Final Report Summary - SAFEDOR (Design, Operation and Regulation for Safety)

The aim of the SAFEDOR project was to improve the safety of maritime transportation and to increase European maritime industries' competitiveness through the integration of safety as design objective into ship design and risk assessment into the approval frameworks.

SAFEDOR aimed to provide additional design freedom for ship and systems and an appropriate approval process that introduces safety as additional objective - additional to standard performance requirements like speed, capacity, endurance etc. - and by proposing a modernised regulatory framework to facilitate risk analysis as additional element of the approval process. This way, the regulator imposes boundary conditions directly on the targeted safety performance of the ship with quantified risk acceptance criteria and the ship designer decides how to achieve the prescribed level of safety cost-effectively. Thus, a path to approve novel ships beyond the current regulatory constraints is offered.

Strategic research objectives were formulated to meet the outlined vision, these being:
- Develop a risk-based and internationally accepted regulatory framework to facilitate first principles approaches to safety.
- Develop design methods and tools to assess operational, extreme, accidental and catastrophic scenarios, accounting for the human element, and integrate these into a design environment.
- Produce prototype designs for European safety-critical vessels to validate the proposed methodology and document its practicability.
- Transfer systematically knowledge to the wider maritime community and add a stimulus to the development of a safety culture.
- Improve training at universities and aptitudes of maritime industry staff in new technological, methodological and regulatory developments in order to attain more acceptance of these principles.

To ensure an effective control of the project, the work programme is broken down into a number of work packages (WPs) which in turn are divided into Subprojects (SPs) and Tasks (TKs). Individual partners have been allocated responsibility for technical co-ordination within the respective WPs, SPs and TKs. In summary, SAFEDOR comprises 7 work packages, 32 subprojects and 221 tasks.
Risk-based design entails the systematic integration of risk analysis in the design process targeting risk prevention/reduction as a design objective. An essential pre-requisite to undertaking this is the availability of fast and accurate first-principles tools. This is addressed in work package (WP) 2 of SAFEDOR. Also knowledge of the effect of design changes/measures to enhance safety cost-effectively (considering all major hazards and ensuing accident categories and scenarios) is crucial. This issue is addressed in a number of work packages (FSA studies in WP4, implementation of first-principles tools in WP2 and in WP3). To pursue this activity effectively, it is necessary to provide an integrated design environment (IT platform) to facilitate and support a holistic approach to ship design (WP5) that enables appropriate trade-offs and advanced decision-making, leading to optimal ship design solutions. The next essential step (design approval) necessitates the development and consolidation of a risk-based regulatory framework to set conditions for design approval that would allow linking ship design performance optimisation with risk minimisation (WP4). To embed the risk-based design process into the heart of the maritime industry, design teams are assembled representing a large sector of the EU shipping and shipbuilding industries to pursue the design (from concept to approval) of innovative ship types that cannot be approved under the current prescriptive rules (WP6). Finally, a knowledge management, training and dissemination system is put in place to maximise benefits by targeting all the stakeholders of maritime safety and to exploit RTD results by systematic evaluation, consolidation and marketing (WP7).

Within SAFEDOR, several engineering tools to predict the safety performance of a vessel in extreme and accidental conditions were newly developed or refined. These tools address the main accident categories, namely collision and grounding, fire and explosion, intact and damage stability, systems' failures. Two benchmark studies on the validation of software tools for the assessment of intact and damage stability were completed.

Eight design teams developed innovative ship concepts at the beginning of SAFEDOR. Two of these concepts, namely the 'Composite Superstructure' and the 'ROPAX of enhanced Survivability' have been further elaborated to the preliminary design stage. Work within SAFEDOR also addressed development of innovative focusing on areas with high impact on safety, such as an innovative bridge layout, a novel system to distribute electrical power and several new concepts for life saving appliances.

A number of dissemination and training measures were planned from the beginning of SAFEDOR to enhance knowledge on risk-based approaches within the maritime industry and to add stimulus towards developing a new safety culture. SAFEDOR attracted a large number of people to the annual public conferences. In addition, annual public reports and presentations were provided together with fact sheets for main stakeholders. Two training courses were organised with one focusing on regulators and the second one on PhD students and young professionals from all the industry. To complement the material for students and experienced engineers alike, besides the offered training course material, a handbook on risk-based ship design was published, which is being offered commercially by SPRINGER Publishers.

The outcome of SAFEDOR comprises the integration of all operational, technological, environmental and human related factors concerning safety at sea throughout the entire vessel life cycle; the demonstration of the potential of risk-based frameworks for safety assessment techniques, integrated design environments and optimisation of ship operation processes for safe and economic shipping.

With risk-based approaches firmly established in the maritime industry, ship owners will be able to realise innovative ships and maritime transport solutions - challenging current rules - relating to, e.g. new layouts or use of new materials and systems. With the novel approval process, implementation of novel and risk-based ships will be faster and more reliable.

The benefits for shipyards arise from the fact that yards acquainted with risk-based approaches are among the first to respond to the increasing demand from ship owners to realise risk-based ships. In addition, production costs are expected to be reduced through application of risk-based approaches.

Marine equipment manufacturers will benefit through enabling new and optimised systems incorporating new functions and materials. Understanding and applying risk-based approaches will be a competitive advantage. The key asset of risk-based designed ships will be the knowledge to prove compliance with risk acceptance criteria, which results in new opportunities for patenting innovative solutions.

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