



# Autonomous Systems for Bathymetry Surveys

## Bibby HydroMap's DriX trials at Gwynt y Môr

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**CATAPULT**  
Offshore Renewable Energy

### Introduction

During the first week in August 2018, Bibby HydroMap undertook a survey of four turbines and three inter-array cables at Gwynt y Môr Offshore Wind Farm off the north coast of Wales, using DriX. DriX is an unmanned surface vessel with autonomous features, designed and developed by iXblue. Bibby HydroMap has assisted in the development of the platform's capabilities to perform bathymetry surveys.

The survey was carried out for a number of reasons; firstly, to provide Gwynt y Môr with a bathymetry survey of selected turbines and inter-array cables to help identify any items of debris and determine the status of cable integrity. Secondly, to act as Bibby HydroMap's acceptance trials of DriX and to identify where its strengths and weaknesses lie. Finally – and most importantly – the survey was carried out to prove to the industry that a platform such as DriX can provide a suitable alternative to current methods of bathymetry survey.

The simplicity of the survey was underpinned by DriX's ease of deployment. This survey proved extremely positive, with operations running smoothly and the data gathered being of a high standard. The trials at Gwynt y Môr were faced with harsh weather, with winds as strong as Force 4-5, but DriX was able to get enough time out at the wind farm to carry out the survey.

Bibby HydroMap considered the trials as a significant success, operations ran smoothly and a lot was learned about DriX. Now Bibby HydroMap hopes to showcase this new technology to a wider audience and further prove that it can be the next step in subsea survey and mapping technology. However, there are important questions that the industry needs to address before autonomous surveys can scale up, including clarity on regulations (codes and certifications).

## Introduction

The term bathymetry is used to describe submarine topography, which is how the depth and shape of land changes underwater.

Bathymetry surveys are initially carried out on offshore wind farms during the consent phase. A crucial part of the decision-making process, they are required so that wind farm operators know what type of ground construction is taking place on, if there are any unidentified objects on the seabed, and generally to assess any potential issues with the seabed before the building phase starts. Typically, licensing states that a bathymetry survey must be carried out every year during the first three years of operation. After this, staged surveys are carried out at the discretion of the wind farm operator. Generally, this takes place on an ad-hoc basis, for example: a survey may be required due to a cable failure or preparation work for a jack-up vessel.



Figure 1: Bibby Tethra. Image: Bibby HydroMap

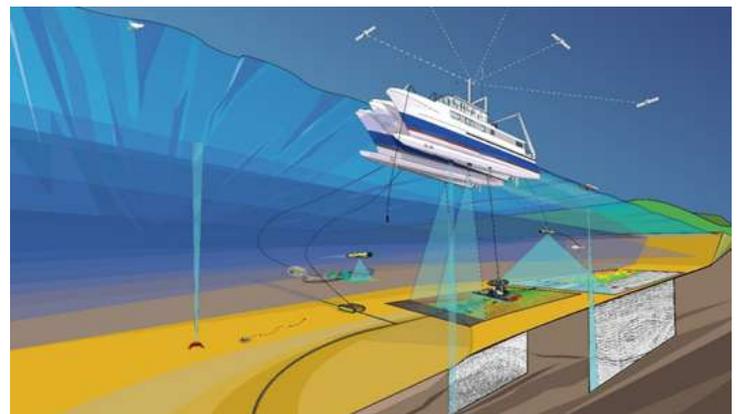


Figure 2: An example of a typical survey. Image: Bibby HydroMap

Currently, bathymetry surveys are carried out by medium-sized vessels (around 10m to 30m). These vessels can be equipped with numerous sensors mounted on the hull, along with towed systems, and can be used to undertake many different types of survey.

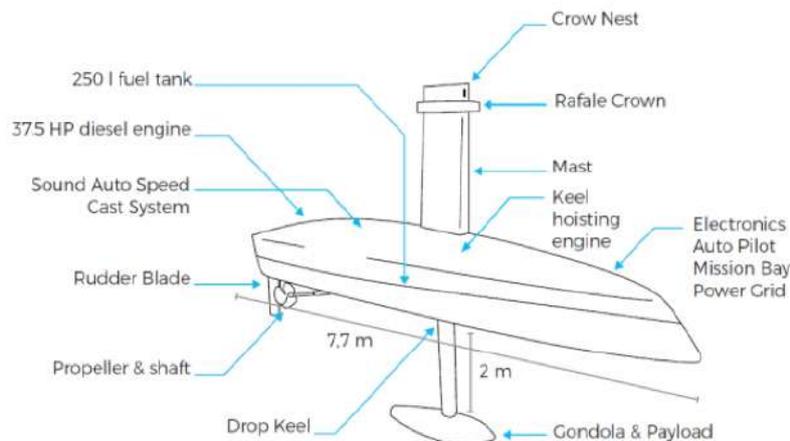
Although this is a well-proven method, there are problems faced by these traditional survey vessels:

- Noise from vessel propulsion systems can have a detrimental effect on data gathered.
- Bubbles generated from the hull movement can alter results.
- Severe motions during high seas can affect the quality of data gathered.
- Meteorological conditions, such as wave height and wind speed, limit the operating window.
- These vessels are relatively few and far between and can be timely and costly to deploy at short notice.

Traditional survey vessels are a proven technique for undertaking bathymetric surveys. However, there is room for an innovative platform that does not suffer from the same problems as are currently faced.

## Introduction

DriX is an unmanned surface vessel, with autonomous features, designed and developed by iXblue for the purpose of carrying out bathymetry surveys. The 7.7m long vessel is equipped with an interchangeable gondola payload, which can be customised depending on the demands of the work being undertaken. The specifications of DriX are provided in Figure 3.



Displacement	14 tons
Beam	0.7 m
Height	3.2 m
Endurance	Up to 7 days
Engine	Diesel
Max Speed	14 kn
Transit Speed	10 – 12 kn
Survey Speed	8 kn
Survey Fuel Consumption	1.8 litres per hour
Communications	Line of Sight (WiFi, radio, SATCOMS)

Figure 3: DriX Specification. Image: iXblue

In terms of vessel mechanics, DriX employs a regular diesel engine and a single propeller and rudder. The step-change comes in the form of its unique hull design, constructed from composite materials and with a revolutionary hull shape that has been optimised for both coastal and offshore surveys. DriX was designed in the iXblue shipyard and its long, narrow hull gives it unrivalled wave piercing capability, minimising the slamming effect and ensuring the utmost stability of the platform and gondola even in rough seas.

The sensors are housed in the gondola: an optimum data gathering environment two metres below the surface, in noise-reduced and bubble-free surroundings. The gondola and its drop-keel support can be retracted into the hull and mast to simplify launch and recovery. The ability to change the gondola and its payloads makes DriX suitable for numerous applications. Bibby HydroMap has designed a custom gondola to house the dual-head multibeam echosounder which was utilised during this survey.

The custom-design of the gondola mounts the multibeam echosounder array at a set angle in a standard ‘T’ arrangement, with both a sound velocity and inertial navigation system also housed within the gondola.

What makes DriX different from other survey vessels is the fact that it is unmanned and partially autonomous. Bibby HydroMap rates its current autonomy between levels two and three, based on the Maritime UK’s Maritime Autonomous Surface Ships (MASS) UK Code of Practice scale of autonomy (Maritime UK, 2018). This allows the vessel to be operated in a number of ways. Bibby HydroMap has identified that the two current modes of operation for DriX are:

1. Operated mode: DriX is piloted remotely.
2. Directed mode: a pre-defined route is drawn for DriX to follow.

Level	Name	Description
0	Manned	Vessel/craft is controlled by operators aboard
1	Operated	Under Operated control, all cognitive functionality is controlled by the human operator. The operator has direct contact with the unmanned vessel (UV) over e.g., continuous radio and/or cable (e.g., tethered UUVs and ROVs). The operator makes all decisions, directs and controls all vehicle and mission functions.
2	Directed	Under Directed control, some degree of reasoning and ability to respond is implemented into the UV. It may sense the environment, report its state and suggest one or several actions. It may also suggest possible actions to the operator, e.g. prompting the operator for information or decisions. However, the authority of make decisions is with the operator. The UV will act only if commanded and/or permitted to do so.
3	Delegated	The UV is now authorised to execute some functions. It may sense environment, report its state and define actions and report its intention. The operator has the option to veto intentions declared by the UV and decision-making is shared between the operator and the UV.
4	Monitored	The UV will sense environment and report its state. The UV defines actions, decides, acts and reports its actions. The operator may monitor events.
5	Autonomous	The UV will sense environment, define possible actions, decide and act. The UV is afforded a maximum degree of independence and self-determination within the context of the system capabilities and limitations. Autonomous functions are invoked by the on-board systems at occasions decided by the same, without notifying any external units or operators.

Figure 4: Definitions for Level of Control. (Maritime UK)

## The Challenge

Bibby HydroMap wanted to trial its new unmanned vessel in more challenging conditions – previous to this test, DriX had only been tested in the relatively calm waters of the Mediterranean. Having already undertaken manned surveys for Innogy Renewables, Bibby HydroMap saw an opportunity to test its new piece of equipment in an operational wind farm. This led to the company embarking on a survey of Gwynt y Môr Wind Farm, making it the first unmanned survey ever undertaken at an operational UK offshore wind farm.



The trial was carried out for two reasons; firstly, to act as Bibby HydroMap's acceptance trials of DriX and to identify where its strengths and weaknesses lie. Secondly, the trial would prove to wind farm owner/operators that an autonomous vessel could provide a better survey than the traditional methods.

The survey was carried out during the first week of August 2018 and lasted five days. The week was fixed in advance in the hope of favourable weather conditions during the summer months.

There were two main areas of interest: checking the integrity of the inter-array cables and surveying the seabed local to each wind turbine in advance of jack-up activity. The survey was undertaken to IHO Standard 1A (International Hydrographic Organisation, 2008) to achieve full coverage, and an additional specification of 0.5m object detection was also set by Innogy Renewables to meet the requirements of its jack-up vessel.

Overall, four turbines and three inter-array cables – 8km of cable in total – were surveyed.

The original plan was to utilise the Operations and Maintenance base for Gwynt y Môr, however, it was found that it was not suitable to deploy DriX due to an inadequate crane. It was therefore decided to carry out operations from Conway Marina.

## The Approach

As this survey also formed Bibby HydroMap's acceptance trials of DriX, two additional vessels were required, a mothership and a rigid inflatable boat (RIB), to act as a response vessel if required.

In addition to DriX collecting survey data, the accompanying mothership also conducted survey operations using traditional survey methodology. This allowed a direct comparison between DriX's survey data and conventional survey data.

In total there were seven personnel onboard the mothership: three to operate and monitor the mothership (two vessel crew and one surveyor). While DriX was operated by a team of two (one DriX pilot and one surveyor), due to nature of the operations two additional people were present to enhance lessons learnt throughout the project. For future DriX operations, only two people will be required to monitor and operate the system.

### Days 1-3

Days one to three started promisingly. DriX arrived at Conwy Marina and within three hours of delivery was in the water and ready for departure. Unfortunately, poor weather conditions limited progress as the marina was hit with Force 4-5 winds, stopping all efforts of getting out of the marina. The conditions on site would not have halted DriX operations, however the support rib used for these trials had a lower weather tolerance and was prevented from leaving the marina.



Figure 5: DriX being lifted into the water at Conwy. Image: Davenport

To utilise the time where the vessels could not leave the marina, the team concentrated their efforts on calibrating all available systems concurrently and building confidence piloting DriX around the marina. Personnel from Bibby HydroMap and iXblue felt this was very beneficial: after these days the team were comfortable in operating DriX in confined areas.

Thanks to the location of Conway Marina, there were more sheltered locations providing small breaks in the poor weather. These periods were used to undertake the calibration of the multibeam echosounder on DriX. Typically, all calibrations and associated processing would have been conducted within one day. When removing the weather downtime factor from the calculations, it was found that the multibeam echosounder calibration took only 15 minutes to conduct, with limited processing to obtain the final product, seen in Figure 6.

Day 4

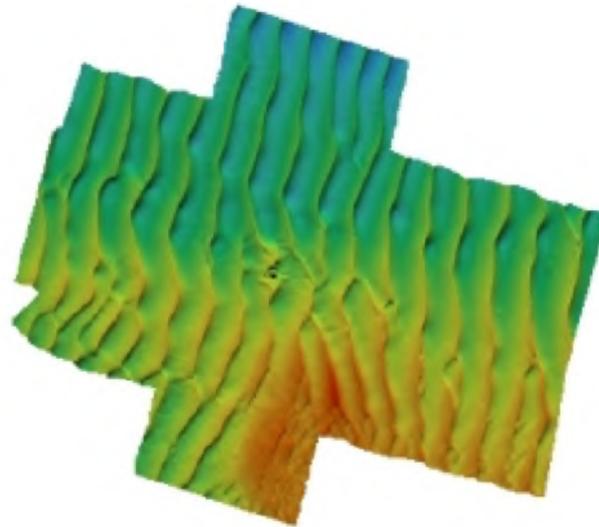


Figure 6: DriX calibration data. Image: Bibby HydroMap

Day four brought relatively good weather conditions giving a window to leave the marina and the opportunity to rigorously test DriX's performance in open water. Although the weather was nowhere near as harsh as before, the conditions were still challenging, with force three winds, significant wave height of 0.8m, and three knots of tide. This provided the opportunity to test DriX in relatively harsh sea conditions, and a chance to see what effect these conditions would have on the data acquisition and quality.

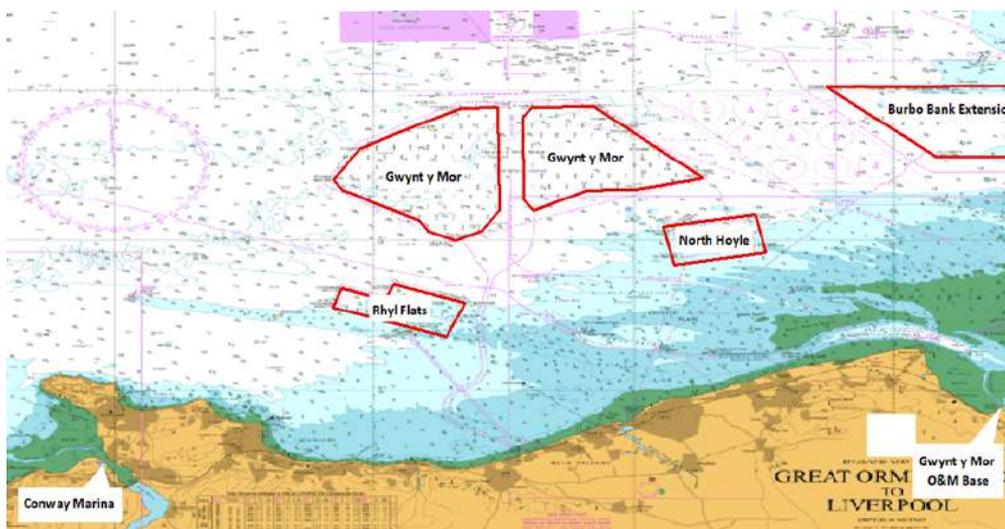


Figure 7: Conway Marina to Gwynt y Môr

The other challenge for the day was navigating DriX out of the channel, from the marina to the wind farm (see Figure 8). This was done by placing DriX in 'operated' mode, with the pilot navigating from the mothership. One of the major concerns when navigating this section of the coastline is the relatively large draught of the vessel compared with the shallow nature of the channel, which could leave DriX in an undesirable situation.



Figure 8: Conwy Marina Channel

Once out at the wind farm, DriX was placed in 'directed' mode. A pre-planned route (line plan) was created and sent to DriX for it to follow. A 400m by 400m box was required around the base of each of the turbines, and a 25m corridor along each of the inter-array cables. A 20m exclusion zone was in place around the base of each turbine, which is standard for most surveys without dynamic positioning (DP) on board the vessel, for safety reasons.

The survey around each turbine consisted of 13 lines, orientated north-south, and two additional lines orientated east-west. The time to acquire the entire turbine box was 29 minutes, with DriX operating at an average speed of 8 knots. The stability of DriX and its ability to pass close to the turbine, in any state of the observed tide on the site, allowed for easy detection of seabed features and exposed cables.

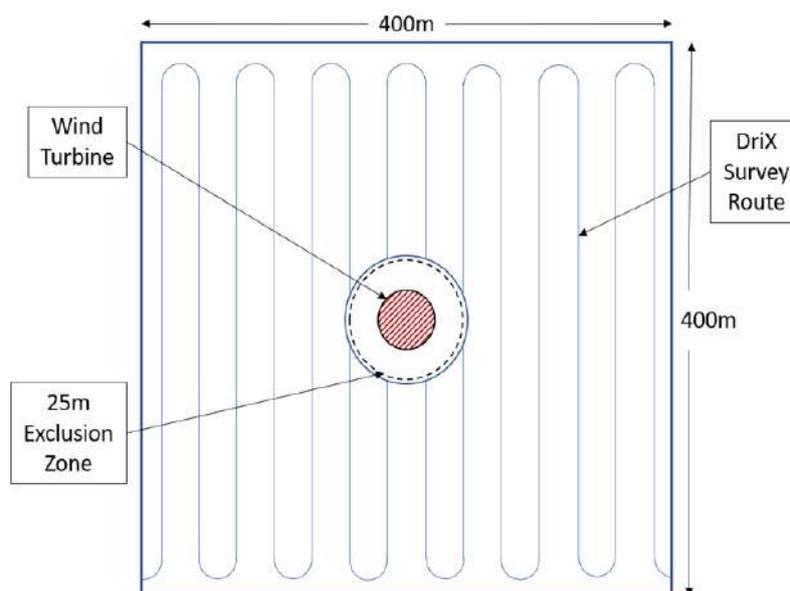


Figure 9: DriX turbine box survey route

Two 400m<sup>2</sup> turbine boxes were surveyed as well as all three inter-array cables totalling 8km. Upon completion of the inspections DriX was remotely piloted back to the marina, in 'operated' mode, where it was berthed overnight. Once back alongside all high-resolution bathymetry data was downloaded from DriX for review the following morning. The data collected achieved a resolution of 0.25m, well exceeding the required resolution of 0.5m.

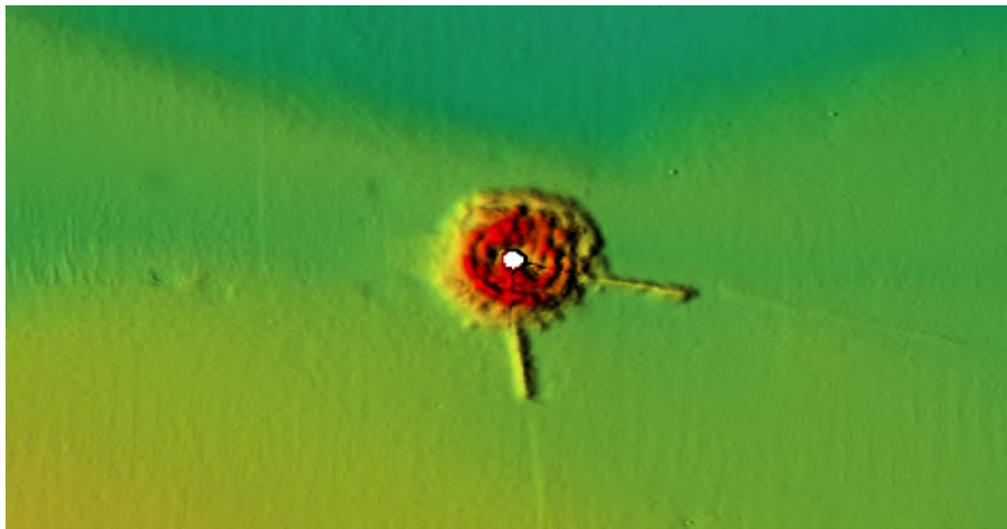


Figure 10: DriX data example. Image: Bibby HydroMap

### Day 5

Weather conditions were similar to the previous day, with harsh but workable sea conditions and wind at Force 2-3, allowing the survey to be completed. The second half of the turbine boxes were inspected and the inter-array cable surveys were re-run. This put the final count in excess of 1.8km<sup>2</sup> of seabed surveyed across the two days at sea.

With operations successfully completed, DriX was piloted back to the marina for recovery. This was performed smoothly, with the boat-crane used to take DriX out of the water than back onto the trailer, concluding a successful bathymetry survey trial.



Figure 11: DriX during surveys. Image: Bibby HydroMap

## Addressing the Issues Surrounding Autonomous Vessels

With no autonomous vessels on the market for applications in offshore wind, wave and tidal energy, the technology is still in its infancy. There are still many areas of uncertainty for operators – here, we’ll address some of the key questions that remain unanswered.

### *Does the vessel need to register with a flag?*

With no “autonomous vessel” category currently defined under the Maritime Autonomous Surface Ships (MASS) Code of Practice, there is ambiguity when it comes to registering unmanned surface vessels with a flag. As defined in the Maritime Autonomous Surface Ships UK Code of Practice, vessels shorter than 24 meters are not required to register to conduct commercial activities in the territorial waters of the UK. For international activities it may be a requirement to demonstrate appropriate registration and larger vessels are required to register under the appropriate Flag state. For these reasons, DriX is not registered with a flag.

### *Does the pilot need to be a certified captain?*

Regarding the certification level of the pilot, it is again unclear what level they should meet. Currently there is no mandatory level that is required, but there is a voluntary code from Maritime UK (Maritime UK, 2018) that can be followed.

This code states that the pilot should be a “competent person.” The MASS code of practice advises that the autonomous vessel operator should have an appropriate Seafarer certificate of competence applicable to the area category and vessel size. As this is being based on maritime law it may not be fit for purpose for autonomous vessel operations. All DriX pilots complied with this voluntary code throughout operations.

### *Who is liable in the event of a collision?*

Generally, when a collision occurs at sea the master of the ship is liable – however, in the case of an autonomous vessel there is no master. In the case of a collision with DriX, iXblue (being the insurers of the vessel) and the pilot at the time would be liable. In the case of a collision in fully autonomous mode, the operator in supervision would be liable. It is likely that this would be the case with most autonomous vessels.

DriX is COLREG (International Regulations for Preventing Collisions at Sea, 1972) compliant but does not comply to all SOLAS (Safety of Life at Sea, 1974) regulations. Both of these standards are centred around humans on vessels and so it begs the question whether autonomous vessels need to meet these standards, therefore causing uncertainty in the industry.

The International Maritime Organisation (IMO) is currently undertaking a regulatory scoping exercise with a target completion date of 2020. The term MASS has been adopted by the Maritime Safety Committee (MSC) of the IMO for their scoping exercise which was accepted at MSC 98 on the 13th June 2017.

### *What if something goes wrong?*

There are many possible scenarios that could be disastrous in the event of an emergency with an autonomous vessel. For example, if direct control is lost this could lead to a rogue ship with no humans on-board to intervene.

In the event that something was to go wrong during operations with DriX, there are three levels of fail-safe, with an additional one in place for the trials:

1. Communications lost: DriX stops in the water, awaiting manual intervention.
2. Power lost: Emergency battery kicks in and DriX stops moving while maintaining minimal communications.
3. Manual intervention: DriX has a pull-cord accessible on the top of the vessel which manually shuts down the vessel.
4. Rib recovery: This was only necessary for the initial trial and in the future will not be necessary.

## The Results

Overall, the trial was regarded by Bibby HydroMap as a huge success. DriX performed well and proved itself in testing conditions. Several advantages of unmanned bathymetry surveys were observed, along with lessons learned.

### *Benefits of Autonomous Survey*

#### *Increased Data Quality*

A major benefit observed during the trial was the high quality of the data collected from DriX, especially in unfavourable weather conditions. The unique design of DriX, and its custom-designed gondola, provide a hydrodynamically quiet platform for housing the multibeam echosounder systems. The mounting of the gondola two meters below the waterline further reduced the effect of vessel noise on the data. Figure 12 shows data collected from DriX during the trials.

DriX delivers near-real time data which is extremely clean and requires minimal further processing. The high quality of data from DriX is suitable for most purposes straight from download, allowing owner/operators the flexibility to make decisions quickly, which can be vital for continued wind farm operations.

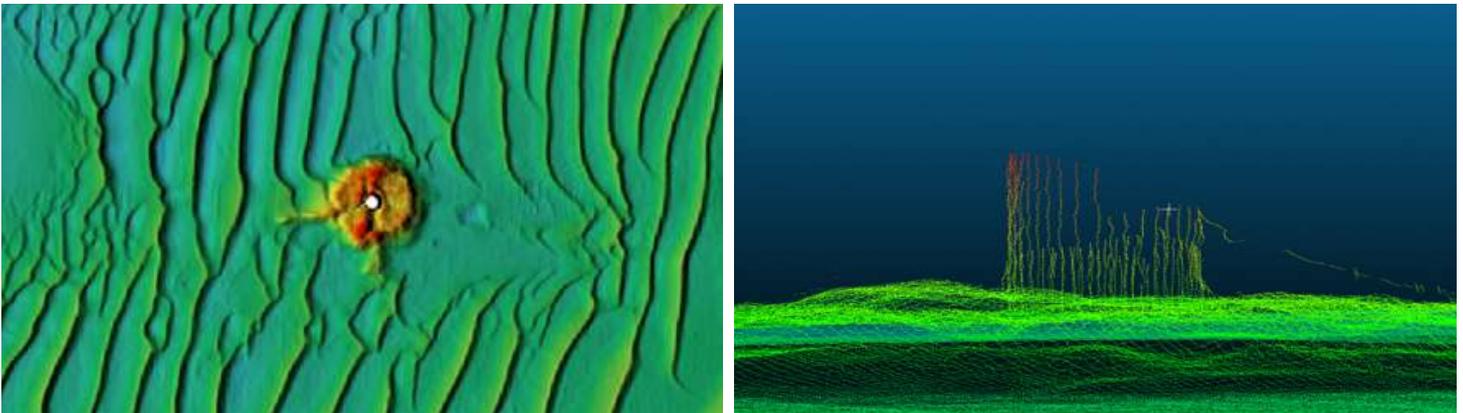


Figure 12: Examples of DriX survey data

Another obstacle commonly met by offshore surveyors is background noise, predominantly from vessel propulsion systems. Noise comparison results from Kongsberg Built-In Self-Test (BIST), between Bibby HydroMap's offshore survey vessel Bibby Tethra and DriX, are shown in Figure 13. The test for DriX shows very little change in background noise with increasing speed, while the noise levels observed on Bibby Tethra were found to be significantly higher – highlighting the advantages of DriX's design for survey purposes.

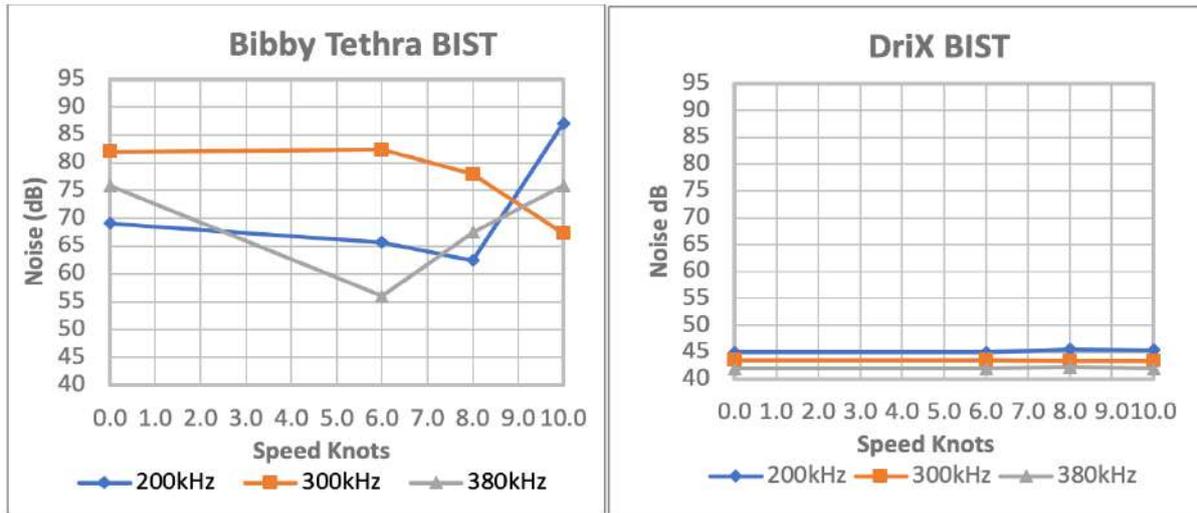


Figure 13: Survey vessel noise compared to DriX noise

### Improved Productivity

One of the greatest benefits of DriX was its increased productivity; DriX performed survey operations at speeds in excess of 8 knots, twice as fast as a traditional survey vessel. In addition, line turn time was more efficient, with DriX completing a line turn in 40 seconds compared to a regular survey vessel at 180 seconds.

### Cost Saving

An obvious benefit of any autonomous vessel is cost reduction; fewer personnel are required, less time is required on site, and less fuel is used. Throughout the whole five-day trial, DriX only needed to be refuelled once, achieving a fuel consumption of 3.5 litres per hour (l/h) throughout the whole trial. It is estimated that the vessel would have a fuel consumption of 1.8 l/h if only operated for survey.

### Flexibility

Using an unmanned vessel allows for greater flexibility for owner/operators of wind farms, as subsea surveys are much more readily available. Deploying any survey vessel can be time-consuming and costly, as the vessel may not be near the site and transporting it there may take some time. A vessel such as the DriX can be easily stored at-site or simply transported over land to the appropriate port, allowing for quicker and cheaper deployment.

This ease of transport and deployment could allow owner/operators to take a more preventative approach to subsea problems and asset management. Instead of waiting for a problem such as a cable failure to arise, an autonomous vessel can perform surveys at regular set intervals, which can highlight changes in seabed conditions. Repeat surveys could also allow modelling of seabed movement to be conducted, allowing annual trends to be identified. This can help owner/operators assess conditions around the wind farm.

## ***Lessons Learned from DriX Trial***

As with any trial of new technology, several lessons were learned during the survey at Gwynt y Môr.

### ***Cost Saving***

During the operations, issues were found with the manual pull cord on the back of DriX. It was found that if a string line was used, once wet this reduced tension therefore activating the emergency switch and stopping the vessel in the water. This was quickly rectified with a replacement line that did not absorb water.

### ***DriX Recovery at Sea***

When DriX needed to be manually handled in water, it became evident that the platform was hard to hold onto, having a smooth surface and little points to grab on to. This raised health and safety issues that were resolved by adding a method of quickly attaching a line to the bow of DriX.

The DriX Deployment System, another method for recovering DriX, has since been developed. The DDS is a cradle which is used to deploy and recover DriX from another vessel at sea. The cradle is lowered into the water and DriX is simply driven into the appropriate spot. Once in place, the whole device can be lifted out of the water onto a suitably-sized mothership, allowing for maintenance to be undertaken and data downloaded.

### ***Water Depth is a Limitation***

The 2m draught of DriX does pose a limitation in certain situations, both for deployment and restricting the workable inshore limit. The deployment location must be suitable to accommodate the 2m draught, this could potentially limit the number of marinas and ports which DriX can be operated from. Also, as DriX cannot “dry out,” the tidal range of the chosen operational port must be considered.

### ***Difficult to Spot***

During the operations in harsh weather it was noted that DriX can become hard to spot – not only by eye but also by Radar. This is obviously a key health and safety risk and to mitigate this Bibby HydroMap plans to install a radar reflector on the platform.

## ***Lessons Learned about Autonomous Vessel Operations***

As previously discussed, the world of autonomous vessels is extremely new and legislation is playing catch-up with the technology. The trial carried out by Bibby HydroMap helped shine a light on some of the key issues surrounding autonomous vessel operations, for example:

- The fail-safe procedures worked well. During the trial, DriX could be stopped or remotely taken over when required. If manual intervention was required it could easily be undertaken.
- For the time being, the voluntary code from Maritime UK proves a good measure of what regulations and codes an autonomous vessel should follow.

To help improve understanding of what is required on an autonomous vessel, further documentation and guidance around regulations should be provided, defining what codes the vessels and operators need.

### ***Beyond Visual Line of Sight Limitations***

A limitation on any unmanned vessel is the distance an operator can be from the vessel. Currently, line of sight with DriX must be maintained at all times – between 2-5km. There are no firm regulations on the operation of unmanned vessels, and it is unclear as to who defines the distance an operator must be from the vessel. In this case the “line of sight” restriction has been set by the insurers of DriX. During the trial the line of sight restriction did not pose an issue as the Wi-Fi link to DriX was exceeded before it was out of sight.

A previous Analysis and Insight paper from ORE Catapult further explains the barriers around Beyond Visual Line of Sight (BVLOS) operations.

To improve control distance, operators could install better communication networks on site – for example some German offshore wind farm sites already have 4G networks installed. This would greatly increase the distance the platforms can be operated from, limiting them to only the line of sight set by insurers.

### ***Real-Time Monitoring***

Currently DriX does not allow for continuous, real-time monitoring of all systems installed on board. To further enhance DriX operations the control system needs to be upgraded to allow this.

To enable full autonomy, the onboard systems must be able to interact with each other and notify the user of any issues.

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## ***Plans for the Future***

This trial has given wind farm operators an opportunity to see the potential of unmanned vessels and how they may develop and change the industry in the coming years.

### ***More Autonomy***

DriX is currently at a level 2/3 on the MASS scale of autonomy. Bibby HydroMap and iXblue expect to increase this to level 4 in future (see Figure 4). This would see the majority of decisions and actions being performed by DriX, with the human operator only coming in to perform high-impact decisions if required. To achieve this DriX will have to be aware of its surroundings and be able to navigate independently. This would represent a significant step forward for autonomous vessels, as it would allow wind farm operators to easily undertake regular surveillance of subsea topography, allowing for preventative maintenance and mitigating risk.

Bibby HydroMap expects to be able to perform most operations from a remote base station on land, with a service operations vessel (SOV) or crew transfer vessel (CTV) on-site for deployment and recovery of DriX and any manual intervention that might be required.

### ***Internet of Things***

To allow for constant analysis of how DriX is performing the team plan to install an internet of things (IoT) on board DriX.

In the broadest sense, the term IoT encompasses everything connected to the internet, but it is increasingly being used to define objects that communicate with each other (Burgess, 2018).

An IoT will allow for a constant assessment of how DriX is performing, letting the operators visualise the health of the platform and allowing for intervention if it is predicted that a fault may occur. The data transmitted from these devices would be transferred independently to the bathymetry data.

### ***Fleet of DriX***

Bibby HydroMap anticipates having a fleet of DriX available for survey in UK and European waters. The size of the fleet will depend on the industry demand for autonomous survey services, and also require the industry as a whole to accept autonomous survey as a method of data collection.

## ***Key Challenges for the Industry***

Two questions that arose over the course of the survey and the lessons learned process stood out as the most important.

### ***Will the DriX replace traditional survey vessels?***

When asked if DriX would ever completely replace manned vessels the answer was clear: not for a long time. DriX is well-equipped to perform bathymetry surveys and does this very well, but there are still many large-scale surveys (such as unexploded ordnance (UXO) and seismic surveys) which DriX cannot, and most likely will not, be able to perform mainly due to their complex nature.

The provision of autonomous bathymetric surveys will hopefully enable a change of mindset in owner/operators, whereby the dramatic cost reductions made possible will allow regular surveys leading to improved asset management.

### ***What can industry do to aid autonomous vessels?***

The industry can do a number of things to assist the wider use of autonomous vessels in renewables:

- Installing better communication networks at wind farms would help operators increase the BVLOS limitation. Increasing the range of operation for autonomous vessels would help reduce costs and complexity of operations.
- Codes and guidelines for autonomous vessels are in need of regulatory clarification. To date, there is no mandatory code to follow for autonomous vessels: only voluntary codes of conduct and recommended practices exist.
- Greater overall confidence in autonomous systems must be shown by the industry – there remains an element of the unknown around the technology. The DriX trial should go some way towards helping, having proven that the technology can work in challenging marine conditions with significant benefits over traditional methods.

If the offshore renewable energy sector is bold and willing enough to trial similar systems, the industry will start to see the benefits from utilising autonomous survey technology on a wider scale.

## Appendices

### References

4C Offshore. (2019, January 29). [Gwynt y Mor](#). Retrieved from 4C Offshore.

[Bibby HydroMap](#). (2018).

Bibby Hydromap. (2019, 01 29). [Bibby Tethra](#). Retrieved from Bibby Hydromap.

Burgess, M. (2018, February 16). [What is the Internet of Things? WIRED explains](#). Retrieved from Wired.

Conwy, N. Y. (2019, January 29). [Pilotage Information and Tide Tables](#). Retrieved from Network Yacht Brokers Conwy

Davenport, T. (2018, October 01). DriX The Future of Hydrographic Survey. Shallow Survey.

International Hydrographic Organization. (2008). IHO Standards for Hydrographic Surveys, Special Publication No. 44. Monaco: International Hydrographic Bureau.

International Maritime Organisation. (2019, February 01). [Convention on the International Regulations for Preventing Collisions at Sea, 1972 \(COLREGs\)](#). Retrieved from International Maritime Organisation.

International Maritime Organisation. (2019, February 01). [International Convention for the Safety of Life at Sea \(SOLAS\), 1974](#). Retrieved from International Maritime Organisation.

iXblue. (2018). [DriX](#). Retrieved from iXBlue.

Maritime UK. (2018). Maritime Autonomous Surface Ships UK Code of Practice. Society of Maritime Industries.

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