Wind turbine installation vessels are more than "ships with legs".

As many offshore wind farms are authorized, developed and constructed worldwide and wind turbines are rapidly getting bigger and bigger, the question rises whether the existing fleet of wind turbine installation vessels can keep up with the increasing demands of this booming offshore wind industry.

In his inspiring lecture for **KNVTS (Royal Dutch Association of Shipping Technicians)**, on 17 October 2018 in Amsterdam, **Erik Snijders** of **SeaOwls** presented his view on the installation of offshore wind turbines, his experience with the existing fleet of installation vessels and his vision on the challenge that the offshore wind industry is facing. Erik is a naval architect with a great passion for the design of jack-up rigs and vessels. His jack-up consultancy firm **SeaOwls**, based in Rotterdam, specializes in design, engineering, construction, modifications and operations of this remarkable type of vessel. He is recognized in the industry as an expert in four-legged jack-up vessels.

History and future of offshore wind farms and wind turbines

Erik took his audience back to the early days of offshore wind energy. In 1991, Dong Energy (now Ørsted) built the Vindeby wind farm in Denmark in a water depth of just a few meters with turbines of 450kW capacity and 35m rotor diameter. The world's first offshore wind farm was a fact. In the years after, several wind farms were built in the North Sea, testing wind turbine designs and installation methods offshore. Available construction vessels and coastal water jack-up pontoons were used to perform the building of these farms. But it took

until 2010 when large-scale construction of offshore wind farms took off in the UK and later in Germany. A dedicated vessel was needed to build the wind farms, and the first wind turbine installation vessels (of the third generation) arrived on the market in the period 2012-2016. A cross-over between a ship and a jack-up barge, ready to transport four to six wind turbines from port out to sea and perform the assembly of the wind turbine while elevated above sea level. But turbines have grown bigger and bigger at an unexpected rapid pace since then. From the 3.6MW turbines (120m rotor diameter) that were installed in 2012, we have already seen turbines of 5MW, 6MW and 7MW and are now installing 8MW turbines with 164m-rotor diameter.

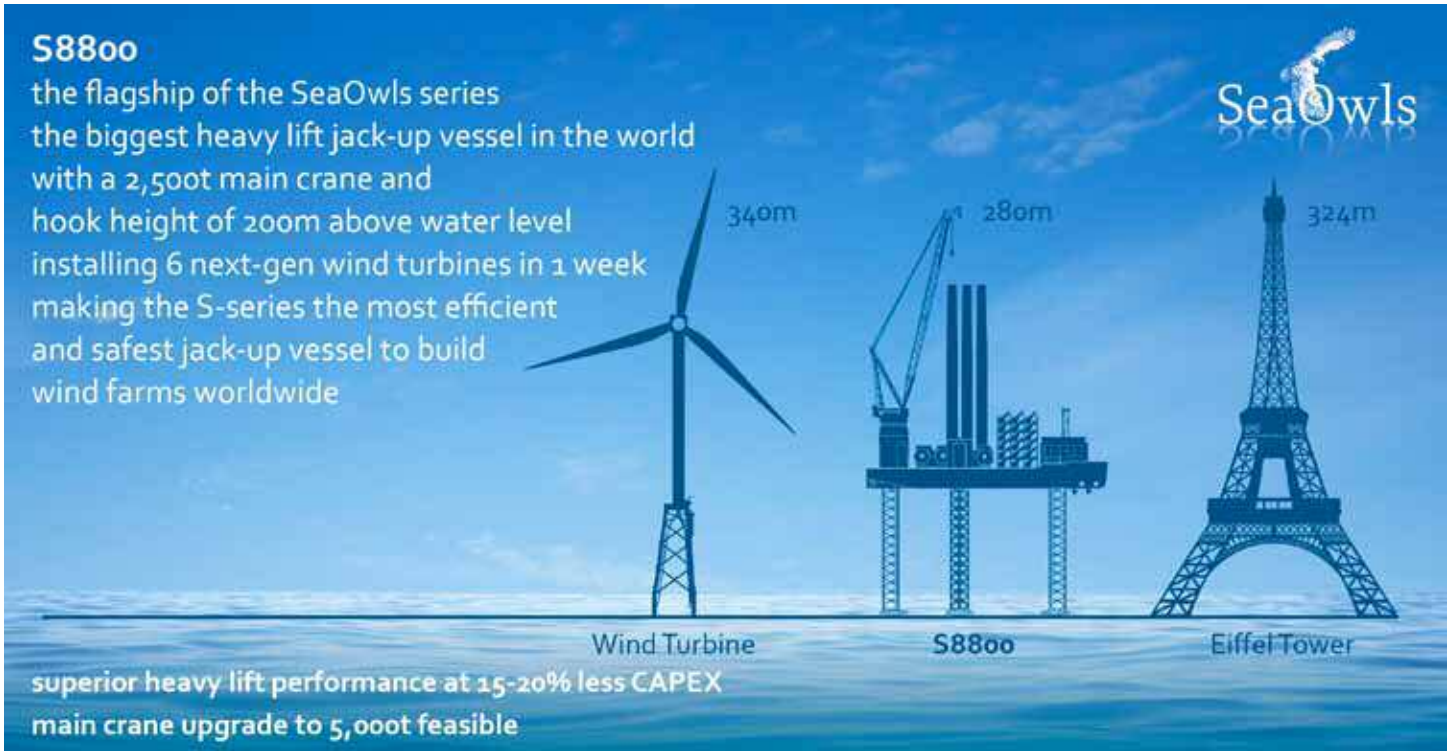
Wind turbine installation challenge

Erik told the audience that the installation of today's 8MW machines is already extremely challenging for the available fleet of wind turbine installation vessels and most vessels have therefore been upgraded with larger cranes and longer legs to catch up with the new standard turbine size. But the heavier and larger wind turbine components need to be accurately handled at higher altitudes and the upgraded vessels can only perform safe lifts when reducing the allowable weather conditions. It is therefore no surprise that we see the turbine installation rates of most vessels dropping significantly. And now turbine manufacturers announce next-generation wind turbines with double-digit capacities and blades of more than 100m length to enter the market soon.

Search for the perfect heavy lift jack-up vessel

Where other design companies only highlight the above issue and explore the boundaries of their existing designs, SeaOwls took the challenge to find a suitable solution to install the next-gen turbines and started with a blank page.
Looking at the third-generation wind turbine installation vessels, we see a lot of "ships with legs" and a few "jack-up barges with propulsion"."Ships with legs" are somewhat narrower than jack-up barges and relatively heavy structures. Based on conventional ship design, legs and footings, jacking systems and main crane were addedand integrated with the ship's structure.The "jack-up barges with propulsion" are more efficient structures, intended to perform as a standing platform above the water. Seakeeping characteristics of these barge designs have been neglected to some extent.
Both structural design concepts were never specifically developed for the extreme crane operations that are required by the offshore wind industry. The narrow width and the primary structural arrangement (torsion box) that connects the legs make it costly to scale-up these designs for future wind turbine installation.

Fourth-generation wind turbine installation vessel



Erik and his team realized that focus on the structural design, as a support for the main crane,is the key aspect for a successful jack-up vessel design. It took them two years to develop a series of heavy lift jack-up vessels, standing out and ready to become the fourth-generation wind turbine installation vessels.

On board **KAPITEIN ANNA** at the NDSM-pier in Amsterdam harbour, Erik showed the present KNVTS-members a scale-model of the jack-up vessel, based on the following five patented features, distinguishing each **SeaOwls** heavy lift jack-up vessel from any other vessel:

1. The four legs are placed in a diamond-shape pattern, with a large distance between bow, stern, portside and starboard leg.
2.The vessel hull is shaped like a kite with a sharp bow and broad transom.
3.The primary load-bearing structure connects the starboard with the portside leg, and the bow leg with the stern leg in a cross-shape arrangement.
4. The main crane is configured wrapped-around the stern leg with the clear view on the centre of the vessel's main deck.
5. The combination of structuralarrangement and hull form allows for stepless scaling of vessel dimensions and capacities.

As a principle, the combination of large leg spacing and cruciform primary structural beam arrangement ensures that all vessels of the S-series will be the lightest structure(and 15% lighter than conventional vessels)to support the most demanding heavy lift operations.

Flagship vessel S8800

The presented dimensions and capacities of the flagship S8800 brought some turbulence to the cabin. Her length of more than 164m, width of 104m and payload capacity of 16,000t are needed to transport and install six next-generation wind turbines in a one-week cycle.

A main crane with 1,250t at65m-reach capacity suits to perform all installation phases of these turbines. To overcome the shortfall of the existing fleet, the structural design already allows for a future crane upgrade to unrivalled 5,000t at 50m reach, which will ensure a long economic life for the vessel.

The S-series has been expanded with smaller sister vessels S6300 and S4500, all capable of handling and installing the next-gen wind turbines. The smallest type S2000 is the perfect jack-up vessel for windfarm operations and maintenance services. With her modest hull dimensions of 80mx50mx6m,she can supporta lifting operation of 500t at 30m radius and 125m hook height, above the main deck. The presentation ended in a lively discussion, where the interested and experienced audience was given the opportunity to ask questions on the technical details of the new design concept. The expected last question "is there already a contractor interested to order and build this vessel?" was also put forward. Erik Snijders and SeaOwls are confident that the market is in need and ready to order new wind turbine installation vessels, as the drive to worldwide offshore wind energy is real and the larger wind turbines will certainly come. And at this moment, they have the only vessel design that matches the requirements of the industry. **Photo's : Piet Sinke (c)**

Visiting address	Oudedijk 111 3062 AD Rotterdam The Netherlands	Website	www.seaowls.com
		Dutch Chamber of Commerce	54096901
Postal address	P.O. Box 4001 3006 AA ROTTERDAM The Netherlands	VAT number	NL851159539B01
		Follow us on LinkedIn	SeaOwls
Company e-mail	feedback@seaowls.com	Follow us on Twitter	SeaOwlsBV
Telephone	+31 (0)10 820 9898		