[j.brouwer@gbms.nl](mailto:j.brouwer@gbms.nl)



BETTER SHIPS, BLUE OCEANS





Hapag-Lloyd



NYK



BUREAU VERITAS



WAN HAI LINES LTD.

WE CARRY, WE CARE.

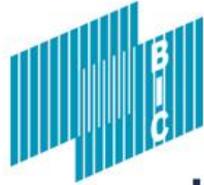


ClassNK



CCS

CHINA CLASSIFICATION SOCIETY  
中國船級社



World Shipping Council



SECURING YOUR VISIONS



MACGREGOR



DIE DEUTSCHEN VERSICHERER

IGP&I

International Group of P&I Clubs



SAMSUNG HEAVY INDUSTRIES



GERMAN LASHING  
ROBERT BÖCK GMBH



Container Technology



INTERNATIONAL MARITIME ORGANIZATION

DTN

ABB



RADAC

level, tide and wave monitoring



TNO

GBMS  
REDUCING CONTAINER LOSS

navis™

TUHH

Technische Universität Hamburg



Monohakobi Technology Institute



MARIN

BETTER SHIPS, BLUE OCEANS

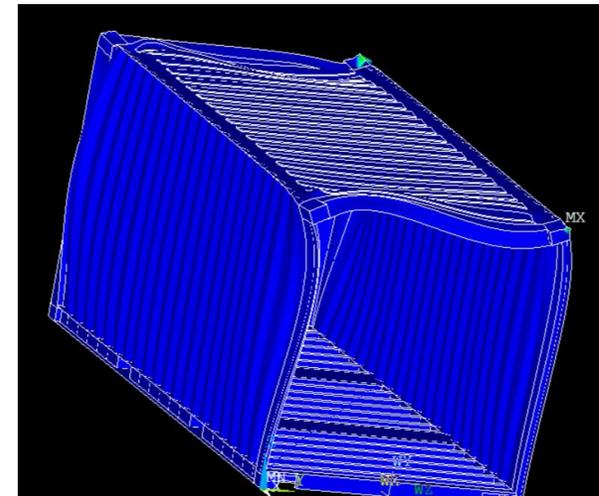
## Strength of Containers & Lashing Gear

**Identify how the aging and wear of the container corner castings and twist locks influence the strength of the connection between the containers.**

Material tests are done to know the material strength limits of (used) equipment. A dedicated test rig has been build, first tests December 2023.

Test results are used to validate high fidelity models of the connection between containers.

Outcome: Limit loads and safety margins.



## Discrepancy between actual and planned stow configuration.

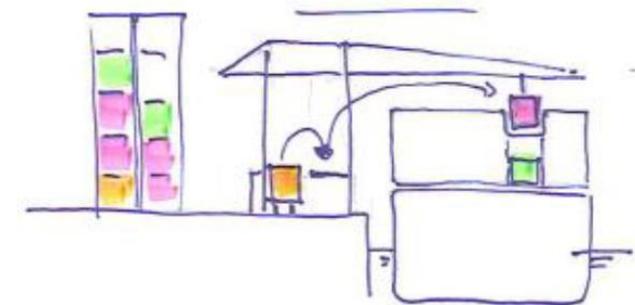
Onboard survey of actual deck stow shows that 15-20% of containers are mis-stowed depending on company and terminal. There are strong concerns about VGM, declared content and the structural condition of containers.

The effect of mis-stows is evaluated and especially a concern in high utilized stacks.

A Workshop with terminals was held May 2023 to identify & discuss improvements.

A follow-up workshop is planned.

Outcome: Recommendations to ensure compliance of departure stow plan to the actual stow for VGM and stow position.



## Vessel motions

**Assess the motion response of large container ships and provide insight in how to avoid extreme motions.**

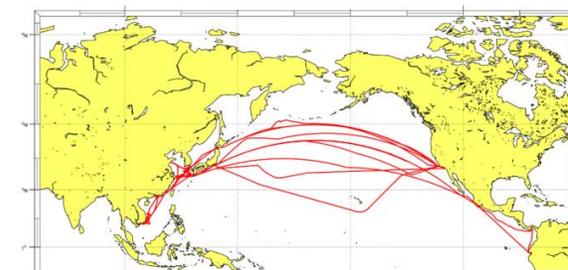
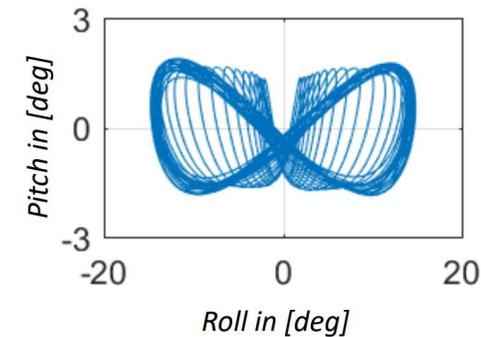
Incident review identified excessive motions as root cause of large scale incidents.

Seakeeping model tests with 10kTEU and 15kTEU vessels confirm the risk on parametric roll and synchronous roll in 3-4m wave height.

On board measurements on 3 vessels characterize the normal in design motions.

Numerical simulations to determine out-of-design guidelines are ongoing.

Outcome: Definition of "in design" and critical parameters leading to "off-design".



## Securing Loads

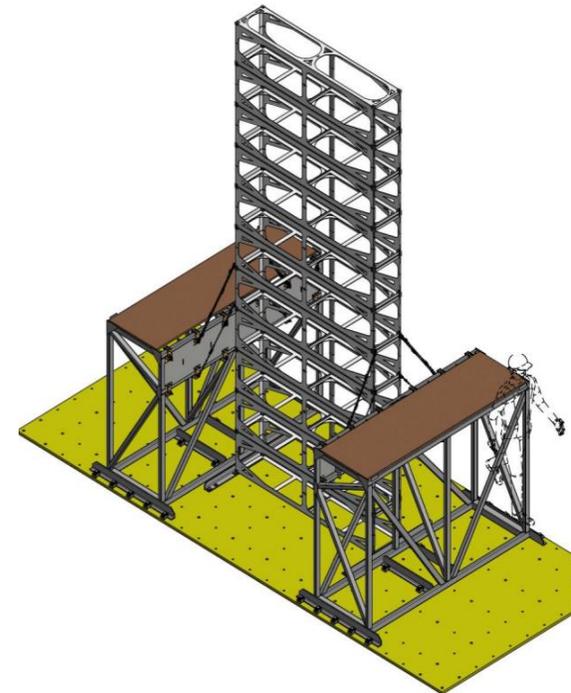
### Reliability of lashing software force calculations in planning stage .

Scale model tests to provide reference data of stack behavior and loads are completed.

High fidelity numerical calculation of tested conditions are ongoing.

Scale model test results are provided to class societies to evaluate their approaches with coarse calculation models as used in stow planning.

Outcome: Recommend baseline requirements for container stack load solvers and safety margins.



# WG5 – MARIN

Maritime Research Institute  
Netherlands

## Crew Governing Role and Control



### Assess how ships crew can prevent and anticipate “off design” conditions

Notice to mariners distributed to increase the awareness on the risk of parametric roll, with videos and a low fidelity calculation tool.

Crew Survey provides insight in challenges:

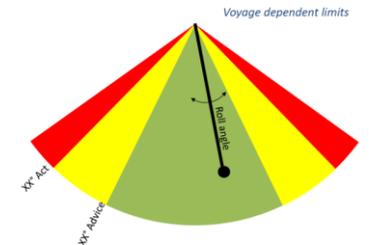
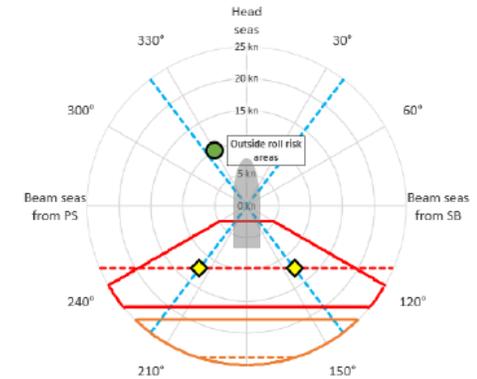
It is difficult for crew to keep an overview of the loading process of thousands of containers.

Roll natural period is an important factor in decision making, yet the reliability and accuracy is limited.

Mariners claim to know how to prevent, recognize and act on parametric roll but very few experienced it and the actions described are diverse.

Define functional requirements to prevent out-design roll conditions in operation (*pending feasibility of using with moving base simulator*).

Outcome: Proposal for best practice on information required to prevent off design conditions in operations.





WG6 – AMSA Australian  
Maritime Safety Authority

## Regulatory Reform

**Recommend amendments to relevant regulatory frameworks to proactively support adoption of best practices in the industry.**

Relevant effective rules are identified.

- Introduce minimum requirements to planning, loading and transit stages wrt transparency, control and audit.
- Mandatory status for loading/lashing software and baseline requirements.

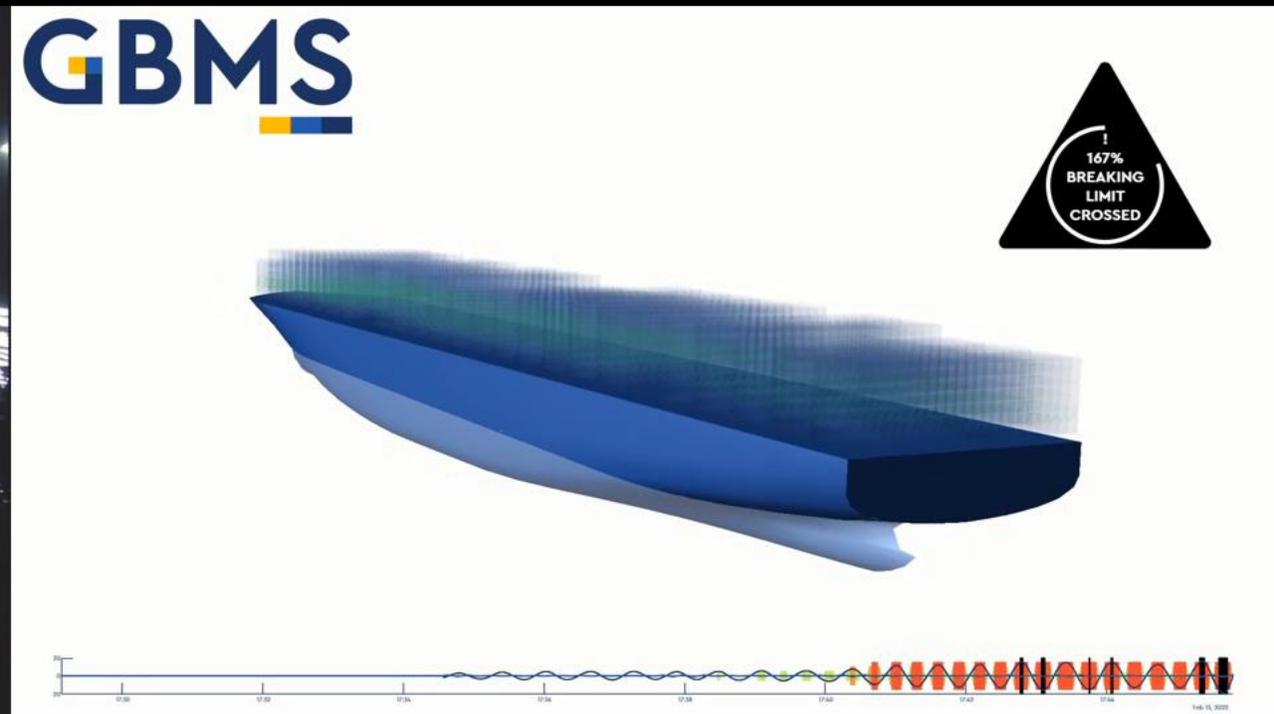
Informative papers submitted to CCC-9 and MSC-106.

Preparing for submission to CCC-10 (June 2024) based on inputs from results of the working groups.

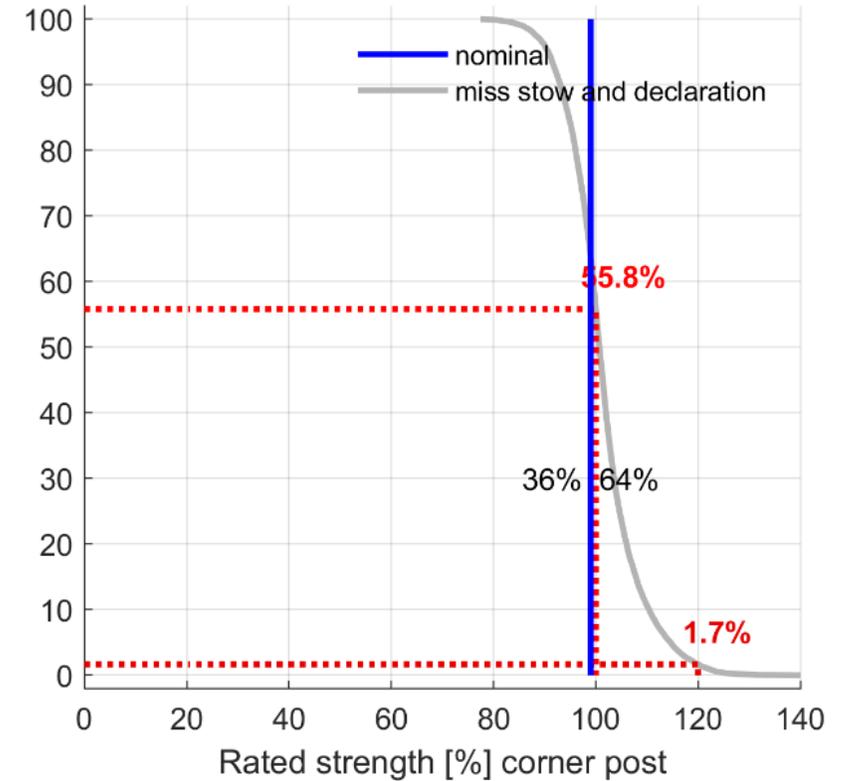
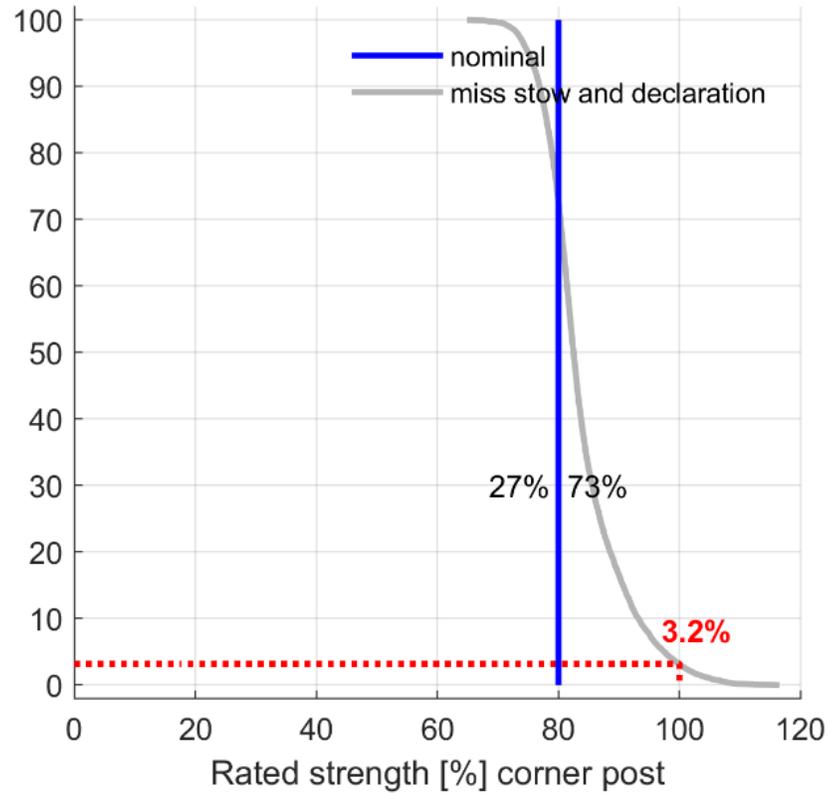
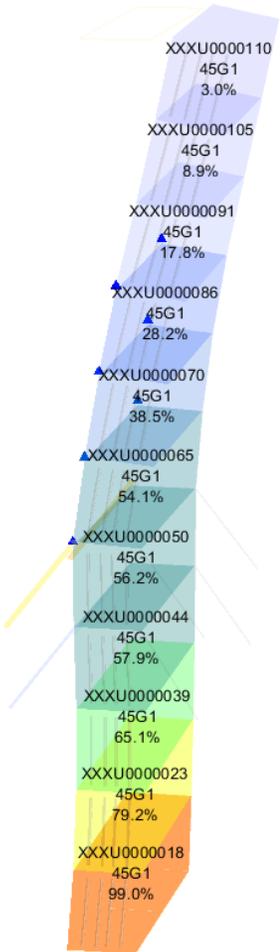
1. SOLAS VI, Reg.5, IMO -Conceptual proposed additional clause as 5.5.1
2. SOLAS VI, Reg.5, IMO -Conceptual proposed additional clause as 5.7.
3. Harmonised system of survey and certification (HSSC), 2017 (CA) 2.2.1.30.1).
4. Revision to MSC.1/Circ. 1353/Rev.2:
5. Standard Training Certification and watch keeping (STCW) Chapter V.
6. Regulatory Proposal #3 Regulation: 14 –Safe Manning ~ Resolution A.1047(27).



# DEVELOPMENT BASED ON RESEARCH

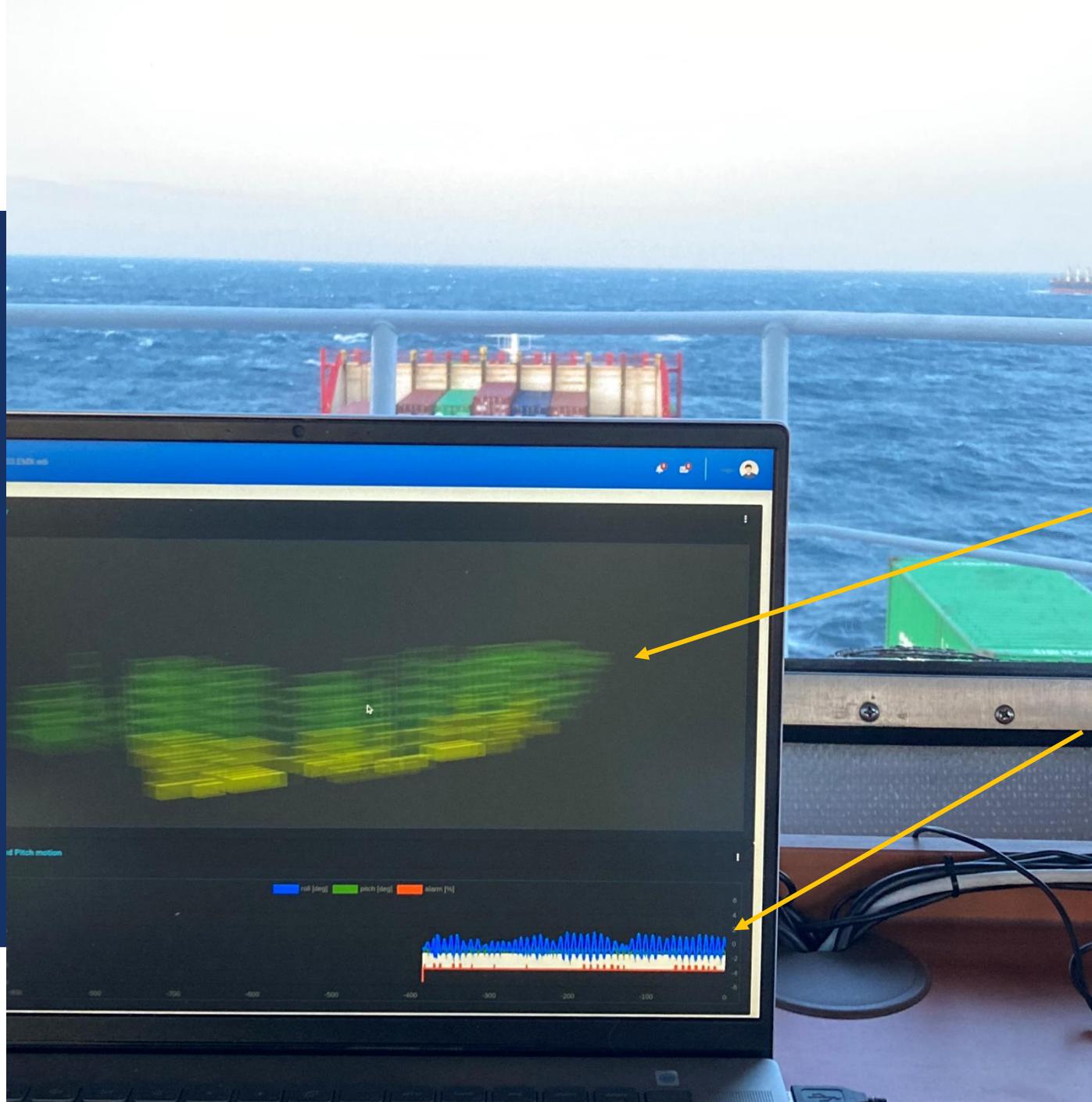


# GBMS CONTRIBUTION TO WG2



# GBMS

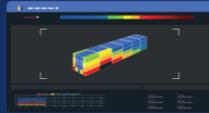
REDUCING CONTAINER LOSS 



# GBMS' SOLUTION

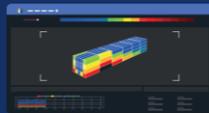
- Real-time monitoring of forces between the containers
  - Direct visualization at the bridge
  - Logging of ship motions for hind-cast analysis.
  - Single-sensor solution
- 
- Crew is timely warned and can take evasive action

# SOLUTIONS



## SENSORIUMC ONBOARD

Check CSM and rules  
Monitor in real-time  
Logging and reporting



## SENSORIUMC OFFICE

Design verification  
Onshore support  
Planning automation

## GBMS' LASHING SOLVER



All major class rules  
Fast and non-linear



## SERVICES

Analysis of new building  
User specific requirements  
Contract research

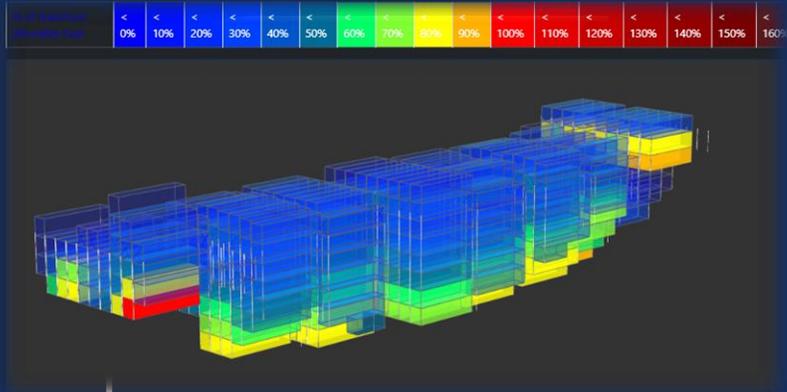


1010  
1010

## CLOUD API

Integrate the GBMS solver  
in your software, tooling  
and processes

# SENSORIUMC ONBOARD (1 of 2)



**A Digital Twin monitoring container stacks in real-time**

## PRE-VOYAGE

- Complete control over container operations ensuring safety & efficiency

## WHILE SAILING

- Continuously monitor container stack loads in real-time
- Logging of all ship motion data to enable data analysis and quality assurance
- Instantly detect excessive loads & triggering immediate warnings

## POST-VOYAGE

- Reporting of loads & hindcast analysis



[Click here for a Youtube introduction to SensoriumC](#)

**GBMS**

# SENSORIUMC ONBOARD (2 of 2)



-  Intranet server for UI and real time calculations
-  Primary ship motion sensor
-  Optional ship motion sensors

## Working principles of the system

### COMPONENTS

- 1 server-computer
- 1 Primary motion sensor
- + any optional additional sensors

### CONFIGURATION

- Based on CSM, CSA, GA
- Configured by GBMS
- Installed / retrofitted in port

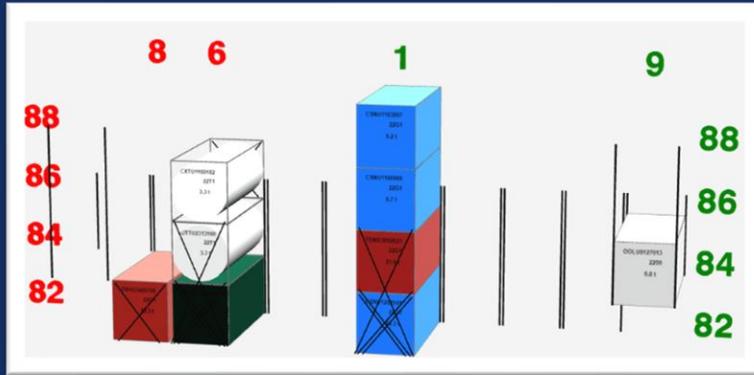
### USAGE

- Access from any onboard PC
- Upload BAPLIE file and go
- Motions + stowage = loads



[Click here for a Youtube demonstration of SensoriumC during storm Pia](#)

# SENSORIUMC OFFICE



A Digital Twin of the ships configuration for in office

## DESIGN SUPPORT

- Compare class rules
- Design Lashing arrangements

## ONSHORE SUPPORT

Perform in-depth analysis of BAPLIE files before departure to ensure highest safety levels

Support ship crew with advice incase of deviations from standard.

## QHSE

Study voyage performance, incidents and create analytical reports

# GBMS

REDUCING CONTAINER LOSS

# CLOUD API

## INTEGRATION

Call the GBMS lashing solver using the Cloud REST API

Integrate into your own software...

...or process work flow

Well documented

GBMS' modular tools are build to provide optimal service

The Cloud API and other GBMS tools share the same proven knowledge base an computational algorithms.



### GBMS SensoriumC API (0.5.0 Preliminary)

GBMS: [info@gbms.nl](mailto:info@gbms.nl) | URL: <https://www.gbms.nl> | License: GBMS license 1.0 | [Terms of Service](#)  
GBMS SensoriumC Open API Specification

The GBMS SensoriumC API provides fast tools to perform class-CSM check on a BAPLIE file for almost any set of class rules.

#### Container-sets

##### getContainerSets

**GET** /container-sets/{IMO-number} >

Try it

Returns list of all Container Sets available for a ship with IMO number provided

Request >

Responses >

Response samples >

##### uploadBaplieFile

**POST** /file-upload >

Try it

uploads attached BAPLIE file

Request >

Responses >

##### downloadBaplieFile

**GET** /container-sets/{set-id}/download >

Try it

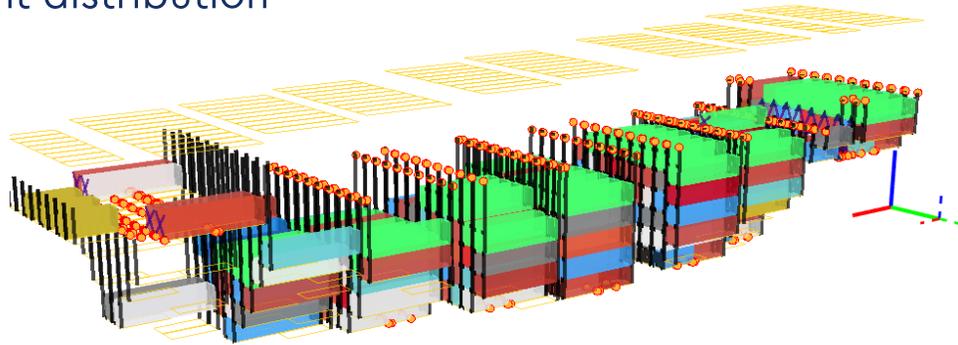
> operationId: > downloadBaplieFile



# CURRENT DEVELOPMENTS (1 of 2)

## AUTO STOWAGE

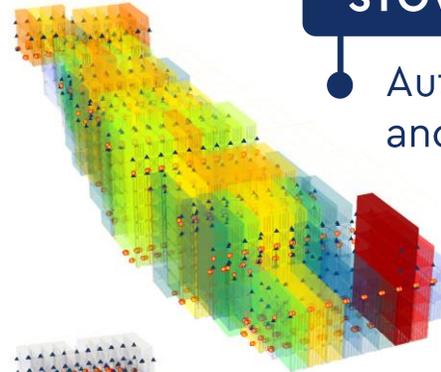
- Plan containers automatically
- Optimize trim by controlling weight distribution



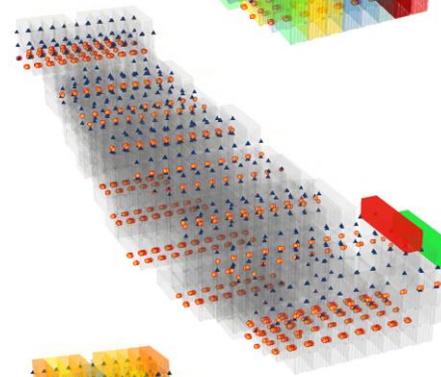
[Click here for a Youtube auto stow demo](#)

## STOWAGE ISSUE SOLVER

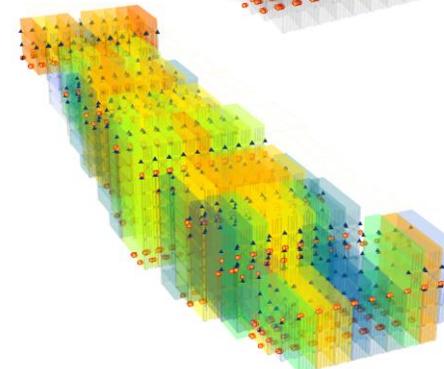
- Automatically identify issues and suggest solutions



Before



Suggested restow



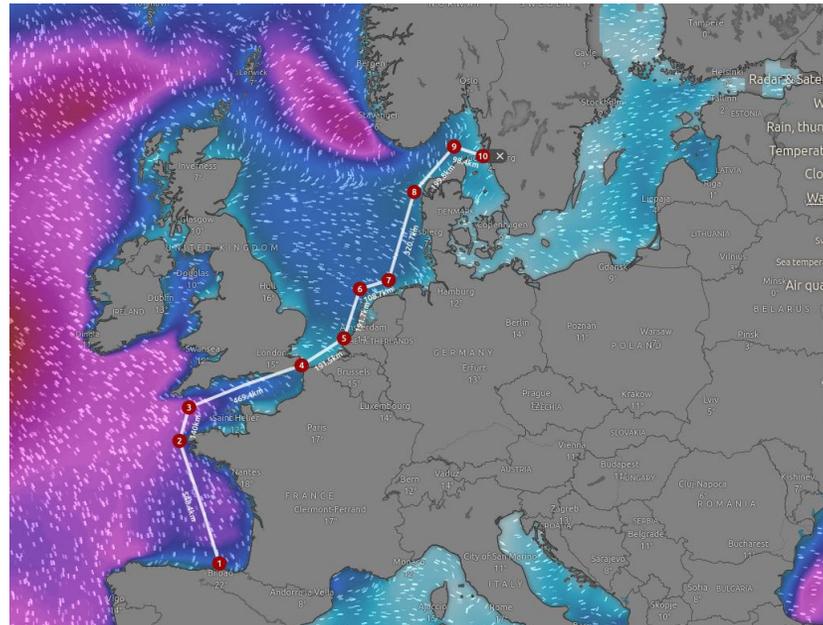
After

**GBMS**

# CURRENT DEVELOPMENTS (2 of 2)

## FORECAST

- Implementation of weather forecast rules from various class
- Predictions based on hydrodynamic models



## IMDG

- Implementation of IMO DG assistance module



GBMS aims at reducing the damage and loss of containers at sea.



Thanks for your  
attention!

**GBMS**