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Experience with Virtual Reality aided design and engineering

Naval architects Knud E. Hansen give an insight into how it has incorporated its proprietary VR system ShipSpace into the initial design process

Engineers and designers at naval architects Knud E. Hansen have been exploring and developing Virtual Reality (VR) with the use of ShipSpace since 2016. “Feedback from our customers has been tremendously positive about the use of VR for ship design”, says Ken Goh, a senior mechanical engineer in the company and an advocate for the technology from the outset. “Drawing reviews are still necessary, but we get much more thorough and richer feedback when it comes to reviewing working spaces and accessibility issues. People are astounded by how realistic VR is, how they can move and see in a very natural way. They are able to use the VR tools in just a few minutes. Even reluctant users are comfortable and productive in less than half an hour.”

Goh notes that many early adopters have been put off using VR because of poor implementation and performance issues. “Earlier VR theatres and caves cannot really be considered as true VR since they have many display inaccuracies due to the projection limitations, people often get motion nausea after 10-15 minutes as they are flown around by another person. With ShipSpace and the Head Mounted Display (HMD), the view is 100% accurate. You are fully in control of what you see and how you move around the space. You also always feel secure because you’re always standing on something.”

Regardless of the benefits of HMDs over earlier VR systems, poor user interfaces and inadequate graphics performance with stuttering and laggy image display, will still lead to a poor VR experience. Goh says: “Without the correct computer hardware and software the VR experience can be unconvincing, uncomfortable and can quickly cause disorientation, nausea and headaches for the user. These are problems that ShipSpace has been specifically designed to overcome. We regularly have had people using ShipSpace for hours without any motion nausea issues.”

	Space required	Cost	360 degrees	Close objects	View accuracy	Wearable	Motion nausea
Theatre	Medium	Low	No	Yes	Low	Glasses	High
Caves & domes	High	High	Yes	No	Medium	Glasses	Medium
Head Mounted Display	Low	Medium	Yes	Yes	High	HMD	Low

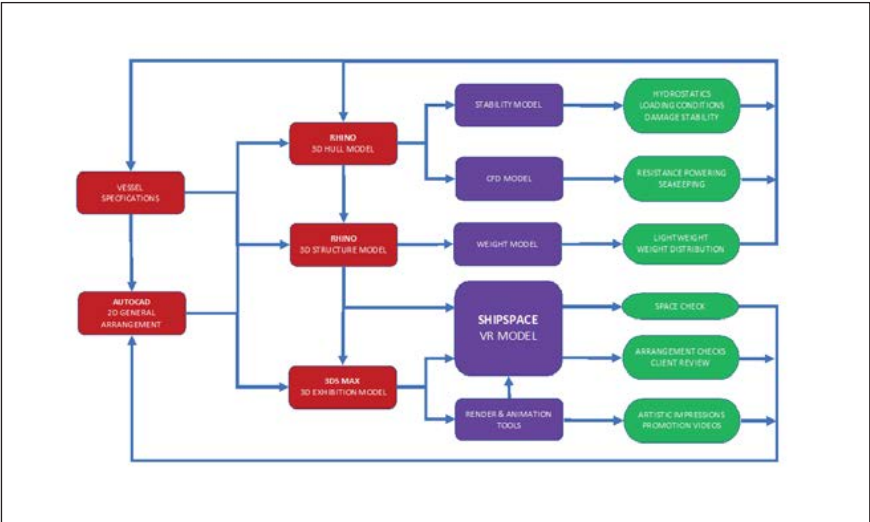
Figure 1: Benefits of HMDs over legacy VR types

Since the majority of design work undertaken by the company is in the initial design phases of a vessel project, the challenge has been to find more efficient methods and processes to enable the 3D digital models required for VR to be used earlier in the design process. In commercial ship design, typically there are only a few thousand hours to develop the initial concept design including studies, arrangements, calculations and specifications. In contrast, during the detail design phase, many hundreds of thousands of hours can be

spent on the 3D models required for the shipyards’ production processes. It is worth noting that 75-90% of the ship’s acquisition cost is committed in the initial design phase despite only 1-2% of the ship budget being spent on the concept design.

Every design still needs to start with a 2D general arrangement drawing, specifications and initial calculations. The hull is then modelled in 3D so that the vessel stability and hydrostatics can be assessed. The hull lines can then be adjusted for buoyancy and weight moments and

Figure 2: Initial design workflow and modelling



then used for CFD modelling to refine resistance and powering estimates. From the stability model, the surface areas, centre of mass, and weight distribution for all the compartment bulkheads can be collated to refine the structural weight estimate. The superstructure is also simply modelled in 3D so that the entire vessel weight can be more accurately calculated. This is important since the structure accounts for 60-80% weight of an unloaded vessel depending on ship type.

These simple 3D models can then be checked with ShipSpace VR tools to ensure all the vessel's compartments, tanks and voids, especially those with highly irregular shapes, can be suitably manufactured and be accessible once built. Making changes to watertight compartments later in the design process can have large repercussions on the arrangement of the vessel. These early checks can significantly de-risk the vessel's final design and make for a better designed vessel in which use of space has been highly optimised without effecting manufacturability or serviceability of the new vessel.

The simple 3D model can then be quickly brought to life by embellishing with external details, textures and colours. At the initial design stage, this model needs to be aesthetically accurate even though technical accuracy of details is low. For example, even though the lifeboat has been specified, the actual maker and model have not yet been chosen, so such details are more representative than necessarily accurate. External renders of this exhibition model give the customer an accurate visual impression of the vessel. Furthermore, the model can be explored at full scale with the ShipSpace VR system to give the customer the most realistic experience of the new vessel and allows for detailed feedback about the arrangement that is simply not possible from just looking at drawings or pictures.

Adding interior details to the model also enables the interior arrangement to be reviewed. The wheelhouse is always of high interest, since it allows visibility and sightlines to be checked with high accuracy – something that is not possible even with an expensive physical mock-up built inside a factory. For ro-ro vessels,

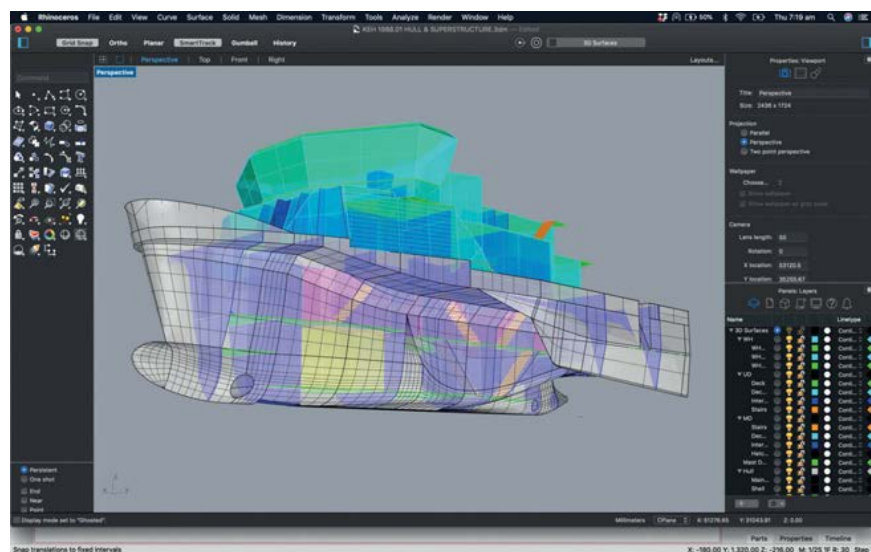


Figure 3: Simple hull and structural 3D model

drivers have been able check that they can negotiate ramps and pillars while trying to manoeuvre their trucks around crowded decks. Driver assessed sightlines and two-way traffic can also be tested. Chefs have been checking cooking arrangements of galleys and scientists, the layout of their labs and equipment for sampling and sensor deployment.

Further down the design process, Knud E. Hansen has been working with clients to implement the ShipSpace system to facilitate the review of the final detail design of blocks before they go to production. The system enables multiple users to meet together, similar to video conferencing, except that users are inside the 3D model. Participants can see and hear each other through avatars in a realistic way. It is akin to a site meeting on a virtual ship. This has proven to be an extremely powerful way of conducting design reviews, since people notice details that are easily missed when

reviewing on a computer screen. This is largely due to the natural way you view the model with a much larger Field-Of-View (FOV) and stereoscopic vision only possible with an HMD.

If there is an issue with the design, participants can quickly discuss the issue, make measurements, add 3D mark-ups to the model, take photos and voice memos to instruct design corrections. You can even spawn objects to illustrate required changes or pose mannequins to highlight human factor issues. ShipSpace virtual meetings enables reviews to be conducted by participants across different sites, making the review process much faster, and allowing more experts and stakeholders to contribute to the design. The system can also be used by production personnel who would like to familiarise themselves with the design and plan installation sequencing with other labour trades so that people are not getting in



Figure 4: Assessing human factors of tender boat launch and recover

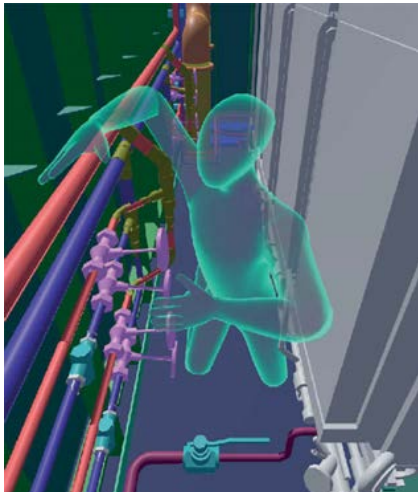


Figure 5: Accessibility for servicing

each other's way or causing rework issues.

The company has also assisted in the redesign of existing vessels using the ShipSpace system. For example,

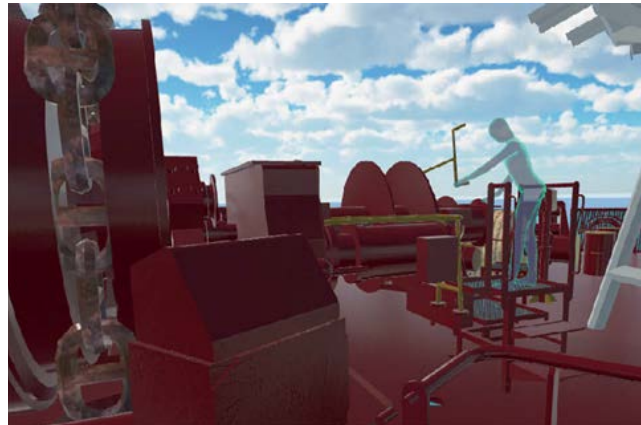


Figure 6: Role playing for redesign of mooring decks

where a mooring deck has proven to be too congested and difficult to work in operation, or for retrofit of scrubbers in crowded funnels and casings. As the company gains more experience with working in VR more opportunities for working smarter and more effectively are

certain to arise. Goh says: "ShipSpace has been a game changer for us. At the start we only thought of it as a sales tool, but the use cases just seem to keep coming. VR has matured quickly from a fancy toy to a powerful collaboration system for creating better ships more efficiently." **NA**

RINA-QINETIQ Maritime Innovation Award

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The Award is made annually to either an individual or an organisation, in any country. Nominations for the Award may be made by any member of the global maritime community, and are judged by a panel of members of the Institution and QinetiQ. The award will be announced at the Institution's Annual Dinner.

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QINETIQ

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Nominations may be forwarded online at www.rina.org.uk/maritimeinnovationaward

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Nominations should arrive at RINA Headquarters by 31st December 2019.

Queries about the award should be forwarded to the Chief Executive at hq@rina.org.uk