



Aalto University
School of Engineering

Enhancing SAR Communication and Decision Making using Vessel TRIAGE: Concept and Developments

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The Finnish Lifeboat Institution, Finland
NAPA Ltd, Finland

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Hamburg, Germany, 28-30 November 2016

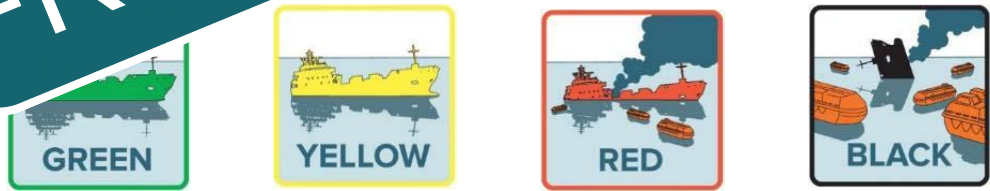


WIDE COLLABORATION



**42 PARTNERS
FROM 15 COUNTRIES**

TRIAGE Method





A method for assessing and communicating the safety status of vessels in maritime distress situations



Vessel TRIAGE Concept



VIDEO

2:52

<https://www.youtube.com/watch?v=ckkv7o5G5L8>

Vessel TRIAGE catalyst

COSTA CONCORDIA

13.01.2013

Thyrranean Sea



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Vessel TRIAGE catalyst

LISCO GLOARIA

09.10.2010

Fehmarn Belt



Vessel TRIAGE catalyst

AMORELLA

14.12.2013

Archipelago Sea



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Vessel TRIAGE

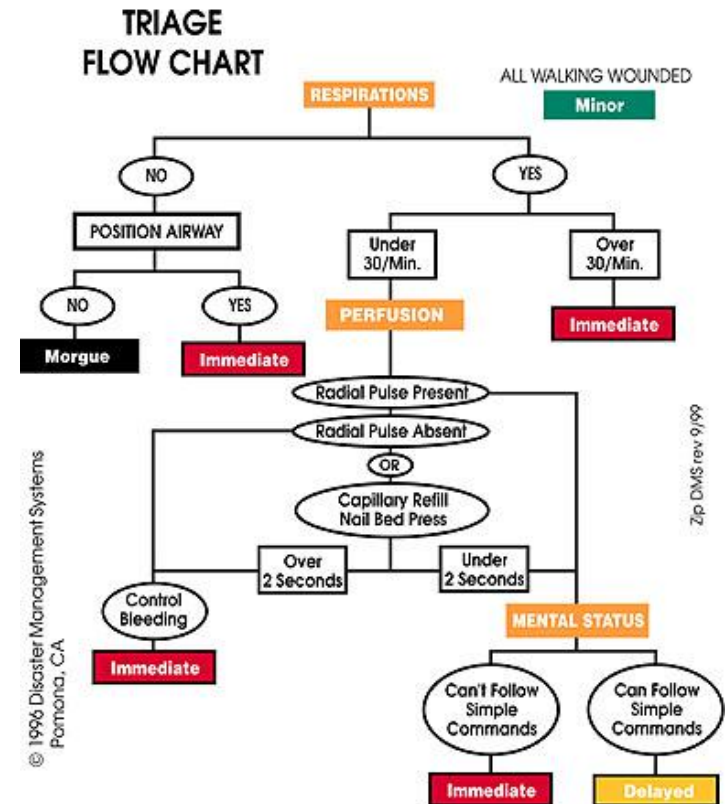
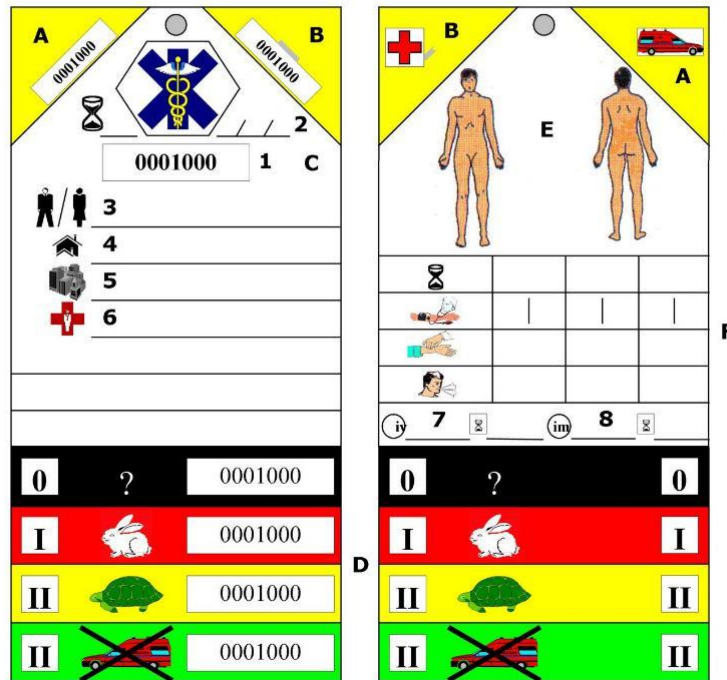
Cooperation between SAR services and various actors would be significantly more effective

**Nationally and internationally
At sea and on land**



Medical triage principle...

TARJETA DE TRIAGE



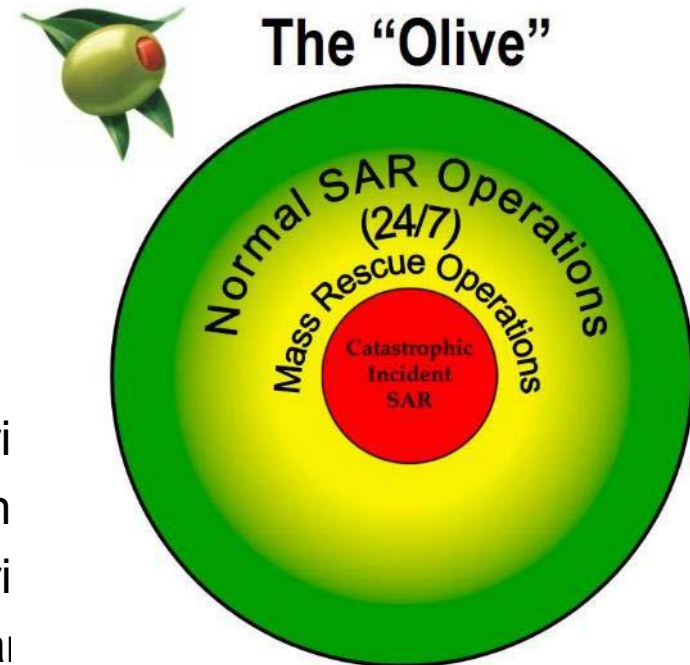
... Vessel TRIAGE application



GREEN	YELLOW	RED	BLACK
Vessel is safe and can be assumed to remain so	Vessel is currently safe, but there is a risk that the situation will get worse	Level of safety has significantly worsened or will worsen and external actions are required to ensure the safety of the people aboard	Vessel is no longer safe and has been lost
<p>GENERAL SITUATION</p> <ul style="list-style-type: none"> - The situation aboard is stable. Although the vessel may have been damaged by the accident, this damage does not threaten its seaworthiness or the people aboard. - The damage to the vessel has been assessed. It is highly unlikely that the damage will spread or get worse. - The vessel still protects the people aboard against the prevailing conditions. 	<p>GENERAL SITUATION</p> <ul style="list-style-type: none"> - Damage to the vessel might affect its seaworthiness or the full extent of the damage has not as yet been determined. - Internal damage control measures and rescue operations have not been completed. Damage control is possible with reasonable resources available to carry out the proper measures. - Damage to the vessel may pose a direct or indirect threat 	<p>GENERAL SITUATION</p> <ul style="list-style-type: none"> - The vessel is significantly damaged, affecting its seaworthiness, and there is a threat to the people aboard. - A fire, leak or other damages to the vessel are not under control and escalation is highly likely. - The vessel no longer protects the people aboard against the prevailing conditions. - Major external resources are required. 	<p>GENERAL SITUATION</p> <ul style="list-style-type: none"> - The vessel is capsized, broken, sunk, burnt or otherwise damaged so badly that it no longer provides protection to the people aboard against the prevailing conditions (that is, the vessel has totally lost its seaworthiness). - Even if the vessel is still completely or partly afloat, it is no longer safe to work aboard, even to save human lives.
<p>OPERATIONAL FOCUS</p> <ul style="list-style-type: none"> - Damage control or firefighting operations are not or are no longer required. - If there are injured people aboard, the operational focus is on emergency care. - Only patients in need of urgent care are evacuated from the vessel. - Active monitoring of the situation aboard is important. - Continuous monitoring of the situation aboard is important. 	<p>OPERATIONAL FOCUS</p> <ul style="list-style-type: none"> - Damage control or firefighting operations are not or are no longer required. - If there are injured people aboard, the operational focus is on emergency care. - Only patients in need of urgent care are evacuated from the vessel. - Active monitoring of the situation aboard is important. operations. - Continuous monitoring of the situation aboard is important (risk of the situation turning "red"). 	<p>OPERATIONAL FOCUS</p> <ul style="list-style-type: none"> - The operational focus is on evacuation of the vessel. - All non-essential persons will be evacuated from the vessel. - Patient classification may not be able to be carried out aboard the vessel. - If enough resources are available, damage control/ firefighting will be carried out to provide extra time for evacuation. - Emergency towing to shallows could be an alternative to evacuation, or a means of gaining time for actual evacuation. - Continuous monitoring of the situation aboard becomes more important (damage usually spreads progressively = significant risk of the situation turning "black"). 	<p>OPERATIONAL FOCUS</p> <ul style="list-style-type: none"> - The operational focus is on rescuing people on the hull as well as searching for and rescuing those in the water. - Patient classification cannot be carried out aboard the vessel. - Operations involving diving or rescue by means of hull penetration are special operations that are planned and decided on separately. - As a rule, additional personnel are not dispatched from land into the vessel.

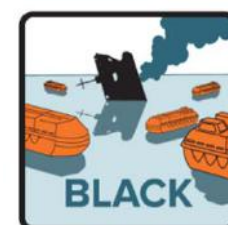
Other SAR classification systems

- **According to Emergency Phases**
International Maritime and Aeronautical
 - Uncertainty Phase
 - Alert Phase
 - Distress Phase
- **According to size of the Accident**
 - Daily mission (1-10 persons OR max 2 seri
 - Multi Patients mission (less than 20 person
 - Disaster (over 20 persons OR over 10 seri
 - Multi Actor case (humans, environmental a



Vessel TRIAGE categories

GREEN	YELLOW	RED	BLACK
THE VESSEL IS SAFE AND CAN BE ASSUMED TO REMAIN SO	THE VESSEL IS CURRENTLY SAFE, BUT THERE IS A RISK THAT THE SITUATION WILL GET WORSE	THE LEVEL OF SAFETY HAS SIGNIFICANTLY WORSENERED AND EXTERNAL ACTIONS ARE REQUIRED TO ENSURE THE SAFETY OF THE PEOPLE ABOARD	THE VESSEL IS NO LONGER SAFE AND HAS BEEN LOST



Vessel TRIAGE categories: examples

GREEN

THE VESSEL IS SAFE AND CAN BE ASSUMED TO REMAIN SO



Vessel TRIAGE categories: examples

YELLOW

**THE VESSEL IS CURRENTLY SAFE,
BUT THERE IS A RISK THAT THE
SITUATION WILL GET WORSE**



Vessel TRIAGE categories: examples

RED

THE LEVEL OF SAFETY HAS SIGNIFICANTLY WORSENERED AND EXTERNAL ACTIONS ARE REQUIRED TO ENSURE THE SAFETY OF THE PEOPLE ABOARD



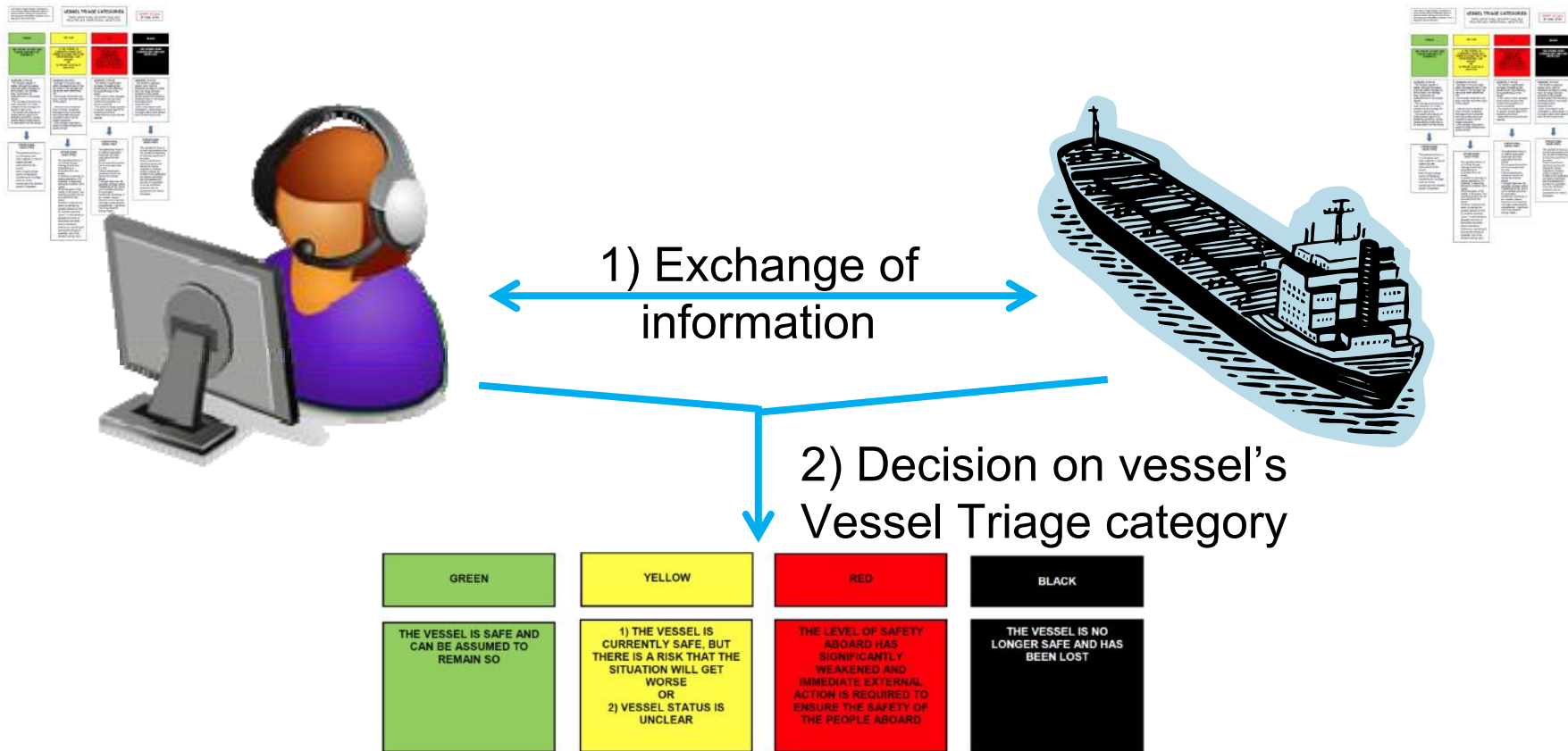
Vessel TRIAGE categories: examples

BLACK

**THE VESSEL IS NO LONGER SAFE
AND HAS BEEN LOST**



Common language



Threat factor matrix

Threat factors	GREEN	YELLOW	RED	BLACK
Flooding	Flooding affects a limited or contained space and has no effect on the vessel's stability and seaworthiness.	Flooding can be kept under control with pumps and watertight compartments, but the seaworthiness of the vessel is restricted.	Extensive flooding or progressive flooding to undamaged watertight compartments. Flooding cannot be kept under control and poses a direct danger on the entire vessel.	Flooding is so severe that evacuation operations are no longer possible. OR Vessel has capsized or sunk.
Listing, decrease of stability	Listing or decrease of stability does not affect the seaworthiness of the vessel.	Seaworthiness of the vessel is restricted due to a decrease of stability or a notable list.	Large heel angles. The seaworthiness of the vessel is significantly impaired, its stability is threatened and there is an imminent need to evacuate.	Stability is decreased to such an extent that evacuation operations are no longer possible. OR Vessel has capsized or sunk.
Decrease of manoeuvrability	Vessel's manoeuvrability is hampered, but the vessel can still proceed on its course.	Vessel has lost its manoeuvrability, but is still capable of emergency anchoring or drifting safely.	Vessel has lost its manoeuvrability and is not capable of emergency anchoring or drifting safely.	(Not applicable)
Black-out	Functions important for ship operations are kept running by backup systems while the fault is repaired.	Operational capability of the vessel is limited: Backup systems do not work as planned OR functions important for ship operations are kept running by backup systems, but the fault cannot be repaired at sea.	A full black-out of long duration that cannot be repaired at sea poses a direct danger on the entire vessel.	(Not applicable)
Fire, explosion	Fire has been extinguished and there is no danger of reignition AND/OR the consequences of an explosion do not affect the vessel's safety.	Fire or explosion affects only a limited area and can be brought under control with the vessel's own or external damage control/firefighting resources.	Fire cannot be kept under control OR the consequences of an explosion pose a direct danger on the entire vessel.	Conditions on board the vessel are not survivable. The consequences of the fire or explosion pose a direct danger to persons aboard. OR Vessel has been destroyed.
Danger posed by hazardous substances	Release of hazardous substances on board does not pose any danger on the vessel.	Release of hazardous substances on board poses a danger in certain sections of the vessel, but the release can be contained to these sections.	Release of hazardous substances on board poses a direct danger on the entire vessel.	(Not applicable)

Threat factor matrix – example

Threat factors	GREEN	YELLOW	RED	BLACK
Flooding	Flooding affects a limited or contained space and has no effect on the vessel's stability and seaworthiness.	Flooding can be kept under control with pumps and watertight compartments, but the seaworthiness of the vessel is restricted.	Extensive flooding or progressive flooding to undamaged watertight compartments. Flooding cannot be kept under control and poses a direct danger on the entire vessel.	Flooding is so severe that evacuation operations are no longer possible. OR Vessel has capsized or sunk.

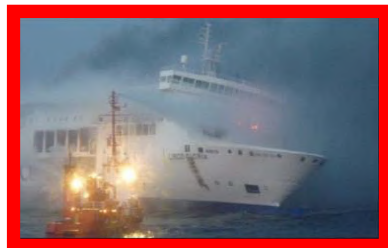
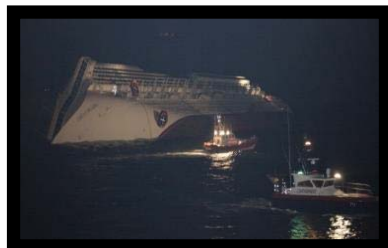
Working principle for categorization

Threat factors	GREEN	YELLOW	RED	BLACK
Flooding YES	Flooding affects a limited or contained space and has no effect on the vessel's stability and seaworthiness.	Flooding can be kept under control with pumps and watertight compartments, but the seaworthiness of the vessel is restricted.	Extensive flooding or progressive flooding to undamaged watertight compartments. Flooding cannot be kept under control and poses a direct danger on the entire vessel.	Flooding is so severe that evacuation operations are no longer possible. OR Vessel has capsized or sunk.
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Decrease of manoeuvrability YES	Vessel's manoeuvrability is hampered, but the vessel can still proceed on its course.	Vessel has lost its manoeuvrability, but is still capable of emergency anchoring or drifting safely.	Vessel has lost its manoeuvrability and is not capable of emergency anchoring or drifting safely.	(Not applicable)
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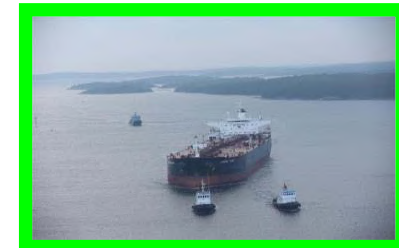
Vessel TRIAGE category

GREEN	YELLOW	RED	BLACK
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Operational focus based on Vessel TRIAGE classification



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OPERATIONAL FOCUS	OPERATIONAL FOCUS	OPERATIONAL FOCUS	OPERATIONAL FOCUS
<ul style="list-style-type: none"> - Damage control or firefighting operations are not or are no longer required. - If there are injured people aboard, the operational focus is on emergency care. - Only patients in need of urgent care are evacuated from the vessel. - Active monitoring of the situation aboard is important. 	<ul style="list-style-type: none"> - The operational focus is on limiting damage / damage control and preparations for possible evacuation from the vessel. - In addition to carrying out damage control measures and rescue operations, it is important to determine the actual condition of the vessel. - At the discretion of the master of the vessel, non-essential persons can be evacuated from the vessel. - Proactive measures are taken to stabilise the situation aboard so that its condition becomes "green" or alternatively to allocate more time to evacuation and other rescue operations. - Continuous monitoring of the situation aboard is important (risk of the situation turning "red"). 	<ul style="list-style-type: none"> - The operational focus is on evacuation of the vessel. - All non-essential persons will be evacuated from the vessel. - Patient classification may not be able to be carried out aboard the vessel. - If enough resources are available, damage control/ firefighting will be carried out to provide extra time for evacuation. - Emergency towing to shallows could be an alternative to evacuation, or a means of gaining time for actual evacuation. - Continuous monitoring of the situation aboard becomes more important (damage usually spreads progressively = significant risk of the situation turning "black"). 	<ul style="list-style-type: none"> - The operational focus is on rescuing people on the hull as well as searching for and rescuing those in the water. - Patient classification cannot be carried out aboard the vessel. - Operations involving diving or rescue by means of hull penetration are special operations that are planned and decided on separately. - As a rule, additional personnel are not dispatched from land into the vessel.



Vessel TRIAGE

Technology development



Threat factor Stability and Flooding

- Based on SOLAS s-factor

$$s_{final} = K \cdot \left(\frac{GZ_{max}}{0.12} \cdot \frac{range}{16} \right)^{\frac{1}{4}} \quad K = \sqrt{\frac{15^\circ - \phi}{15^\circ - 7^\circ}}$$

GREEN	small heeling and good stability, $s_{final} = 1.0$
YELLOW	increased risk due to heel and/or decreased stability: $0.8 \leq s_{final} < 1.0$
RED	large heeling and/or decreased stability: $s_{final} < 0.8$

- Based on comparison of

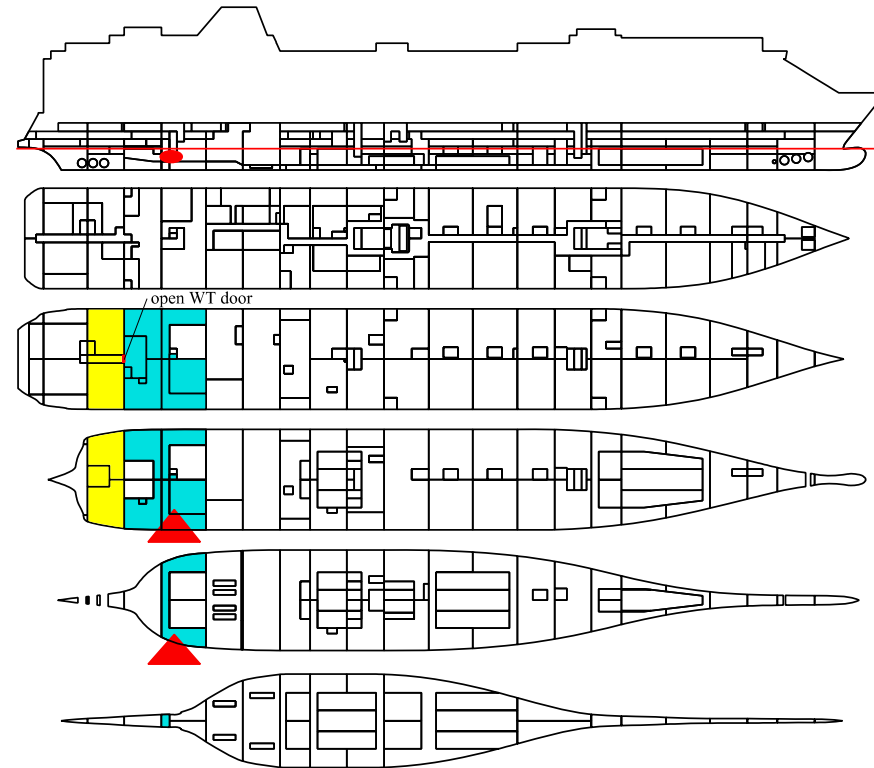
- actual measured/predicted flooding extent
- interpolated maximum floodable length for that location

$$F_{ext} = \frac{L_{flood}}{FL(x_{flood})}$$

GREEN	flooding is limited to a single WT compartment
YELLOW	more than one WT compartment is flooded but $F_{ext} \leq 1.0$
RED	Flooding extent exceeds floodable length, $F_{ext} > 1.0$

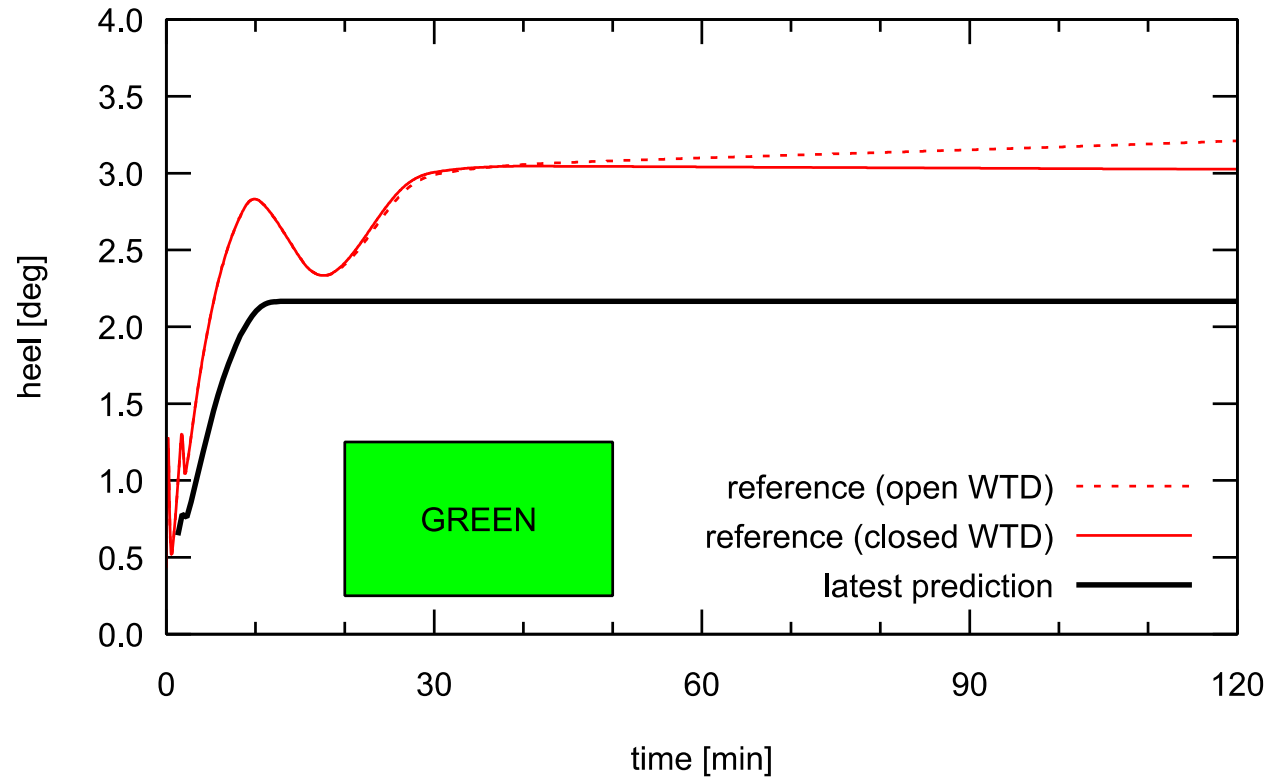
Example: collision damage

- Large passenger ship
125000 GT
- Collision damage to 2 WT compartments
- One open WT door that is
successfully closed after 10
minutes before flooding
progresses



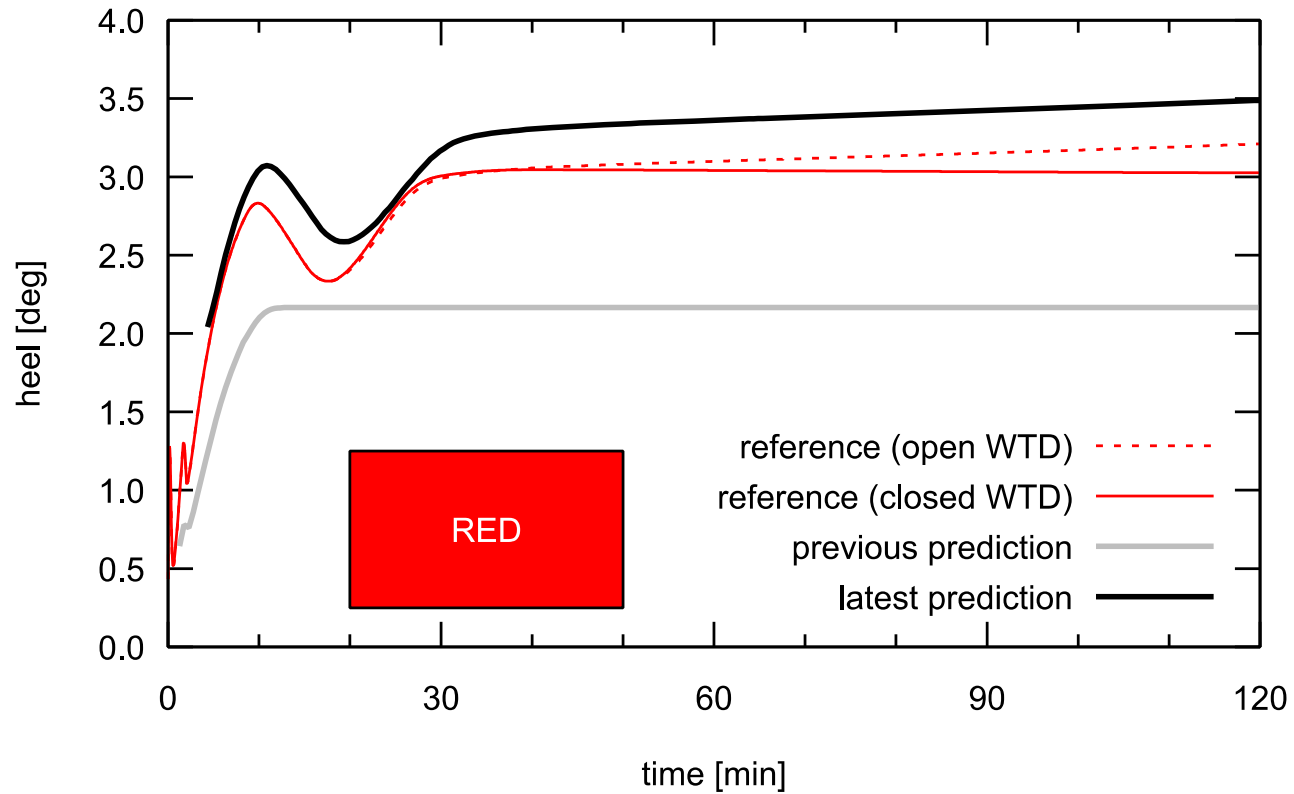
Water detected in one WT compartment

1st prediction

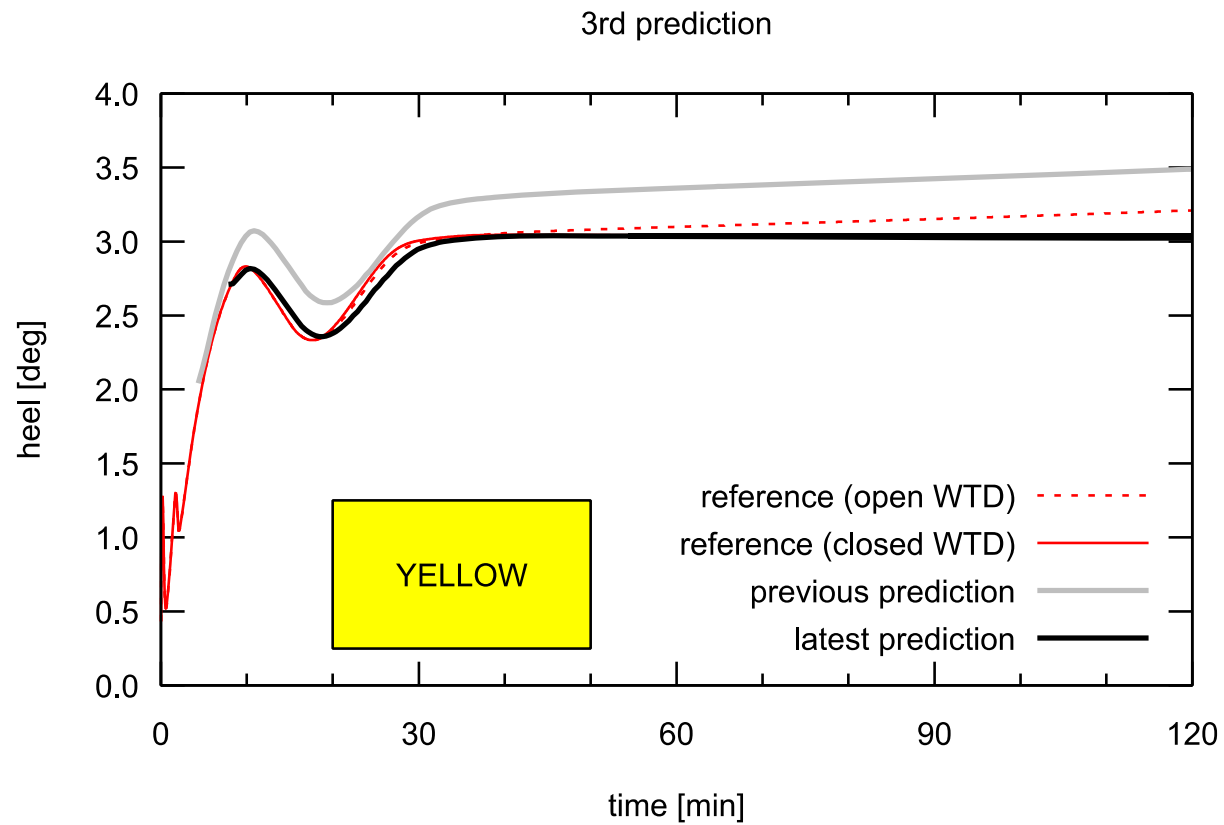


Water predicted to spread because of open WT door

2nd prediction



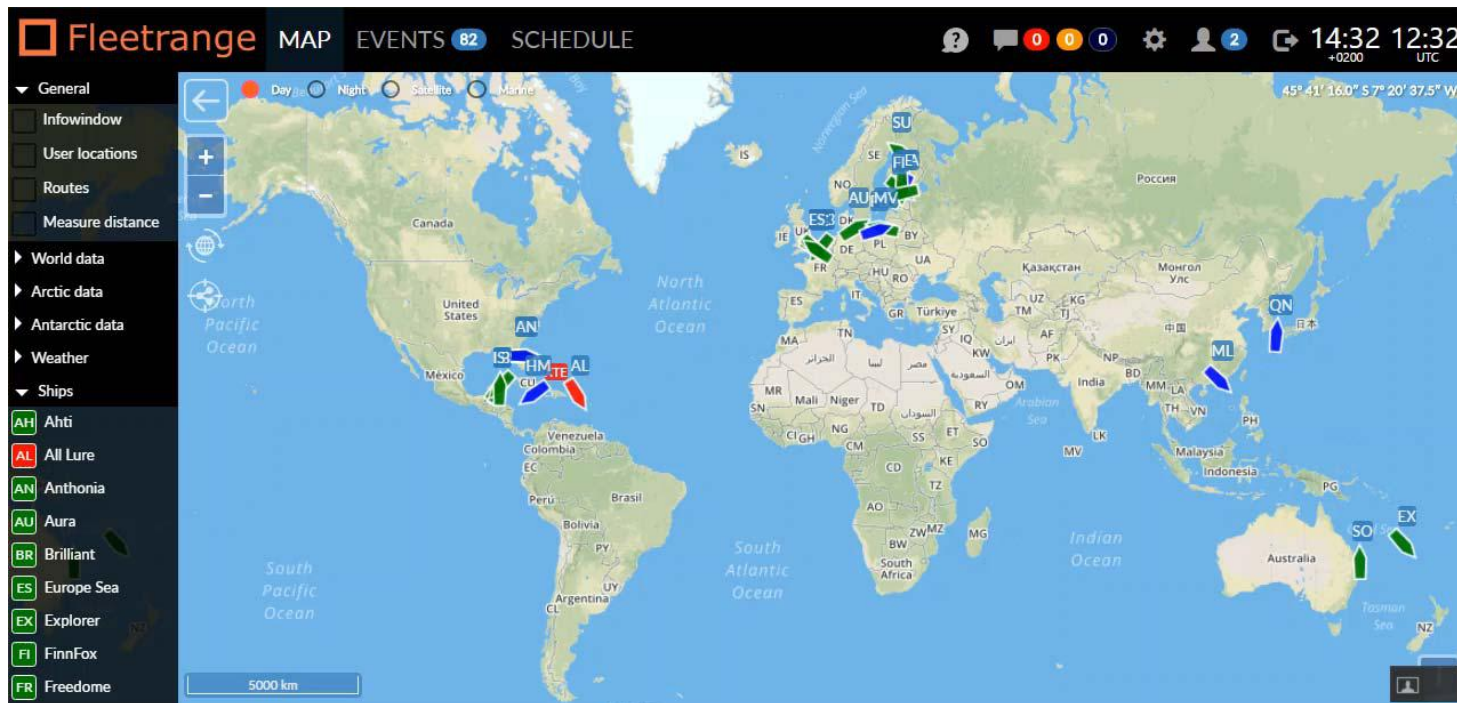
WT door closed, flooding limited to two WT compartments



Fleetrange service

The screenshot displays the Fleetrange service interface. The top navigation bar includes 'Fleetrange', 'MAP', 'EVENTS 166', and 'SCHEDULE'. The right side of the header shows the time '14:35' and '12:35 UTC' with a '+0200' offset. The main map area shows the Baltic Sea region, including parts of Norway, Denmark, Sweden, Finland, Estonia, Latvia, and Lithuania. A vessel named 'FINNFOX' is highlighted in the Baltic Sea, with a green arrow indicating its movement from Helsinki towards Tallinn. The assessment panel on the right provides details for the vessel: 'FINNFOX HELSINKI->TALLINN', 'Under way using engine', and 'Last seen 6 mins ago'. It shows a 'GREEN' assessment status and a message: 'Ice damage and water in forepeak, currently contained'. The panel also displays the number of crew (145) and passengers (1236), and offers options to 'Start new TRAINING assessment', 'Start new REAL assessment', or 'Cancel all assessments and return to normal'. A 'Confirm and next' button is visible at the bottom of the panel.

Fleetrange service



Place of refuge - risk assessment tool

A risk assessment tool that feeds the decision making process

An unified and coordinated command and control of the situation

A structure for rapid and effective decision-making.

Risk criteria based ranking of potential places of refuge (Vessel Triage).

Input from all the stakeholders when designing a strategy and a risk assessment procedure.

Establishing technical and objective criteria and procedures for risk assessments pertaining to requests for refuge.



Vessel TRIAGE

Regulatory development



NCSR3 concerns and comments to Vessel TRIAGE

- Valid for all accidental situations
- No additional workload to crew
- Benefit to communication should be confirmed
- SAR response decisions should not become Master responsibility
- No conflict with existing emergency assessment and communication methods
- Application should be consistent between individuals
- Communication procedures should be harmonized across multiple SAR regions
- Regulatory implications should be accounted for

Future international development...



Finnish Transport Safety Agency and Finnish Border Guard will submit the Vessel Triage initiative to ICAO-IMO approval:

2015 Vessel TRIAGE METHOD has been presented to ICAO-IMO Joint Working Group with a proposal for testing and a long term goal to implement it in the IAMSAR Manual

2016 Vessel TRIAGE METHOD was presented to NCSR3. Proposed and agreed to recommend further testing.

2017 Vessel TRIAGE METHOD was presented to NCSR4. NCSR4 did not support the inclusion to the IAMSAR manual at this time and encouraged for further testing.



Shared Situational Awareness

Shore Side
Responders



JRCC / MRCC



Distress
Vessel



Shipping
Company



HIGHLY POSITIVE DEVELOPMENT

EUSBSR FLAGSHIP PROJECT

- EU Strategy for Baltic Sea Region PA Safe supports this initiative and has included it to the new Policy Area on Maritime Safety and Security program
 - To become a leading region in maritime safety and security

NAPA LTD

- Applies Vessel TRIAGE principles and colors in its passenger ship flooding damage stability systems
- Internationally 90 % market share on cruising industry

PLACE OF REFUGE DECISION PROCESS

- Finnish Transport agency will include Vessel TRIAGE method in their place of refuge decision making process

MIRG SOP'S

- Emergency responders will benefit from this method
- Nationally and Internationally

SHIPPING COMPANIES WANT TO IMPLEMENT

- Finnlines, Tallink-Silja, Viking Line, Bore want to implement in their safety management systems in due course.

IMRF SUPPORTS THE INITIATIVE STRONGLY



INTERNATIONAL
MARITIME RESCUE

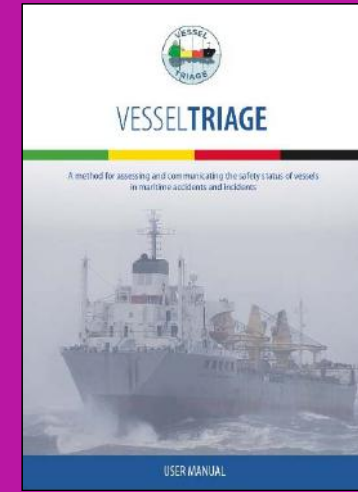


***”No: Vessel TRIAGE is not the answer
to life, the universe and everything.
But it will help improve understanding.
And that alone makes it worthwhile”***

David Jardine-Smith IMRF secretary

Thank you. Questions?

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