



Waterborne Transport



HORIZON EUROPE

Workshop:

“Horizon 2020 Research and Innovation
delivering smart, green, safe and
competitive waterborne transport”

07/02/2022 | 09:30 – 16:15

Residence Palace (Brussels) and online

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FLooding Accident REsponse (FLARE)

FLOODING ACCIDENT RESPONSE

Project FLARE - Duration: June 2019 – May 2022 (Nov. 2022)

IAB



Contract number 814753



Ship Response after Accident Flooding

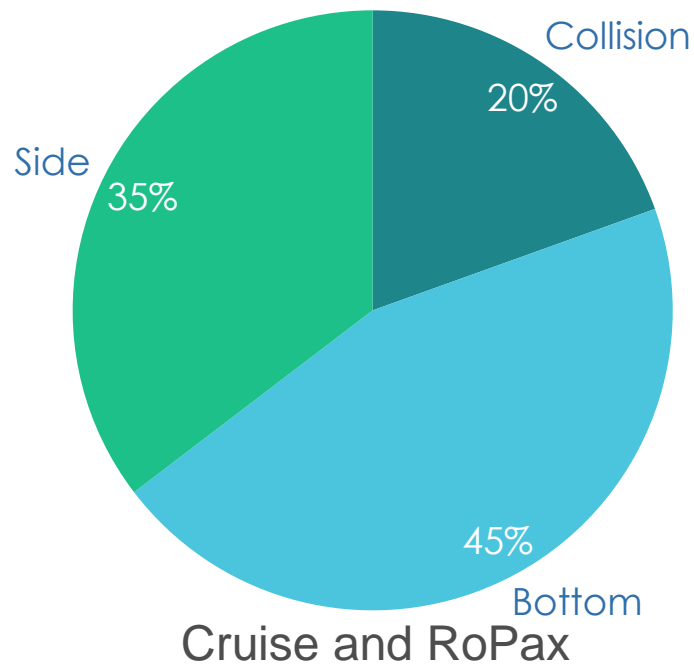
- The disastrous *Costa Concordia* in front of the Island *Giglio* in 2012 (and before it *Express Samina/Paros* and *Sea Diamond/Santorini*) showed the vulnerability of passenger ships against side and bottom grounding
- Long raking damages are not considered so far in SOLAS
- EMSA3 and eSAFE projects already showed a way to consider all hazards in one probabilistic harmonised model
 - Collision
 - Bottom grounding
 - Side grounding/contact
- *Risk from collision* (that is the basic accident type in SOLAS) *has the lowest impact based on most recent statistics of passenger ship accidents*



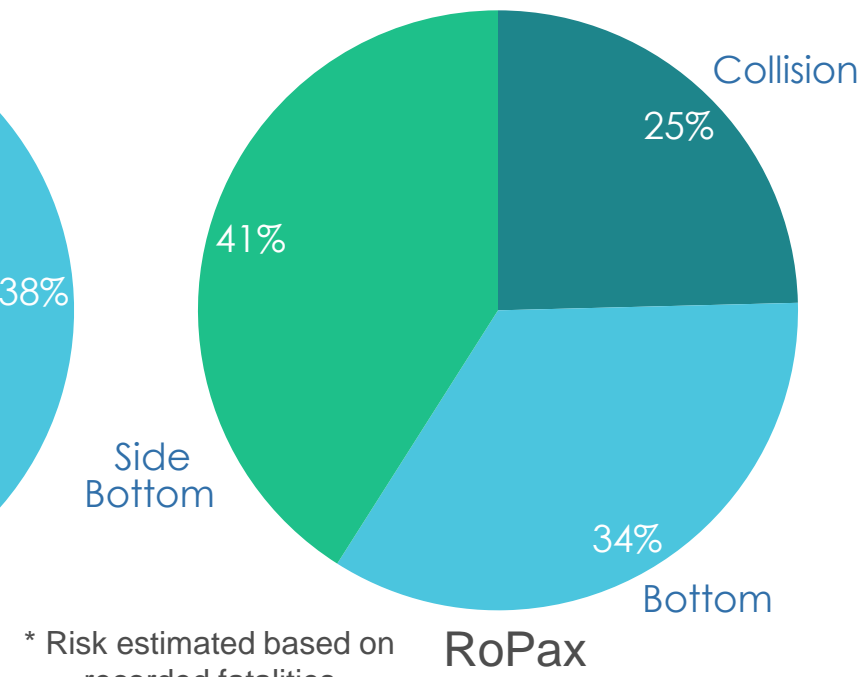
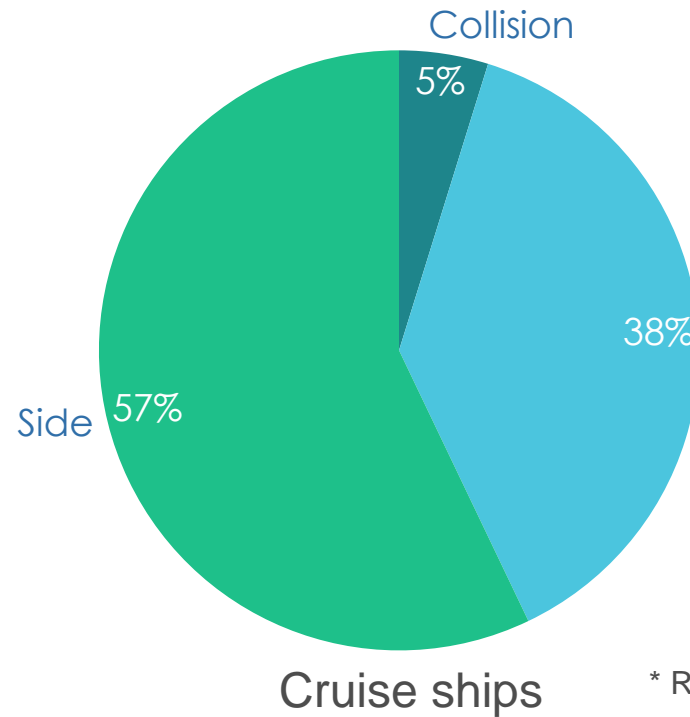
Contribution of Passenger Ship Hazards

- Result of accident statistics

Frequency of flooding

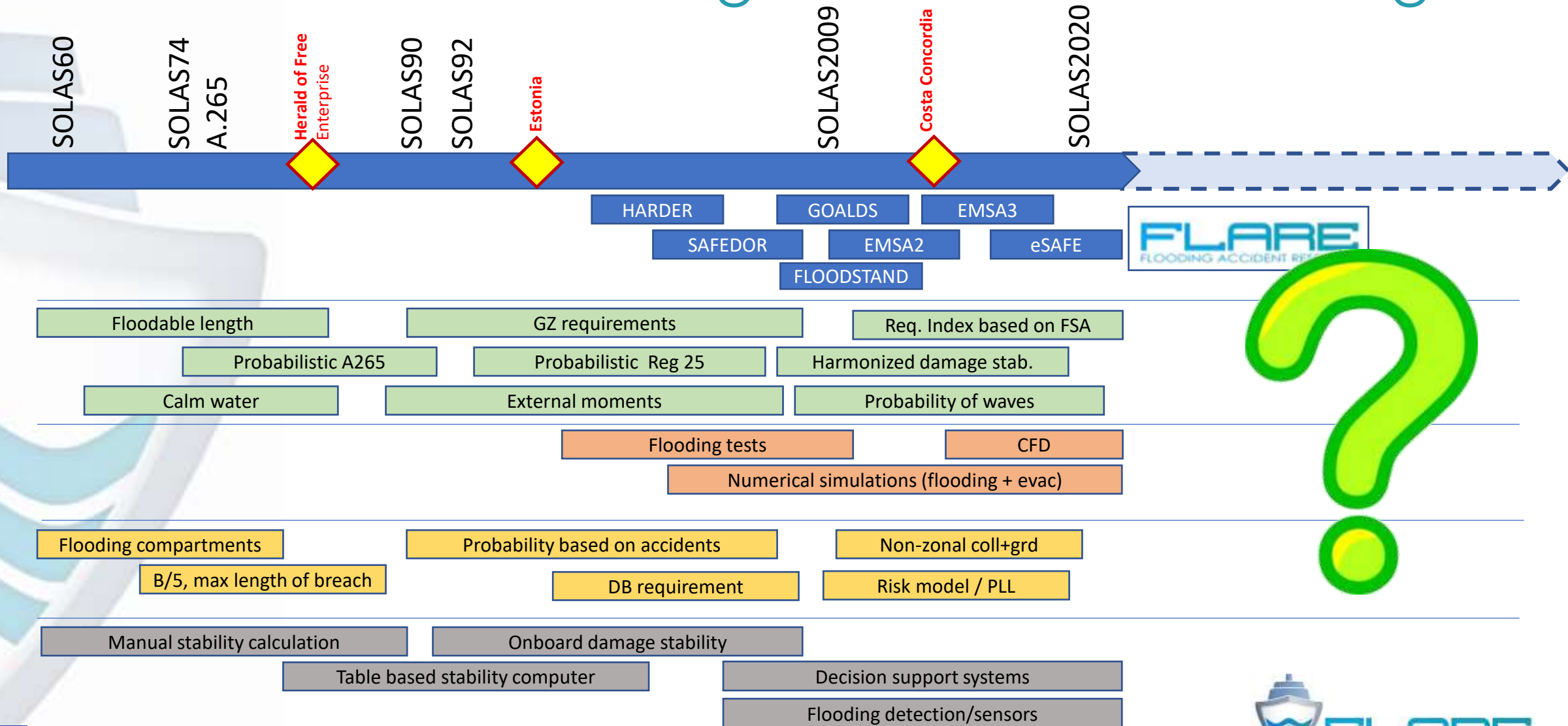


Estimation of risk*



* Risk estimated based on recorded fatalities

Passenger Ship Survivability after Flooding: Where are we coming from and where we go?!



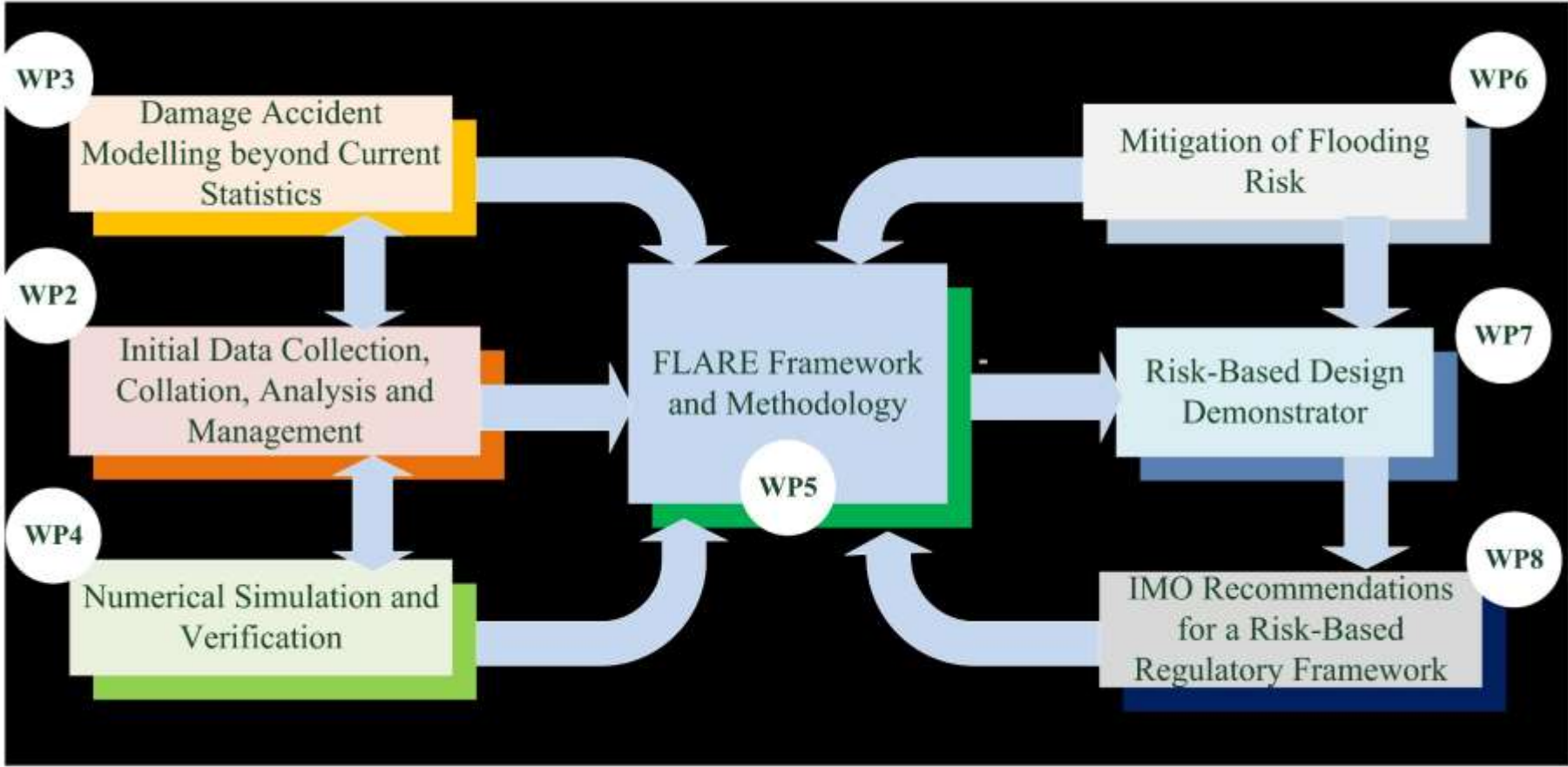
Where we are now in SOLAS

- Harmonized probabilistic approach for cargo and passenger ships
- Additional and higher requirements for passenger ships
- Collision damage stability assessment based on probabilities of damage extent and location; the probabilities of the breach, the survivability and other parameters are mainly based on damage statistics of cargo ships
- Water on deck issue of RoPax ships is now considered
- Bottom grounding is only considered via a deterministic requirement of minimum double bottom height
- Damage stability and evacuation are only linked in an indirect way by a rough empirical model
- There is only a required index for collision; R-Index is based on FSA

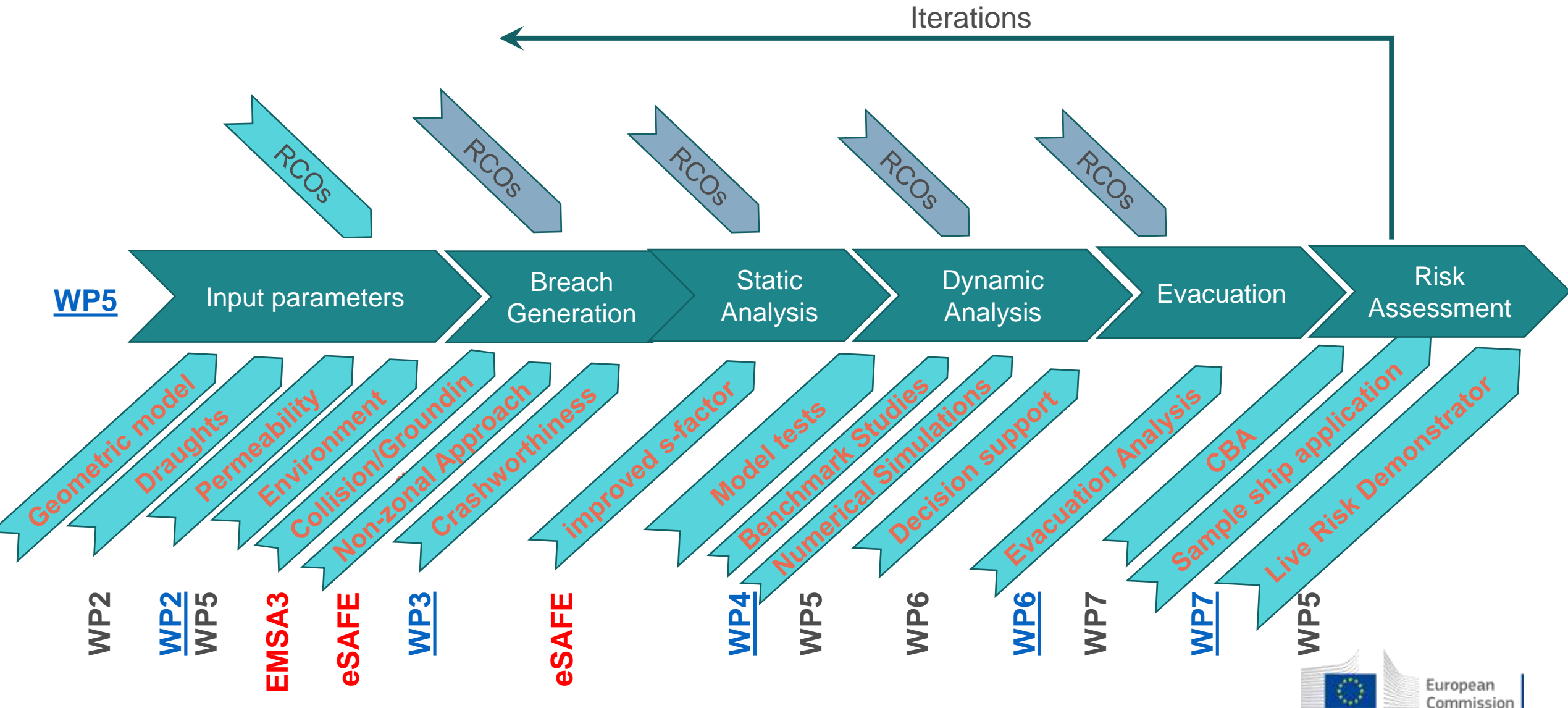
Where are we already beyond SOLAS

- Numerical flooding simulations are state of the art in industry
 - FLARE Numerical benchmark studies and verification by model experiments
- Evacuation simulations have been used over many years
- **Design improvements are driven by simulations**, but are sometimes in contradiction with simplified/empirical SOLAS requirements
- **Intensive research over the last 30 years** has delivered a better insight to flooding events and mitigating measures
- **Voluntary onboard policies by the industry** have shown significant reduction of risk

FLARE project objectives, work-packages and organisation



Taking Stock and Moving Forward



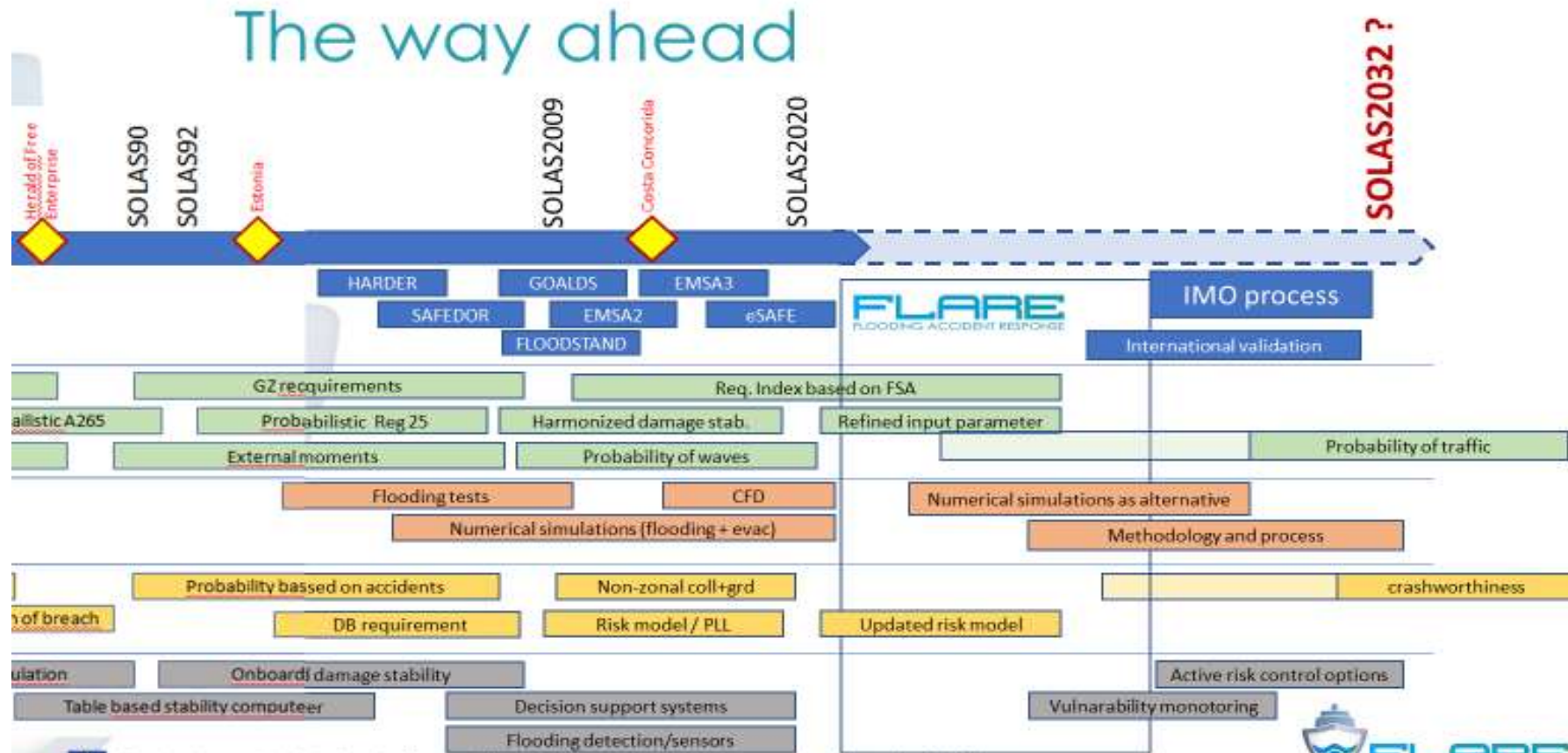
What has to be done now?

- The FLARE method is to be applied to a wider range of ships and designs
- FLARE will ensure that the results will be made available to the maritime community and regulators
- A Formal Safety Assessment FSA is to be carried out to establish the required level of safety
- An anchor point at IMO ([WP8](#)) should be established to share results and initiate the discussion among member states (see FLARE presentation at EU Passenger Ship Safety Group on December 13, 2021)

FLARE will deliver more tangible results

- **Basic input parameters have been validated**
 - Operational draughts
 - Permeability of modern ships
- **A suitable process to combine static and dynamic calculations/simulations has been developed**
- **Standards how to perform and approve numerical simulations**
- **Validation of Risk Control Options for sample ships**
- **Combination of flooding and evacuation simulations**
- **Proof of concept by industrial end-users (shipyards, class, operators)**

The way ahead to IMO (WP8)



The project has received funding from the European's Horizon 2020 research and innovation programme (Contract No.: 814753)

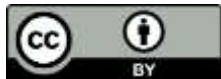


European Commission

Dissemination Activities

<https://www.flare-project.eu/>

Thank you



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Data Collection, Collation, Analysis and Management (WP2)

Objectives:

Preparing and collecting suitable input data to form a foundation for the following work

Main Results

- Sample ships designed
- Operational data collected >>>> new draught distribution proposed
- Permeability checked >>>> new values for permeability proposed
- Traffic data analysed >>>> first steps into the use of actual traffic density, basis for WP3
- Risk model >>>> previous risk model (GOALDS, EMSA3) updated and restructured
- Accident data base >>>> all possible sources considered, data base consolidated and risk model quantified with updated frequencies

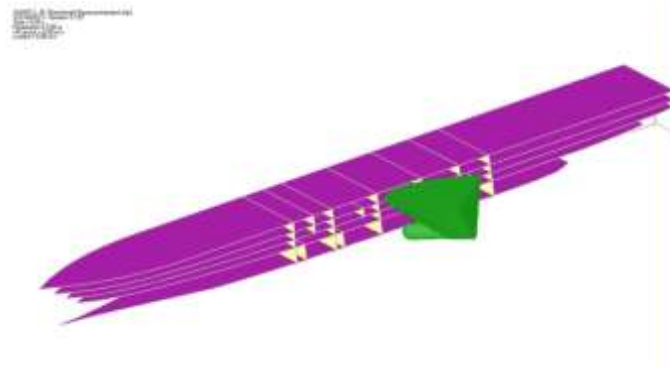
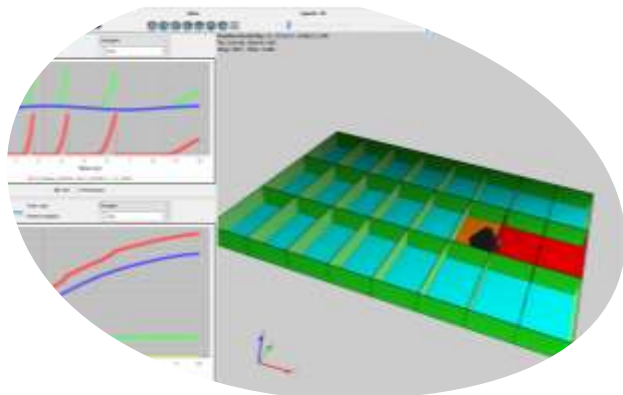


Damage Accident Modelling beyond statistics (WP3)

Objective: Development of methods to assess the influence of **crashworthiness** on ship damage stability

Main Results

- Developed Direct and Comparative methods for the assessment of damage stability using rapid multiphysics models
- Demonstrated the effectiveness of methods for collision and selected grounding scenarios involving Ro-Pax and Cruise line vessels



Outlook

- Further testing of comparative method and developments of combined strength and stability models for the side grounding scenarios is necessary
- Subject to further development implementation of methods within the context of SOLAS 2020 and beyond is feasible



Damage Accident Modelling (WP3)

Objective (WP3) : Methods to assess the influence of crashworthiness on ship damage stability

Method 1: Comparative approach

Reference ship



Reinforced ship



Structural analyses

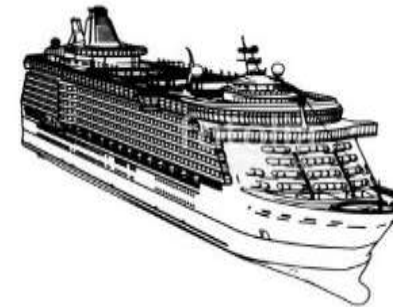
Scaled SOLAS Damage distributions



$$\Delta A = A_{CWS} - A_{RS}$$

Method 2: Direct approach

Reference ship

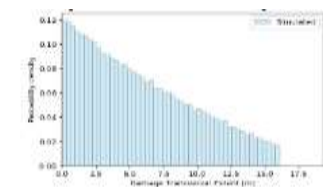
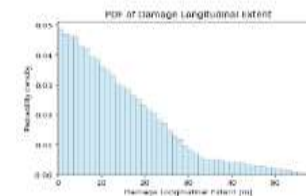


Scenarios
(big data analytics)

Structural analyses

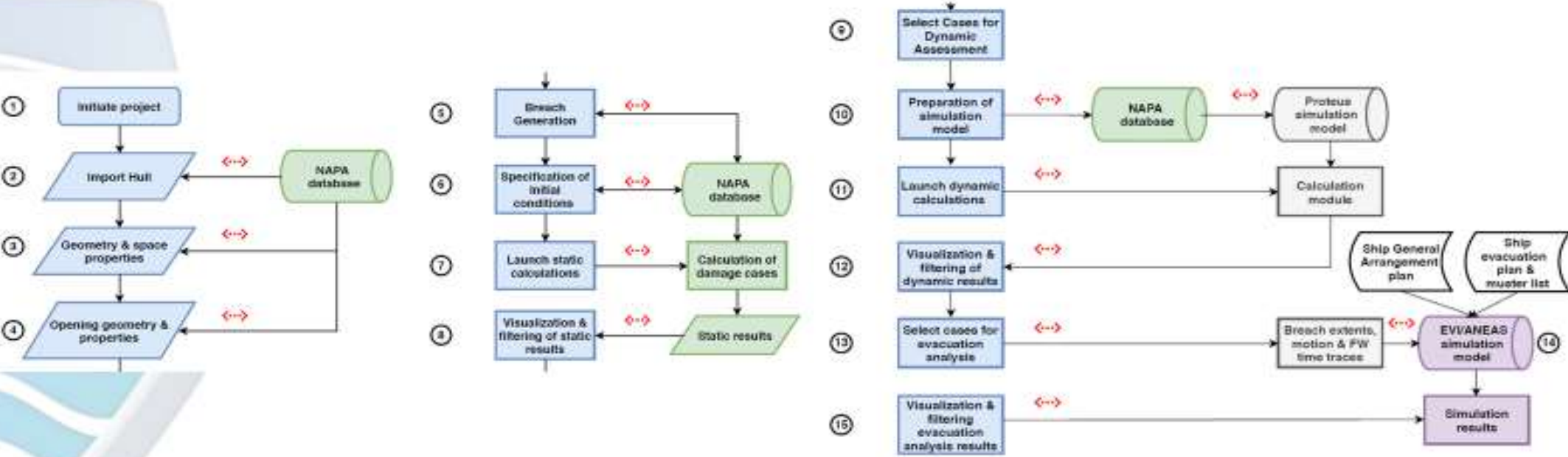


Specific damage distributions



The main goal of **Flooding Risk Model** (WP5) is to develop a framework to enable different independent **software components/tools to be linked** and used under a described process to **provide application-specific solutions** in support of life-cycle flooding risk assessment and management (**FLARE FRAMEWORK FF**).

WP 5 objectives and results – Process



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Mitigation of the Flooding Risk (WP6)

Objectives

Advanced operational vulnerability assessment onboard

Flooding severity assessment onboard

Risk control options for post-accident flooding emergencies

Main Results

New methods for onboard vulnerability assessment and flooding severity assessment

Extensive crew questionnaires held

30+ RCOs identified and most promising studied in detail



Outlook

Newly developed methods improve situational awareness and support decision making onboard both in intact and flooding situation

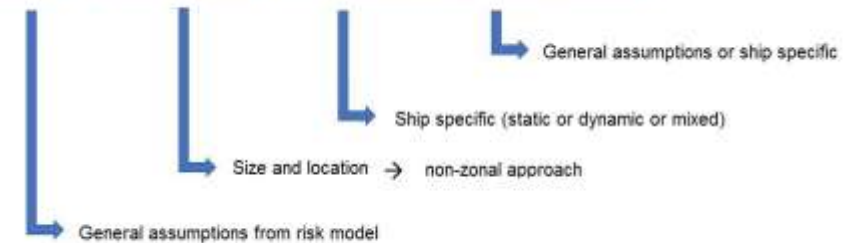


Risk-Based Design Demonstrators (WP7)

Objectives

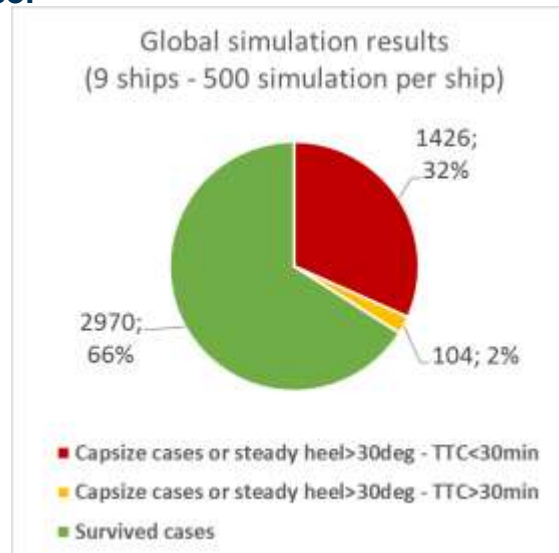
- Calculation of the flooding risk for sample ships by FLARE Framework
- Analysis and implementation of the mitigation measures (including cost estimation)
- Implementation of an enhanced CBA tool allowing to put safety, cost and environment into one picture when assessing RCOs
- Demonstration of the management of the operational/accidental flooding risk over the life-cycle of the vessel

$$PLL = \text{hazard-freq.} * \text{breach-freq.} * (1 - \text{survivability}) * \text{fatality-rate}$$



Main Results

- New procedure for calculation of flooding risk (collision, side and bottom grounding) with two level approach (static & dynamic analysis)
- Flooding risk calculated for 9 ships (seven SOLAS 2020 designs and 2 SOLAS 90 existing ships)



Outlook

- The methodology for grounding risk assessment is mature and it may be included in the SOLAS framework in the short term
- New procedure to calculate the flooding risk with two level approach, static and dynamic analysis both, could replace the present SOLAS approach in the long term



IMO recommendations for a risk-based regulatory framework (WP8)

Objectives: Make recommendations to IMO (SDC/MSC) with respect to

- Amending existing prescriptive regulations
- Introducing a new holistic evaluation framework for passenger ship damage stability
- Providing further guidance for the assessment of novel RCOs on damage stability

Main Results

- List with shortcomings of current IMO framework and proposals how to address these
- Classification of proposals regarding amendments to framework and alternatives to framework

Outlook

- Inform stakeholders on details of the proposal
- Select topics to be brought forward to IMO and prepare submissions



Dissemination & Exploitation (WP9)

Objective: to enable and optimise the impact of FLARE and pave the way to market-uptake of the project results through:

- **Coordination of project dissemination and communication activities** aimed at society and the general public in broad terms
- **Liaison** with the European Commission, the International Maritime Organisation as well as the Advisory Board
 - **FLARE presentation at EU Passenger Ship Safety Group on December 13, 2021**
- **Development and sharing of experiences and innovative solutions** with external stakeholders and end-users
 - Int. Conferences, Maritime Safety Fora, Internet Media, Publications
- **Coordination of efforts for dissemination** within the FLARE consortium

Regular FLARE webinars :

- The FLARE project is organizing a series of webinars dedicated to the main results of the project. Two webinars have been already carried out:
- 1st webinar: “Ship Damage Stability” – 25th November 2021
- **2nd webinar: Fundamental Data and Approach for Flood Risk Assessment” – 3rd February 2022**
- Next webinars: 3rd March TBC; ...**monthly**



Costa Concordia bottom/side damage



Transatlantic Liner *Andrea Doria* sinking after midship breach by the *Stockholm* (1956)

