RINA MARITIME INNOVATION COMMITTEE

Theme: Hydrodynamics & Propulsors

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Hydrodynamics & Propulsors

This theme covers the hydrodynamic processes, tools and technologies that may be used to support the performance evaluation of marine vehicles, to improve performance and to ensure designs meet legislative requirements.

Objectives

- The key objectives and drivers for developing technology and innovation in hydrodynamics and propulsors include:
  - To demonstrate that designs comply with current and emerging legislation, particularly that of IMO.
  - Improved safety through hydrodynamic design and testing.
  - The continuing requirement for improved efficiency and reduce fuel consumption through hydrodynamic optimisation.

Driver Priorities (1)

These are the drivers that we believe will have the most significant impact on the marine industry

Driver	Technology Description
IMO legislation EEDI/EEOI	The EEDI (Energy Efficiency Design Index) for new ships is an important technical measure that was introduced to promote the use of more energy efficient equipment and engines; its introduction was expected to stimulate innovation and technical development of all the components influencing the fuel efficiency of a ship from its design phase. The Energy Efficiency Operational Indicator (EEOI) is a tool for monitoring ship efficiency performance over the life of the ship. EEOI enables effect of any changes during the operation of the ship on fuel efficiency. Hydrodynamic and propulsor design forms a key part of how improving fuel efficiency and demonstrating design performance against criteria.
IMO guidelines on underwater noise	IMO have guidelines to reduce underwater noise that recognise the short and long term effects of shipping noise on marine life. The dominant source of noise is propeller cavitation which is effectively a feature of the propeller design itself and the quality of the wake into the propeller. Improving propeller design for reduced noise or improving the quality of the wake into a propeller has the potential to reduce hydroacoustic noise.

Driver Priorities (2)

These are the drivers that we believe will have the most significant impact on the marine industry

Driver	Technology Description
IMO 2nd generation intact stability	The IMO 2nd generation intact stability expands on the traditional static stability criteria to included dynamic stability failures such as parametric rolling.
Reduction in fuel consumption	There is greater emphasis placed upon understanding the impact of design changes on the resistance and powering of a ship early in the process; including experimental and numerical methods and model scale to full scale correlation.
Increase in safety culture	There are still challenges with the operation of ships and offshore structures in hostile environments; higher fidelity outputs are required from traditional methods of evaluating responses in rough weather such as the hydrodynamic loads on a ship, the impact of extreme accelerations from small high speed craft on the crew.

Technology Priorities

Technologies that we believe will have the most significant impact on the marine industry

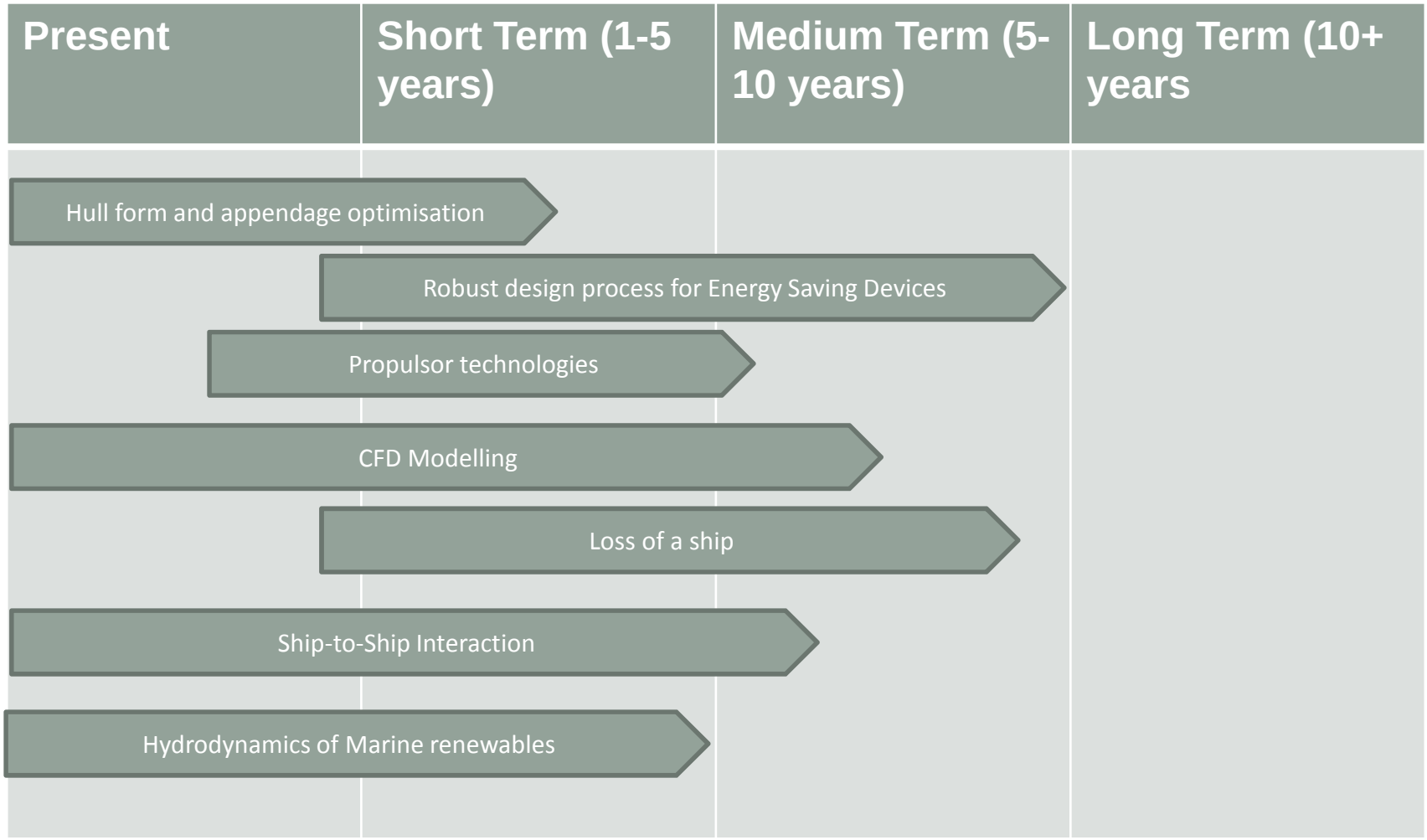
Technology	Technology Description
Hull form and appendage optimisation	Technologies for optimising the hull form for minimum drag optimisation exist but perhaps not used robustly in design; the use of novel arrangements such as bow design to improve the efficiency of the hull are being considered more and more. There is a growth in unconventional hull forms that are targeted towards low drag or improvements in seakeeping performance.
Energy Saving Devices	The aim of an energy saving device is to reduce the power requirement of a ship without adversely affecting its capability. The use of novel technologies to improve the efficiency of the design are being introduced, however, in many case the physical mechanisms by which these devices work are no always full understood, implying there is a lack of robustness to the way ESDs are used in design.
Propulsor technologies	There are a number of technologies, that are beyond that typical of a traditional propeller, that are aimed at improving propulsor efficiency and/or improving cavitation related noise.

Technology Priorities

Technologies that we believe will have the most significant impact on the marine industry

Technology	Technology Description
CFD	The use of advanced CFD techniques in the design process including unsteady CFD and predictions at full scale; providing these techniques have been fully validated for the particular application.
Loss of a ship	An accurate definition of the boundary between survival and loss of a ship is required in any framework for assessing ship safety. The direct assessment of the stability of a design against these new criteria require specific model tests or simulations to be undertaken; in some cases these techniques require further development.
Ship-to-Ship Interaction	Development of numerical and physical methods for evalutating the ship-to-ship problem to include skin-to-skin, RAS (UNREP), ship to ship transfer at zero speed, tug– ship interaction and ship passing scenarios.
Hydrodynamics of Marine renewables	Experimental and numerical modelling of such devices, including the simulation of the Power-Take-Off systems

Exploitation Timescales



Challenges & Risks

- Introduction of further legislation may mean that the current tools and techniques require improvements.
- Disruptive technologies may present challenges for current hydrodynamic assessment methods
- Price of oil has a significant impact on the motivation to optimise design for fuel use (perhaps tempered by the IMO EEDI).
- Greater reliance on hydrodynamic modelling requires robust verification and validation of the methods, designers need to understand the applicability of the results

Conclusions – Hydrodynamics & Propulsors

- Innovation in hydrodynamics and propulsors is largely lead by the introduction of legislation aimed at reducing greenhouse gases, reducing the impact on marine life and increasing safety.
- Hydrodynamics is considered a mature technology so impact on design is evolutionary rather than revolutionary.
- Changes to legislation and disruptive technologies may challenge the suitability of existing tools and techniques.