Quality made to fit

Rommert-Jan Schoustra, naval architect with Blom Maritime, gives an insight into the application of 3D scanning and its potential to revolutionise ship design, production and maintenance

3D scanning is already common practice in the repair and conversion industry. The recent surge in scrubber and ballast water treatment modifications has also significantly increased the companies offering 3D scanning services.

In the repair industry 3D scanning makes it possible for engineers to make a new design on top of an accurate existing design. This significantly improves accuracy of the design, makes it possible to use more prefabricated parts and significantly reduces manufacturing time and project cost. This article shows some of the benefits 3D scanning can bring to designing a new vessel and how it can help the engineers.

When starting work on a conversion we always begin from a 3D scanned vessel. This makes it possible to adjust everything to the accurate geometry of the ship. A whole new design is laid as a puzzle over the existing ship, just as a GA engineer fits all necessary components into a new GA. Many years of experience have made it possible to work effectively in point cloud and to custom fit every solution to the ship.

Figure 1: Scanner and surveyor engineer

What is a 3D scan and point cloud?

A short explanation about laser scanning might be useful. The scanner (Figure 1) works like a 3D camera, using a laser to make distance measurements of everything in its field of vision. To collect data of a large area, multiple scans need to made and connected. The scanner produces millions of points that are combined in a point cloud, which is a cloud of each measured location. This point cloud can be converted automatically or by hand to CAD faces or solids. This makes it possible to gather the data as .stp, .dwg or any other commonly used format.

There are numerous open source or off-the-shelf software packages to show the point cloud. Our own in-house tool NUBES makes it possible to show a point cloud and a design on any computer with an active internet connection. This gives clients the possibility to check the custom design in the scanned virtual ship from their own office. It is a vital tool to communicate the design and show the clients exactly what will be installed. This will reduce risk, installation time and make sure there are no unexpected surprises.

Most engineering packages work on supporting point cloud data, which means that engineering can be done directly in the point cloud as well.

Feedback and making a virtual vessel

Even though the benefits of laser scanning is well proven for the repair and conversion industry, it's still relatively unknown in the newbuild and design industry. In the past the foreman and the engineer would actively work together and have regular face to face meetings. Nowadays the shipping industry has changed to a truly global industry, where often the design of the vessel no longer take place next to the shipyard. This means that designers are forced to use many video calls, emails, pictures and drawings to make sure their ideas are accurately produced.

3D scanning could be a very useful addition to the tools that are commonly used now. How many times have engineers been forced to try to see all the details from photos, which never show exactly what is needed? A photo or video will never be the same as actually being there.

But the next best thing is a point cloud, where the designer can walk through the virtual ship, measure required distances and check details. This point cloud can be referred to at any time and at any place to make modifications, troubleshoot or redesign. 3D scanning could be an

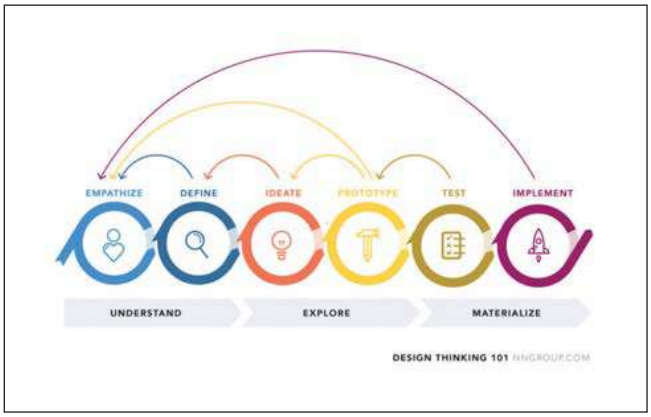


Figure 2: Design process (Source: Nielsen Norman Group)

excellent tool to make sure the feedback loop from implementation to empathise is made more clearly. The design loop itself (Figure 2) is assumed to be common and does not require further explanation.

It is not only highly rewarding for the engineer to see the design build, but it can also be very useful. Production mistakes can be picked up by the engineer but also smart production or design difficulties will become evident. This can be used as two-way feedback, allowing the engineer and producers to improve their skills. The scanned data can also be used for training new personnel where they can see how the drawings are used to build the ship.

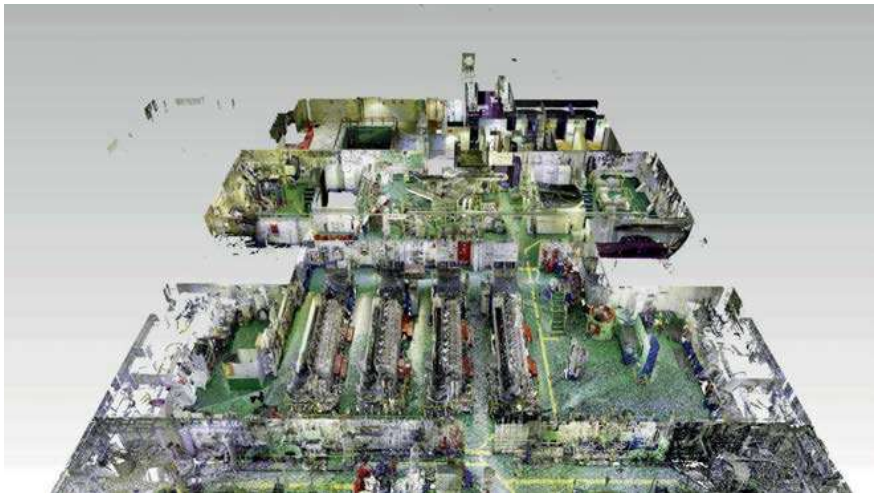
Digital twin of the vessel

As-built drawings are one of the most important operation and maintenance drawing packages that should be created after the vessel's construction in order to show all the differences between initial design and the final product. These can be made for structures, piping, electrical installations systems and any other systems onboard. Good as-built drawings can be very useful for the ship's crew during the vessel's operational life, whether to make alterations or just check what is onboard the vessel and how it is connected.

The biggest problem of as-built drawings is that it takes quite some time to produce them. Furthermore, because they should be produced after finishing the vessel, the engineering team is usually already busy with new projects. In real life, the as-built drawings are commonly seen as bureaucratic work after the ship has sailed.

With the new scanner hardware being able to perform a single scan in only 30 seconds, 3D scanning the vessel could be a viable alternative to producing as-built drawings. A 3D model can easily replace the current as-built drawings and could be given to the customer as part of the service. As an example, Figure 3 shows a scanned engine room and pump room.

Figure 3: Scanned engine and pump room



As-built documentation is the key to executing proper and time efficient operations and maintenance. Based on point cloud and 3D design, we are able to quickly access specific information related to each existing system or part of the vessel. Digital searching options of the point clouds make it possible to be in the area of interest within seconds. Changing the philosophy from manual searching in folders, drawing by drawing, to a digital option which provides us with a 3D overview.

All these technologies already exist and are implemented on a daily basis in existing plants thanks to, for example, AVEVA software. The technology and knowhow is available, the crucial aspect is implementing it and changing the way of doing things.

FEM and CFD calculations with scanned data as input

As any designer crunching numbers is aware the calculation is only as good as the input. Certain details can be drawn easily but never produced. Currently a good scan will have an accuracy of 1mm, meaning it can be used for CFD or FEM calculations with ease. Both FEM and CFD calculations have been done using this data and usually the meshing errors are bigger than the scan errors.

It is always important to make the input of these calculations as well defined as possible to ensure an accurate result. Most FEM and CFD software packages have good geometry packages, making it possible to insert a scanned geometry directly in the solver. Depending on the required accuracy it is even possible to let the software automatically produce surfaces and volumes directly from the scanned data.

Scanned data can be used as an excellent input to calculate the effect of production details. Sometimes, space requirements or production errors occur. To see if the structure is still strong enough to last the entire product lifetime a simulation can be done and if needed efficiently solved. Flows through piping, ventilation or along the hull can also be modelled around the real structure, including small

deformations and details that might produce cavitation.

The second feedback loop from prototype to empathise can also be easily performed using a scanned model. It is even possible to create an object in the workshop without drawings and then use the scan to make all necessary calculations. This reverse engineering could make the out-of-the-box prototyping a lot quicker. It also helps in the second feedback loop in Figure 2, prototype to empathise.

Conclusion

3D scanning, software and computing power is becoming cheaper and faster every year, making new applications which were too expensive and time consuming in the past possible. This article has shown some of the possibilities of 3D laser scanning but certainly not all. The possibilities are limited only by our imagination and determination.

About us

BLOM Maritime is a world leading supplier of 3D digital data capturing. We specialise in capturing and optimising 'as-is' data for improved engineering and project execution. We provide full-cycle service while ensuring that cost effective solutions are continuously implemented before, during, and after the projects.

We are part of the TECO Maritime Group. Our subsidiary offices, along with business partners are strategically positioned worldwide to ensure a fast response and reliable service throughout.

The entire network of subsidiaries and strategic business partners employs more than 170 employees worldwide. To date we have successfully completed in excess of 3,000 projects, combined from within the various industries we serve. *NA*

Figure 4: Scanned hull in dry dock

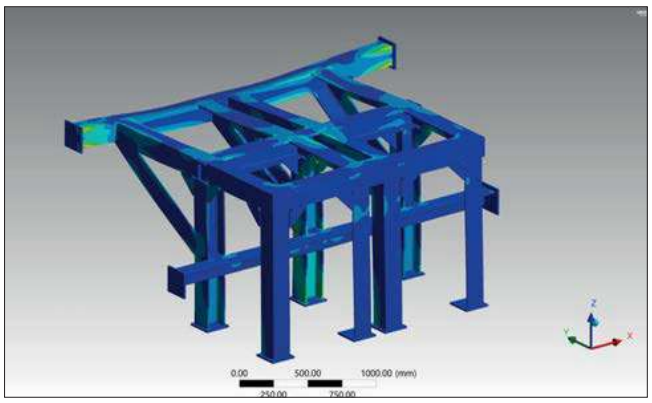


Figure 5: FEM calculation results of existing supports

Enhancing the capabilities of Digital Twins

NAPA's joint research project into Digital Twins, in collaboration with DSME, KMOU and AVL, will create pathways for autonomous ships, writes Deok-Hoon Jang, NAPA Shipping Solutions

Earlier this year, at Nor-Shipping, NAPA announced a project with Daewoo Shipbuilding & Marine Engineering (DSME), engine research institute AVL and Korea Maritime & Ocean University (KMOU) to explore digital ships and related strategic solutions. The partnership will combine a variety of disciplines; bringing together naval architecture, shipbuilding, engines, big data, and software development to push the boundaries of digital twins.

Each partner brings a different angle to the collaboration, co-ordinated by DSME. NAPA, experts in maritime software and Big Data, together with AVL, the world's largest independent company for the development, simulation and testing technology of powertrains and propulsions systems, will develop Digital Twin ship models with digitalised components and a real-time simulation platform to integrate between engine models and ship models, including the simulation tools and methodologies that the partnership projects will require.

KMOU, as a world-leading research institute in the field of maritime studies, transport science and engineering, will contribute by providing the existing infrastructure as a basis for further development and optimisation.

The development of Digital Twin ships and engines is one of the most exciting