Top Tier Joint Industry Project on Containers Lost at Sea

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#IUMI2024

Outline

- Introduction
- Summary exploration phase (phase I)
- Summary technical investigations (phase II)
- Ongoing work (phase III)

Maritime Research Institute Netherlands

- Independent
- Non-profit
- Founded in 1932
- Mission: Clean, safe and smart shipping, sustainable use of the seas

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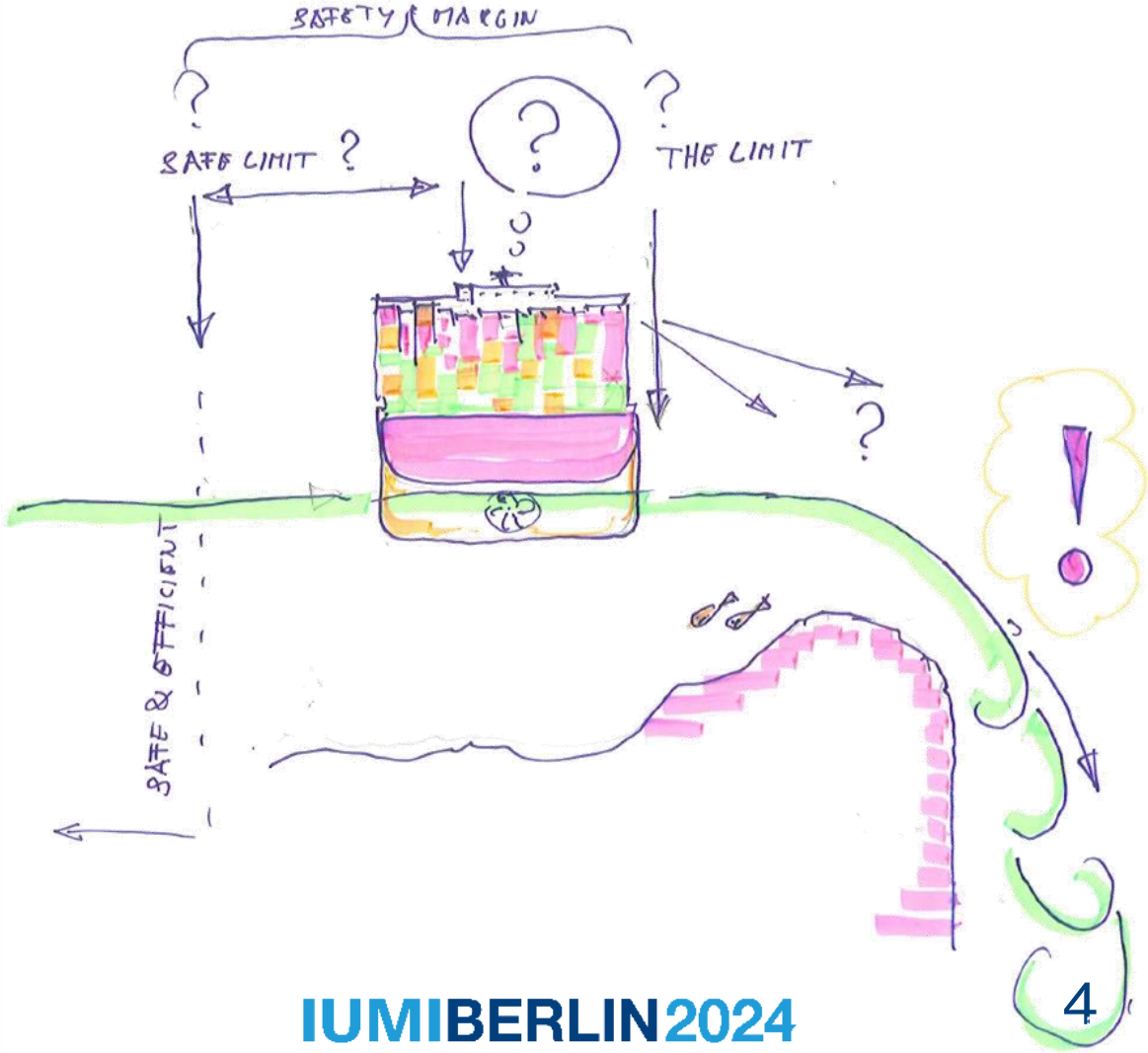
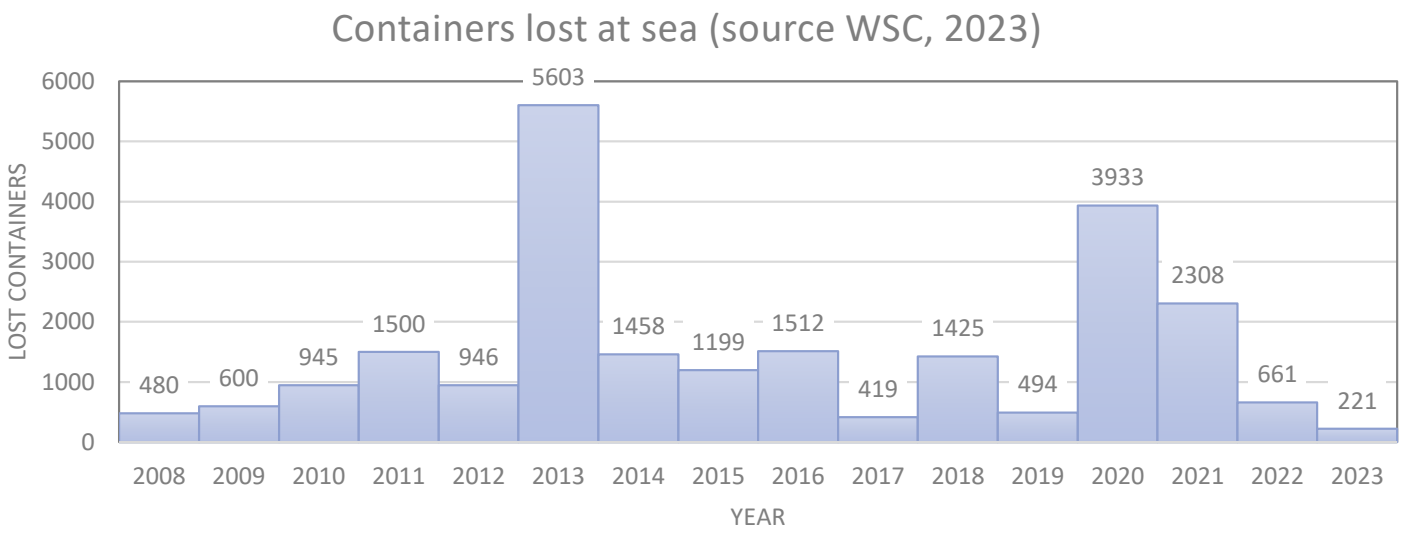
Container ships are not intrinsically safe but are designed to be safely operable



Incidents occurring worldwide

- Although it's only tiny fraction 0.0006%,
  - On average 1482 containers lost per year
  - Last year record low with only 221 reported
- It has potentially large consequences



TopTier

- Joint industry project with 41 participants
- Started in 2021 and runs until end of this year
- Aim: Zero container loss at sea, by improving the quality in entire container transport chain


MAERSK
MSC
ONE
Hapag-Lloyd
CMA CGM
EVERGREEN
seaspan
YANG MING
WAN HAI LINES LTD.
ABS
DNV·GL
ClassNK
CCS
Lloyd's Register
TT
World Shipping Council
GDV
IGP&I
SEC
NSY
SAMSUNG HEAVY INDUSTRIES
DTN
ABB
GRAHAM LASHING
RADAC
TNO
GBMS
navis
AMSA
TUHH
Technische Universität Hamburg
Monohakobi Technology Institute
MARIN
BETTER SHIPS, BLUE OCEANS


Operators
Classification
Insurers&branch
Knowledge
Yards
Suppliers
MAERSK
msc
ONE
OCEAN NETWORK EXPRESS
Hapag-Lloyd
CMA CGM
EVERGREEN
NYK
seaspan
YANG MING
WAN HAI LINES LTD.
ABS
DNV·GL
ClassNK
BUREAU VERITAS
KR
KOREAN REGISTER
CHINA CLASSIFICATION SOCIETY
Lloyd's Register
GDV
IGP&I
International Group of P&I Clubs
TTI
GEC
SECURING YOUR VISIONS
MACGREGOR
LOX
DTN
ABB
TNO
GBMS
navis
AMSA
CSSRC
MARIN
BETTER SHIPS, BLUE OCEANS

IUMI supported /co-sponsored the 3 TopTier IMO submissions

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INTERNATIONAL MARITIME ORGANIZATION

MARITIME SAFETY COMMITTEE
106th session
Agenda item 18

MSC 106/INF.16
30 August 2022
ENGLISH ONLY
Pre-session public release: ☒

ANY OTHER BUSINESS

Update on the progress of the MARIN Top Tier Joint Industry Project (JIP) on securing container safety

Submitted by Australia, Denmark, Germany, Netherlands, Singapore, IUMI and WSC

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INTERNATIONAL MARITIME ORGANIZATION

SUB-COMMITTEE ON CARRIAGE OF CARGOES AND CONTAINERS
9th session
Agenda item 13

CCC 9/INF.25
19 July 2023
Original: ENGLISH
Pre-session public release: ☒

ANY OTHER BUSINESS

Update on the progress of the Top Tier Joint Industry Project (JIP) on container losses

Submitted by Australia, Germany, Kingdom of the Netherlands, IUMI and WSC

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INTERNATIONAL MARITIME ORGANIZATION

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SUB-COMMITTEE ON CARRIAGE OF CARGOES AND CONTAINERS
10th session
Agenda item 11

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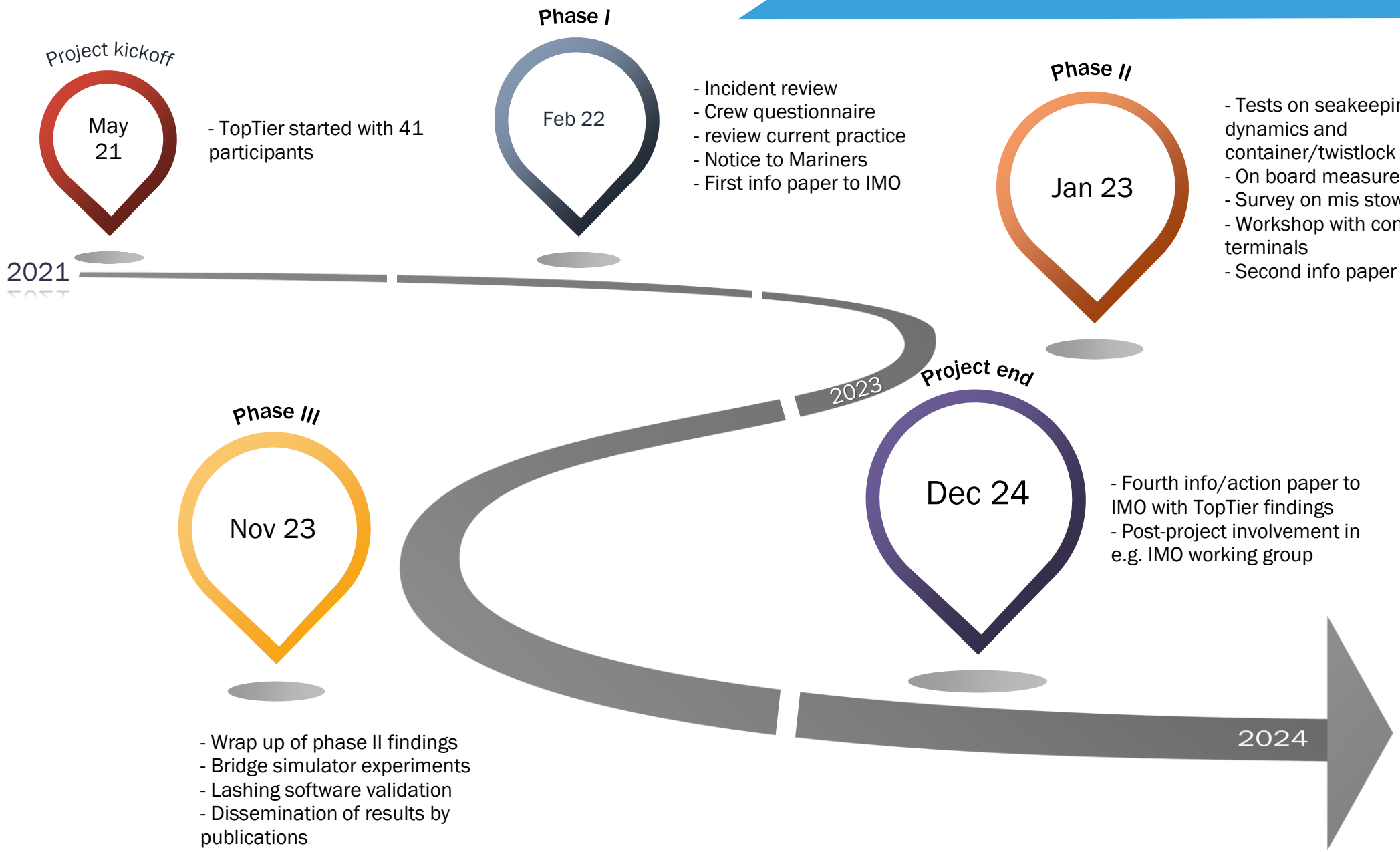
Pre-session public release: ☒

DEVELOPMENT OF MEASURES TO PREVENT THE LOSS OF CONTAINERS AT SEA

Improvements to be considered for the safe transport, stowage and securing of containers.

Submitted by Netherlands (Kingdom of the), Germany, Australia, WSC, BIC, IUMI, IGP&I


Project kickoff
May 21
- TopTier started with 41 participants
Phase I
Feb 22
- Incident review
- Crew questionnaire
- review current practice
- Notice to Mariners
- First info paper to IMO
Phase II
Jan 23
- Tests on seakeeping, stack dynamics and container/twistlock strength
- On board measurements
- Survey on mis stows
- Workshop with container terminals
- Second info paper to IMO
2021
2023
2024
Phase III
Nov 23
- Wrap up of phase II findings
- Bridge simulator experiments
- Lashing software validation
- Dissemination of results by publications
- Third Action paper to IMO
Project end
Dec 24
- Fourth info/action paper to IMO with TopTier findings
- Post-project involvement in e.g. IMO working group

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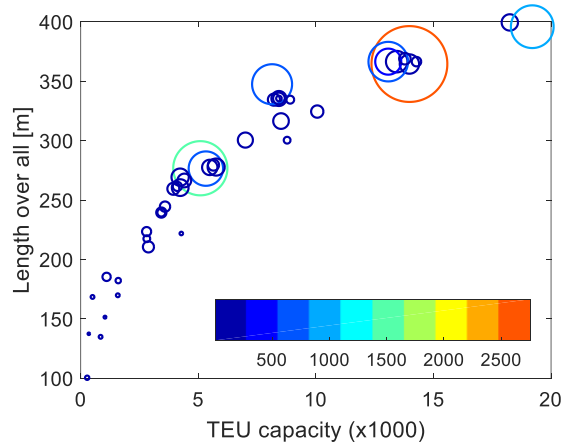
TopTier Incident review

- Review based on public information (if available based on published incident reports of authorities)
  - 44 incidents, almost 10,000 lost damaged containers
  - In 6 incidents more than 10% of total container capacity was lost
  - Incident classification (coupling type and extend of damage to ship motions in waves)
- Report publicly available (and soon also as INF paper to IMO CCC10)

	Resonant roll	Parametric roll (stern)	Parametric roll (bow)	Head & bow quartering	Unknown	Total (#)
(Partial) stack collapse	3			3	2	8
Single (stern) bay collapse	4	1	1	4	5	15
Multiple (stern) bay collapse	2		1		1	4
Multiple bay collapse	3	4	3		1	11
Unknown	1		1	2	2	6
Total (#)	13	5	6	9	11	44



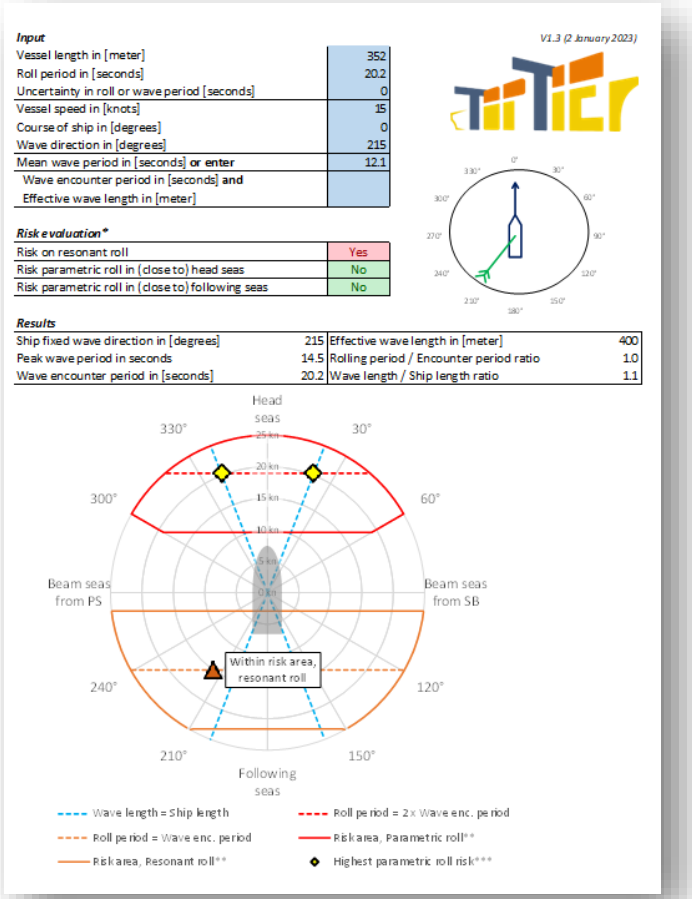
Crew questionnaire

- 1500+ responses
- Resulting in 12 points of attention from crew perspective e.g.
  - *“The final loading plan is only available shortly before departure and often inaccurate”*
  - *“Impossible to overview and control loading process on large containers vessels”*
  - *“Training & decision support which weather conditions and ship motions to avoid is inadequate”*

#	point of attention	TopTier priority	
1	It is difficult for ship’s crew to keep an overview of the loading process of hundreds or thousands of containers. There is limited time, complicated communications, small influence on the process and limited control to implement a change.	mid	TopTier WG2
2	The condition of containers, especially corner castings, are considered a concern.	mid	TopTier WG1/WG2
3	Respondents indicate problems with automatic twistlocks. Multiple respondents have experienced this type of twistlock opening by itself during heavy ship motions.	mid	TopTier WG1
4	Masters find that terminal crew has a focus on fast rather than safe operation. Installation of lashing gear is not always done adequately by stevedores due to time pressure and lack of experience.	mid	TopTier WG2
5	The final loading plan is often only available in the last minutes before departure or after departure and the final loading plan often does not properly represent the cargo arrangement on and under deck.	top	TopTier WG2
6	Time pressure during the loading process is high. Roughly 25% of the respondents feel a commercial pressure to depart with potential risks in loading conditions and/or planned route	high	TopTier WG2/WG6
7	The roll natural period of the ship is an important factor in decision-making, yet the reliability and accuracy of the calculated roll natural period from the loading computer is limited.	high	TopTier WG5/WG3
8	Under way, crews operate in unpredictable circumstances with regard to weather and waves, with a lack of verifiable data about lashing conditions and loads, making decision making difficult	top	TopTier WG5/WG3/WG4
9	Predicting the response of the vessel to weather is hard, especially at night or in confused seas, and as a consequence crews may hesitate to take action.	mid	TopTier WG5/WG3
10	The vast majority of respondents claim to know how to prevent, recognise and act on parametric roll but very few ever experienced parametric roll. The actions described on what to do when it happens are diverse.	top	TopTier WG5
11	Navigation software tools are found to be helpful, however the availability and use of tools is not uniform.	mid	TopTier WG5
12	There is a large diversity in working methods, procedures etcetera, even within one company. Few best practices seem to be defined and there is limited opportunity to learn from each other.	top	TopTier WG5

Notice to mariners

- Based on the incident review it was identified that parametric roll in waves from the stern was a likely cause of some major incidents
- For this reason, TopTier released:
  - The notice to mariners
  - roll risk estimator Excel sheet
  - 3 instruction videos
- Included in first INF paper to IMO (MSC 106/INF.16, Aug 2022)



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Containers & the water bucket analogon

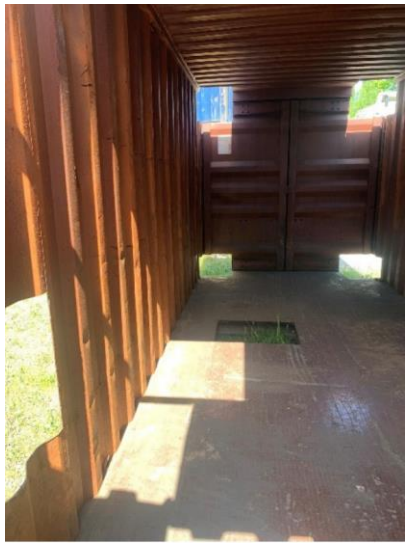
- Carry as much as possible... without spilling on the ground
- Sound bucked w/o leaks
- Do not fill beyond the mark
- First put the mark ...
  - know how it will be / is carried
  - Know how much it will slosh inside
- Carry careful as planned
- Don't trip on obstacles

Incidents might occur when:

1. Actual strength of containers and lashings is less maximum safe working load
2. Actual container mass higher than declared mass
3. Containers are not stowed according the stow plan
4. Ship motions exceed the most severe design case
5. Actual forces in the cargo stow exceed the calculated ones in the lashing software

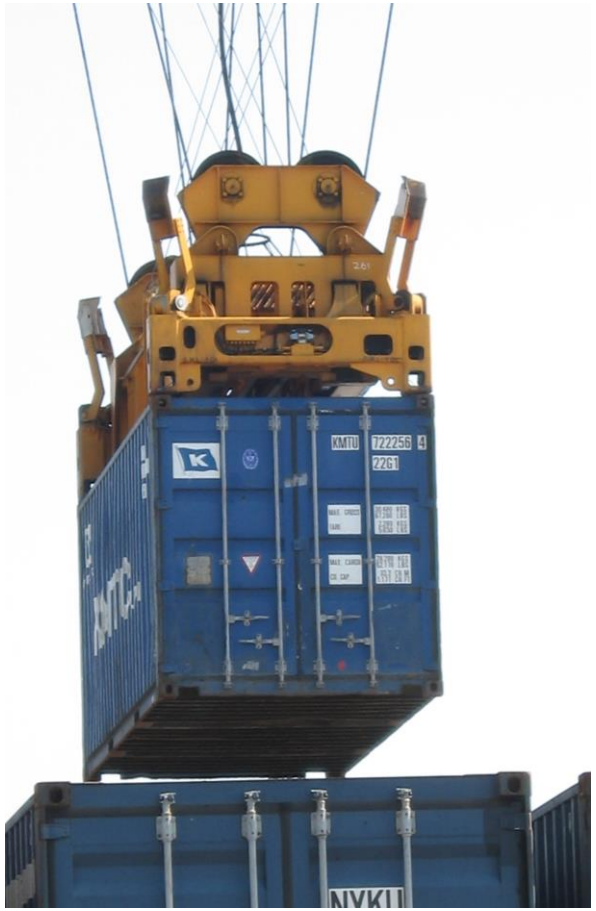
1. Actual strength of containers and lashings is less maximum safe working load

- 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 with used/new corner castings + twist locks



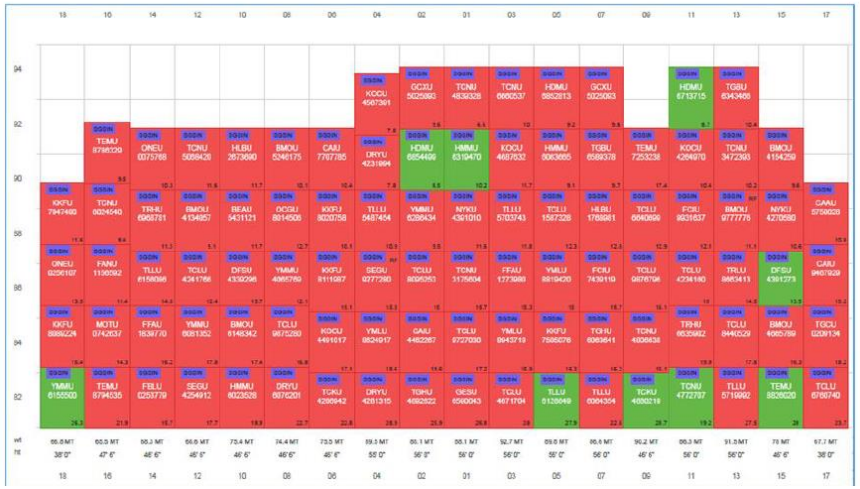
2. Actual container mass higher than declared mass

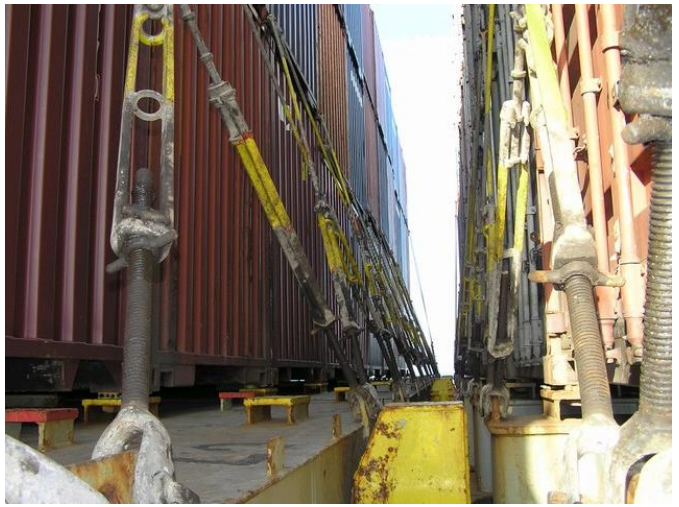
- It is the starting point of every loading plan (stack weight, lashing forces, ship stability…)
- Enforcement of verified gross mass (VGM) by member states, typical allowance 5% & < 1 ton
- Some claim 0.5% overweight containers but limited evidence available
- 3 TopTier examples:
  - Crew questionnaires: >50% respondents mention a deadload of typically 1-5% of displacement
  - 1 terminal, 1 week, 1600 TEU: 13% overweight
  - 1 operator, 10 months, 3.4M TEU: only 0.09% overweight but in 1.2% no VGM available



3. Containers are not stowed according the stow plan

- Together with container mass, the starting point of every loading plan (stack weight, lashing forces, ship stability...)
- Five deck stow surveys on four container vessels showed 15-20% misstows (but in 1 bay 92%!).

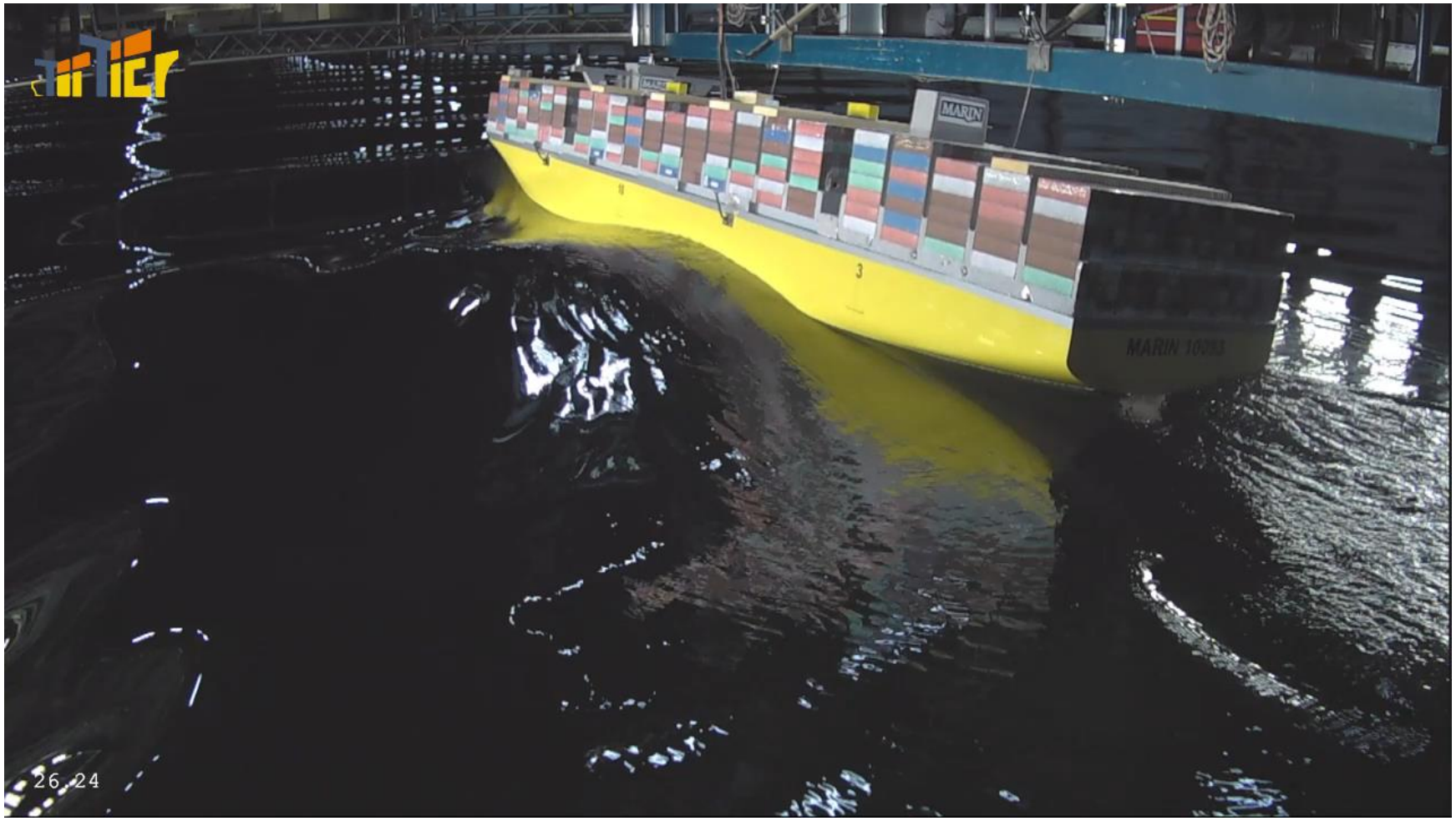




4. Ship motions exceed the most severe design case

- Class societies use design ship motions as starting point for the calculation of the lashing forces.
  - Often unknown to ship crew (and questionable if to be used as limit)
  - Variations between class could be large (in one example varying between 8 and 19 roll angle)
- In heavy weather and without rerouting, design motions can easily be exceeded

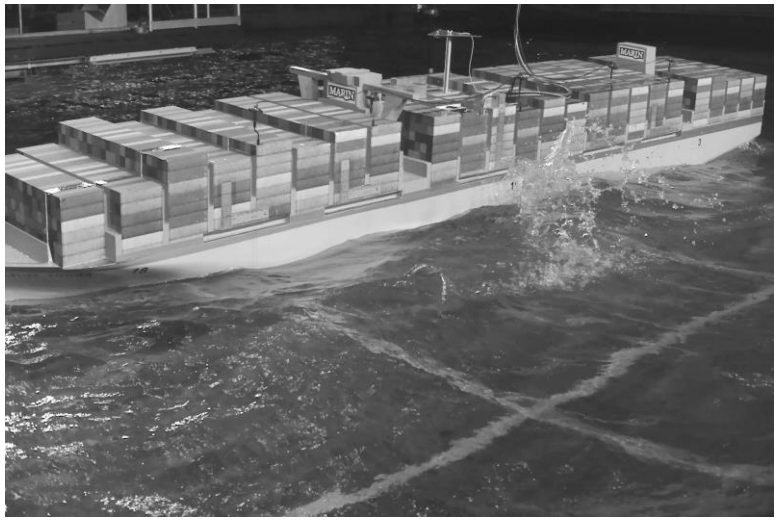
4. Ship motions exceed the most severe design case

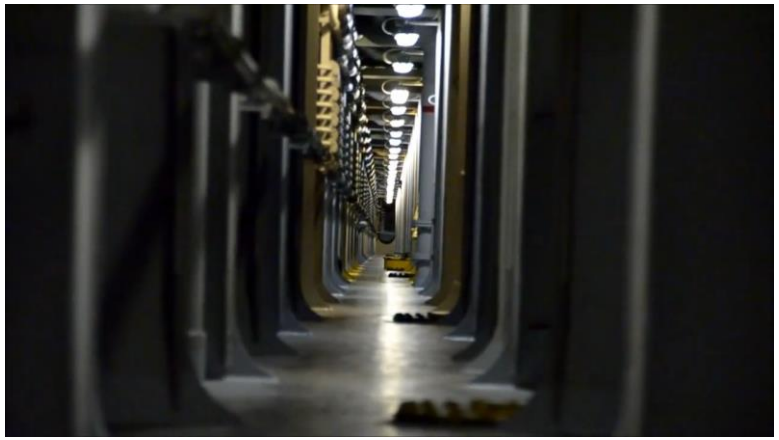


- 10,000 TEU
- 300 m long
- 6 meter waves
- max roll angle 11 deg

5. Actual forces in the cargo stow exceed the calculated ones in the lashing software

- This could have many sources:
  - Ship motions exceeding the limits
  - Off design ship motions like waves hitting container, parametric roll
  - Extreme wind loads
  - Vibrations of ship and/or container stacks
  - Container stack interaction (i.e. stacks hitting each other)





5. Actual forces in the cargo stow exceed the calculated ones in the lashing software

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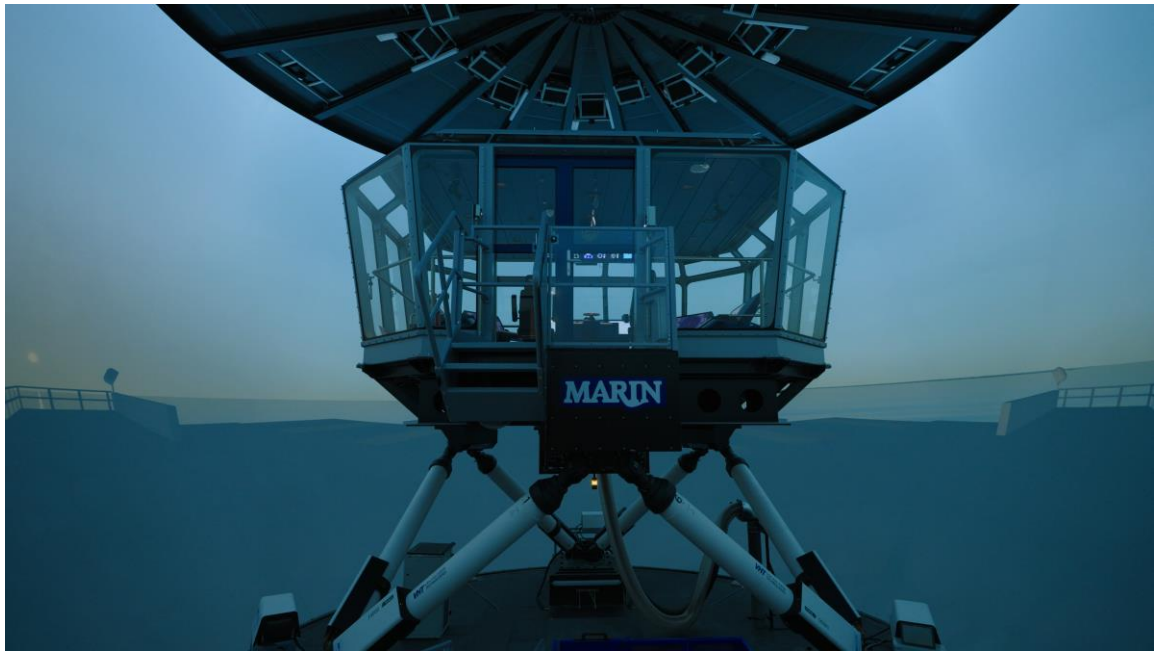
Ongoing work

- Last months of the project
- Finish remaining work and reporting
- IMO CCC10 action and information papers
- Dissemination of results by publications and presentations
- End meeting in November



Preliminary conclusions and recommendations (1/2)

- Keep to design parameters
- Improve crew training
  - Inform on in-design motion limits
  - Explain how to avoid off-design motions
- Final stowage plan to be validated
- Improve (control on) container stacking and lashing
- Promote CTU code

Preliminary conclusions and recommendations (2/2)

- Lashing software:
  - a supplement of the cargo securing manual
  - should support voyage specific assessment
- Harmonised performance standards for lashing software:
  - Installation and availability
  - Software functionality
  - Interface
  - Testing and approval