DAMEN SHIPYARDS – HARDWARE IN THE LOOP – ADVANCED SIMULATION TECHNOLOGY

Damen is utilising advanced simulation techniques to digitally optimise the ship development and design process. The technology is called Hardware in the Loop (HIL), and the company is using it as a tool to improve system integration and controls design before construction even begins.

“During commissioning and sea trials of complex vessels we have often experienced problems with interfacing and software functionality. The main reason for these issues is that the first time that all systems come together is on-board. Integrated functionality is most of the time not checked or to a very limited extent.

A HIL platform offers us a way to face such challenges at an earlier stage, thereby resolving issues quicker, in a better manner and in the comfort of our office.

PRECISION SIMULATION

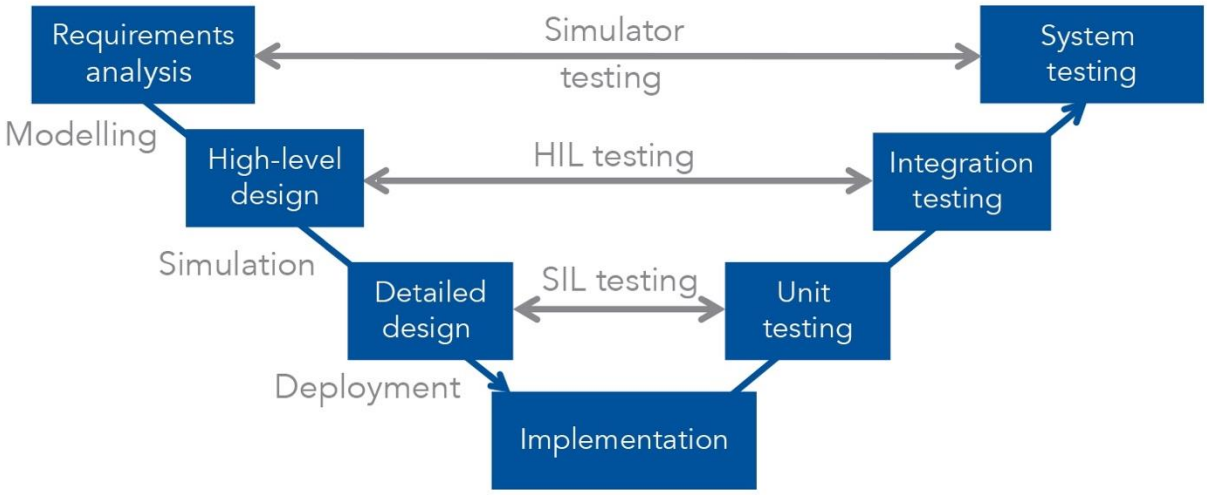
HIL is a platform that enables testing of control systems. The machinery and physical systems connected to the controller that is being investigated are replaced by simulations.

“We can select a control system from a vessel and ‘put it in the loop’ – a simulation environment that allows us to fully investigate the behaviour and performance of that component before we apply it to a full-scale application. The HIL simulation shows us how the controller responds to real operational scenarios.”

“By using simulation technology that can predict performance during defined conditions and operations, we are able to offer our clients extra value. This will allow them to differentiate themselves in their specific market by adding additional workability.”

Looking at other production-based industries, such as automotive and aeronautical, the use of HIL has been seen to save substantial amounts of time and money. “We saw this and it worked well – a little bit like Kommer Damen’s original approach to standardisation after seeing its virtues in the automotive industry.”

Damen very quickly understood HIL's potential in its own operations: "Initially, our idea of applying HIL was for risk management purposes, but we realised that we could also apply this not just to avoid errors, but to improve performance," she notes.



FIRST PROJECTS

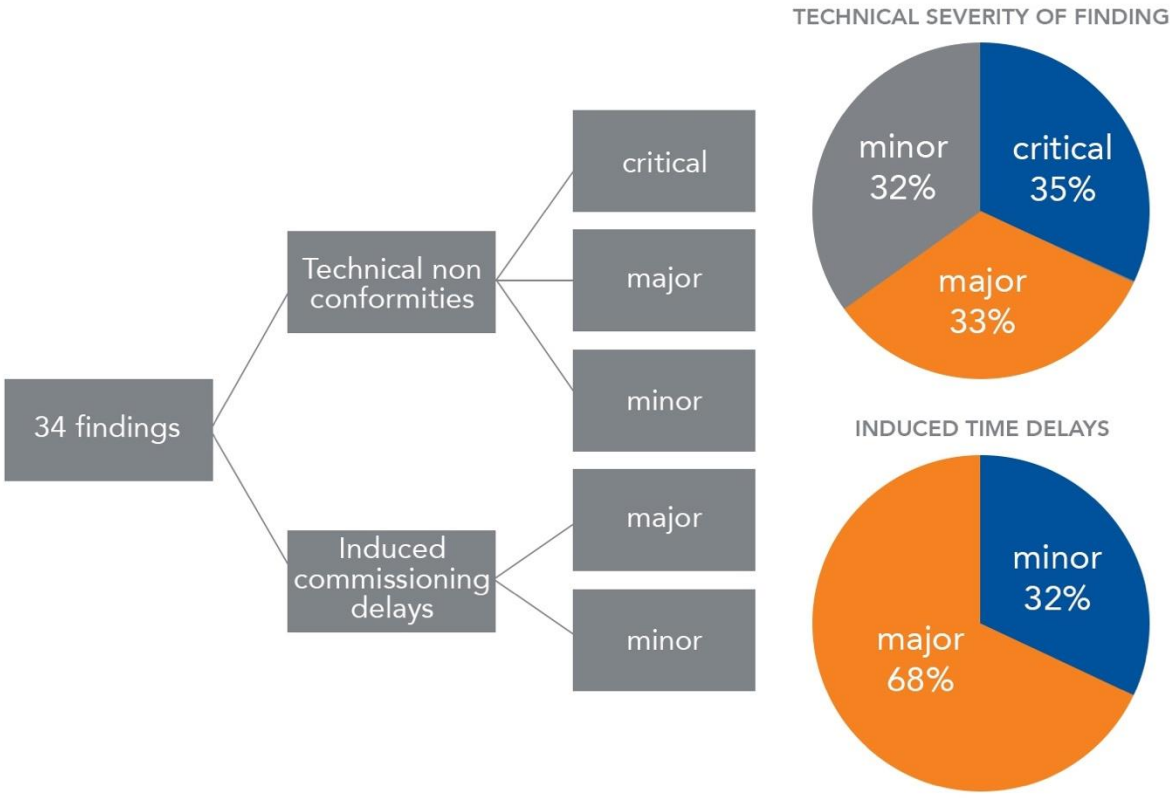
And so began Damen's work with HIL. "One of the first applications was on Bibby Marine Services' Services Operations Vessel *Bibby WaveMaster 1* implemented in MARIN's simulator. In fact, this has been one of the key aspects of this project – to collaborate closely with suppliers and clients, as well as institutes like MARIN, TU Delft etc."

In parallel with this ‘walk to work’ application, Damen decided to invest in its own HIL set-up and a research project was launched to investigate the potential of a real-time simulation environment – making the company one of the few shipbuilding companies in the world to apply HIL.

“The pilot application of the HIL platform was on the Multi-role Aviation Training Vessel *MV Sycamore* for the Royal Australian Navy, from which we had a good response. Trials went well and everyone was very enthousiaste.”

The simulation model runs on the processor hardware of dSPACE. The simulator generates and measures I/O signals via integrated I/O boards. The number of components, and their types, depend on the specific requirements of the project and are configured to fit each application. The implementation software where the interfacing takes place is the Real-Time Interface (RTI). This software is the link between the dSpace hardware and the modelling software of Matlab Simulink.
The first commercial application involved an Offshore Patrol Vessel: “This vessel has two engines per gearbox and a whole array of operational modes and changeovers in addition to two main controllers on the propulsion train from different suppliers. These were brought to Damen and hooked up to the simulator in order to perform

software logics checks and test the integrated functionalities.” The initial findings from these testing sessions were positive: a large number of issues were identified and resolved, all of which would have significantly hindered the commissioning procedure and acceptance trials.



Charter strategies

Focusing clearly on system integration, these projects illustrate how broad HIL technology can be applied. Further examples include:

- Propulsion control systems
- Engine limits/ load control
- DP systems
- System integration testing
- Power management systems
- Hybrid systems

In terms of potential benefits to Damen's customers, HIL technology has three major advantages.

1. Increased fail safe capability of the ship's systems by testing failures and off design conditions and tuning the responses.
2. Enhance quality, save time and money during testing: specified weather conditions can be simulated like in the case of the W2W.
3. Human factor: training ad familiarisation if commissioning engineers and other system users.

PERFORMANCE CONTRACTING

"Performance optimisation is also a part of this; we can offer this to clients wanting a different type of vessel. BC Ferries, for example, were looking to do something more environmentally friendly, and they wanted to make sure it would also be cost-effective. Their question was 'can you guarantee the predictability of a complex system?' The HIL simulator was the way to answer this."

With an eye on future projects and future clients, Ms Xepapa highlights Damen's intention to move towards so-called '**performance contracting**'.

“We often contract on technical specifications, but in the future we could offer a more targeted contract based on the operator’s requirements. This will be a business model of the future.”