Seaway Heavy Lifting sees the benefits of real-time simulation

“Offshore work is all about being prepared”

Courtesy Seaway Heavy Lifting

Report interviews Jan-Peter Breedeveld, SHL Engineering Director about the company’s participation in the OBELICS JIP and the value of real-time simulation for the offshore industry.

Seaway Heavy Lifting, a leading offshore contractor in the global Oil & Gas and renewables industry, has been a customer of MARIN for many years. Based in Zoetermeer, SHL carried out the concept design studies and tank tests for its pioneering crane vessel Oleg Strashnov at MARIN a decade ago. And more recently, SHL has been actively involved in the OBELICS JIP, which has developed heavy lift and ballast operation simulation software suited for an offshore environment.

Mr Breedeveld, who has been with the company for 22 years, comments that SHL is always looking at new technology and was keen to take part in OBELICS. “When we consider the renewables sector, which often needs several heavy lifts that need to be repeated many times, a new approach is required. With turbines and foundations, we have to produce the same lift every day for weeks on end. Part of my job involves looking at how we can make the process more efficient, which was one of the reasons real-time simulation is useful.”

As well as tank tests for the Oleg Strashnov, SHL has worked on a simulation study for motion improvement and multi-body analysis with MARIN. During this time it became clear that the companies have good hydrodynamic analysis capabilities but both wanted to explore the possibilities of ‘connecting the hydrodynamics packages with the visuals’. Soon a two-year JIP, which has recently concluded, emerged for real-time simulations for companies operating crane and heavy lift vessels.

Simulations for offshore work “Until then we could only do hydro-calculations and plot motions, but we were really keen to develop the visuals and connect them for use in real-time simulations. How could we combine hydrodynamic software and animation to make a valuable engineering tool?” There are of course, crane simulators used for training but MARIN and the participants wanted to go beyond this and incorporate all the offshore aspects as well. “This is really a very ambitious project but the JIP proved that the technology is out there.”

During the OBELICS JIP several case studies were prepared by the participants, including a case with SHL’s heavy lift vessel Oleg Strashnov. Because a lot of effort had been put into the development of the models already, SHL decided to carry out several additional simulation exercises at MARIN’s headquarters in Wageningen. This took place in the summer of 2013.

SHL was keen to make the situation as realistic as possible and flew in engineers, offshore superintendents, crane drivers and DP operators, mobilising some 35 people from all over the world. “We also really wanted to link the office and offshore crew and we wanted to get feedback from everyone that would be involved so we can develop this tool.”

Flying everyone in meant that there hadn’t always been a chance for a thorough briefing but SHL and the team pressed ahead. “We knew this was stretching the limit and that we were of the limit of real-time calculation power.”

Stretching the limits Based on a real case, the simulation scenario involved a model of the Oleg Strashnov, together with a crane and barge. The Oleg Strashnov was working in DP-mode and the original DP computer was connected to the OBELICS environment. The SHL team had to ballast and submerge the cargo barge so the base frame structure would pick up sufficient buoyancy to bring the load within the capacity of the 5,000t Oleg Strashnov crane. Then they had to lift the base frame off the barge on DP, move out to the target location and set it down. The barge was not moored but was set on soft springs.

“This was complex, the barge had tanks so we had to include the stability particulars and the base frame also had ballast compartments. We had to ballast the barge and the frame, operate the crane and tugger winches and the vessel ballasting system.” And this proved quite demanding on the system, which actually crashed several times. “We basically overloaded the processors! But we all went away, regrouped and went back with lessons learnt from the first time. However, we are stretching the limits, there is no doubt.”

During the simulation exercise the team discovered several crucial factors for future development. “Importantly, the user interface has to be correct. The crane operator for example, is used to a certain interface. All the readings on the loads and outreach have to be there; if the interface is not right they don’t get the right feedback. And the same goes for all the ballast systems and tanks.”

Environmental conditions such as current and waves could be adjusted during the simulation to find the operational limits during the various stages. The participants


Courtesy Statoil

also found out that when trying to simulate a real situation that offshore operations are very slow! This meant that they had to accelerate the ballast pumps and even skip some parts of the operation. "We really had to think about what we could speed up and crucially, everything has to be predefined, we can't start to change things in the middle of the simulation." Additionally, it appeared that the control of the steering lines was not modelled accurately enough: the advanced control system that is available in reality was not brought into the model.

An important outcome of the simulator exercise was that all the operations were more or less linked to each other and influence each other, he points out. "When we ballast a barge down with the crane connected there are some interaction effects which people ballasting the barge cannot see. The vessel starts to pull on the barge because of the DP system. This is a real influence, not a theory – there is a horizontal force."
It was also very difficult to keep the distance between the barge and vessel constant because of the current load variation. "Keeping the two at a very close distance was very difficult for hours and hours."

Insight into complex operations

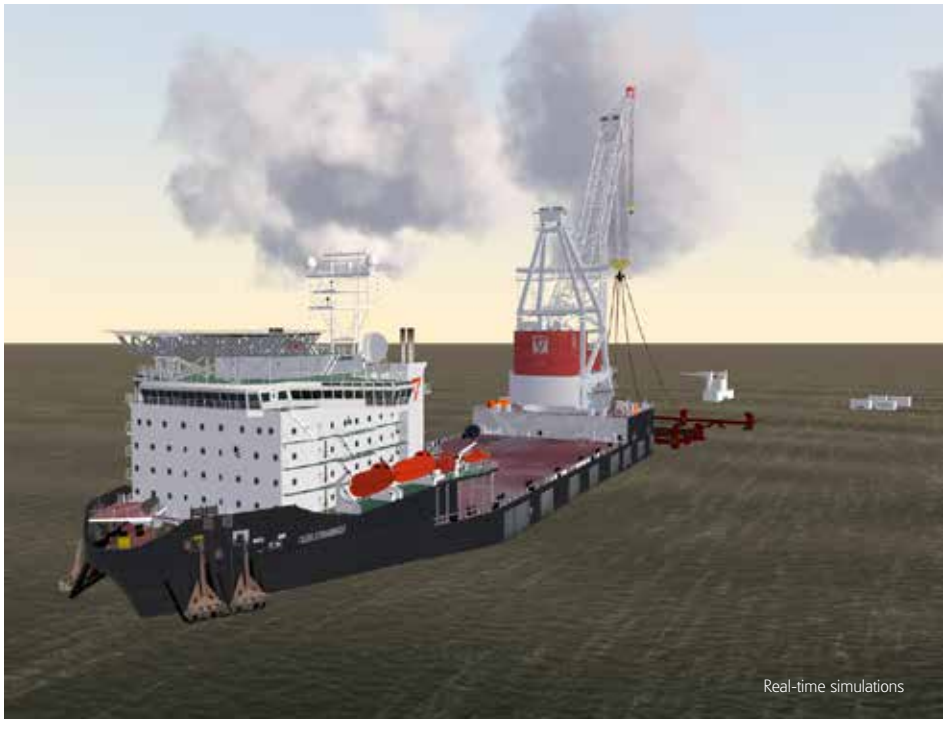
Additionally, another important finding concerned the moment when the barge is submerged and when the base frame had to be lifted off. Clearly, the two detach at a certain time. "If we keep ballasting down and then lift the frame off, the barge comes up again. But how can we define this moment? We found that rather uniquely to engineering, we had to do it step by step, ballasting half a metre at a time. We couldn't just do the operation in two big steps and this requires a lot of interaction between the crane driver and the person handling the ballasting."

The simulation exercise certainly proved worthwhile, says Mr Breedeveld and he sees this development as particularly interesting for non-standard, complex operations or to familiarise the crew with a project. "It is a great opportunity to go through complex procedures and run some alternatives based on various environmental conditions. We can run through the 'what if' scenarios.

"This is also important for an operational review to consider what could be improved. We can go through every step and see it as it would happen offshore. It is not just a drawing on a screen but you can see the project from different points of view – even from above – which is not possible in real life.

"When we ask the offshore crew to do a lift, we ask them to do it once and it has to be right; the captain and superintendent are responsible for the people onboard and the asset. Offshore work is all about being prepared. If these simulation tools can assist them in building up confidence and getting the feel for the operation in advance or if we can give the superintendent better input, it has to be good for the industry." It also helps people be prepared for the unexpected and how they would react if things don't go to plan, he adds.

This simulation exercise led to a good understanding of the problem, emphasises Mr Breedeveld. "Giving people more back up and tools to make them better prepared is important. Ultimately, offshore is all about safety and safety is all about people!"


Real-time simulations