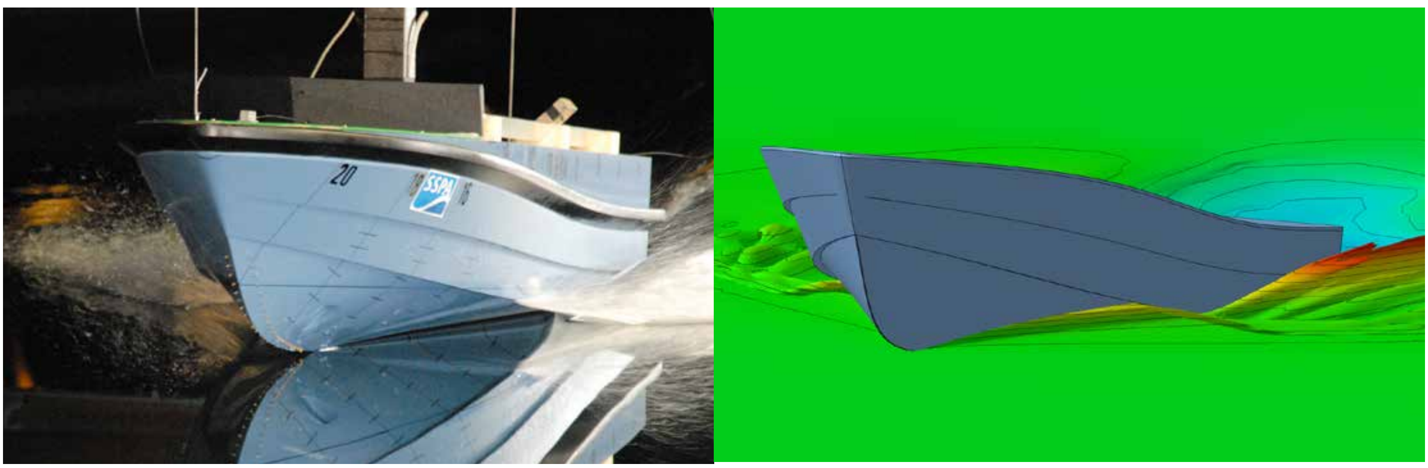
# Strategic research plan for hydrodynamics

What will be tomorrow's challenges in the shipping world, and how can SSPA contribute to the solutions? What kind of services will be requested? What tools do we need to develop to meet these demands? Knowledge-based organisations like SSPA constantly have to adapt to a changing world. Our strategic research plans help us to set the direction and to break down the challenges into manageable goals. Structured research and development is a prerequisite for continuing to support our clients and partners with leading edge, innovative and sustainable maritime solutions.



*Analysing the energy efficiency of the hull on RS 158 Idar Ulstein using EFD, (Experimental Fluid Dynamics) and CFD (Computational Fluid Dynamics).*

## Two-way knowledge flow

At SSPA, all specialist engineers can be involved in research and development (R&D) in addition to the commercial work. This facilitates a two-way knowledge flow between research and business. It also makes the job as a specialist at SSPA stimulating and evolving. The decentralised R&D-organisation does, however, require very clear management with defined goals, roadmaps and prioritisation. Otherwise, it is tempting to solve the problems that are right in front of you, without considering the full picture.

## Accurate and independent evaluation

The starting point of the strategic research plan is also the endpoint: "What is our role in the society of the future?" We believe that our fundamental mission will remain unchanged: to act for sustainable maritime development by providing hydrodynamic advice and expertise. Our main contribution in the hydrodynamic field has always been, and will continue to be, to assist the maritime industry with performance assessments at the design stage. Our recommendations are always based on scientific knowledge that is systematically tested and verified. Without accurate and independent evaluation, the ship building industry cannot develop energy-efficient and safe vessels.

## A range of tools for different situations

The next step in forming the research plan is to forecast which questions society will pose, and try to identify the possible tool that can be used to answer these questions. A potential pitfall is focusing only on the newest and most advanced technologies. However, the toolbox should contain a range of tools for different situations. We need to deliver solutions with a confidence level that is high enough, and at a cost that is in line with that level. Take for example the question: "What will the power demand be for this ship?" In the beginning of the design stage, a rough estimation is probably enough. As the design work continues, a comparative assessment against a similar ship is requested, and later in the process an absolute prediction to the highest possible confidence level is required for the builders' contract or Energy Efficiency Design Index (EEDI) certificate. Obviously, different tools are utilised to provide the predictions in each situation.

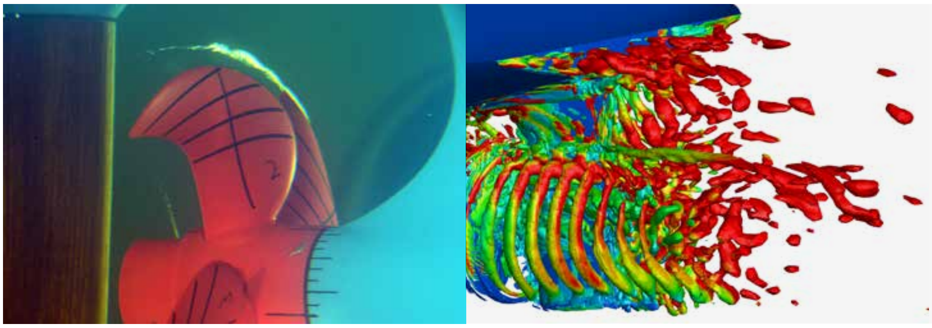
## Identify the gaps

By mapping the anticipated future services and tools, it is possible to identify the gaps where R&D is needed. A gap in the matrix obviously means there is a tool that we need to develop. But it can also mean a tool that we do have, but which is not accurate enough or is too expensive to use.

With the tools map and the identified gaps to hand, the last step in devising the Research Plan is to break down the work into manageable packages, set priorities and draw up the detailed timetable. The work is organised into a number of programmes, and we can present the plan for three of them here.

## Energy efficiency in calm water

The services related to this area include e.g. design optimisation of hulls, propellers and appendages, as well as prediction of the attained speed for an EEDI certificate or builders' contracts. Traditionally, these services have been based on towing tank



*Measuring the propeller efficiency and cavitation erosion, examples of evaluation using EFD and CFD.*

test, Experimental Fluid Dynamics (EFD). There is no doubt that Computational Fluid Dynamics (CFD) will take on an increasing role not only for design optimisation but also for predictions. In fact, it already has. Switching to pure CFD-based methods for high confidence speed-power prediction and comparison of complex cases is still not a reliable option. We believe, however, that there is great potential in using CFD and model testing in combination.

Most of our R&D activities in this programme are aimed at improving today's methods by developing different types of CFD/EFD hybrid methods (combined methods). Some examples worth mentioning are form factor determination, effective wake scaling, propeller open water curve scaling, submerged transom scaling, skin friction scaling of rough and fouled surfaces, skin friction scaling of appendages and scaling of energy saving devices.

New methods finally need to be internationally accepted and formalised as standards. For that reason, and as part of SSPA's strategic research programme, we are currently chairing the newly started Specialist Committee on Combined CFD/EFD Methods under the International Towing Tank Conference (ITTC).

## Seakeeping and energy efficiency in waves

Up until now, the seakeeping assessments at the design stage have most often focused on safety and manoeuvrability, but gradually more attention is being given to the effect of waves on fuel consumption. The introduction of the weather factor $f_w$ in the EEDI rule (Highlights issue 64/2017) has paved the way for this development. There is a risk, though, that optimisation towards lower energy consumption (i.e. a better EEDI) will lead to ships that are dangerously underpowered. This risk will be addressed by the International Maritime Organization (IMO) regulations limiting the minimum installed engine power, which will call for the assessment of a ship's manoeuvrability in severe weather at the design stage. That is a very challenging task to simulate in model tests, and even more demanding with numerical tools.

A consequence of the new trends is that we will need to deliver seakeeping assessments that are more accurate and precise than before, and of different types than what we are used to, e.g. more regular waves and lower speeds. Our R&D projects in this programme aim to meet this demand by improving test technique and smart processing of measured data so that we can maintain the competitive costs and delivery times. At the same time, we are also working on new strategies for using seakeeping CFD methods in the design process as well as assisting with procedures based on the model test.

## Propeller cavitation and erosion

The ambition to achieve higher energy efficiency leads to propeller designs with small safety margins in relation to cavitation and erosion. On top of that, there is increasing awareness of the harmful effect of ship-generated noise on sea life. We therefore believe that the demand for accurate predictions of propeller cavitation at the design stage will continue to grow. Our R&D in this area includes e.g. the development of a new testing technique using acoustic emissions. Moreover, research is being carried out on CFD-based prediction methods for erosion and noise emission, even though there is still a long way to go before commercial applications are likely to be a reality.

## Worldwide allies

Interaction with the global maritime community is a key part of our strategic research programmes. The aforementioned work in the ITTC Specialist Committee on Combined CFD/EFD Methods is one example. Another is our membership of the ITTC Seakeeping Committee, which among other things deals with the recommended procedures for determining the EEDI weather factor $f_w$. The "Community of Practice on Noise" under Hydro Testing Forum is yet another important research ally. Through these channels, we can receive valuable input and ideas, as well as contributing directly to the development of new global standards and methods. And that takes us back to where we started: our mission to act for sustainable maritime development.

*All photos and illustrations by SSPA.*

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### A question with consequences

The efficiency is 3% higher for one of these propellers. 10 sister vessels are built and each one sails for 25 years. That makes a 500,000 tonne $CO_2$ difference if the right propeller is selected.

Do you dare to take the decision without an independent evaluation?