

THE VERSATILITY OF UAVS IN A REMOTE AND RUGGED ARCHIPELAGO

The challenges of surveying the Faroe Islands



Crewless aerial mapping was recently chosen when surveying the Faroe Islands. For the small team, labour savings provided one advantage of a UAV-based approach. Another benefit was that clear skies are not essential when using drones.

Remotely situated in the northern Atlantic Ocean, roughly equidistant from Scotland, Iceland and Norway, the Faroe Islands form a rugged and rocky archipelago. The cool and cloudy weather, with strong winds and heavy rain possible all year round, means that this is a challenging survey environment. In its search for the best method to capture this stunning environment, the mapping authority has turned to UAVs. This article tells the story of mapping and surveying a truly breathtaking spot on Earth.



The weather is always a factor on and around the 18 islands that make up the Faroe Islands. Too much wind or rain is bad news for surveyors, among others. In the past, Umhvørvisstovan (the Faroese Environment Agency, which is the authority in charge of mapping and monitoring progress across the islands, including coastline mapping) used aeroplanes to capture the imagery needed

for mapping and surveying. However, this was not without limitations because the aircraft had to be booked a few days in advance from photogrammetric companies in Denmark or Iceland. That often proved difficult in view of the changeable weather in the region – especially in periods when most of the companies were busy capturing images elsewhere.



A map showing the location of the Faroe Islands with respect to the rest of Europe.

Turning to crewless aerial mapping

In 2015, Umhvørvisstovan therefore decided to work with unmanned aerial vehicles (UAVs or 'drones') instead of aeroplanes. The local survey team researched the strengths of drone photogrammetry and learned that the UAV-captured geospatial data could generate orthophotos with less work and effort than aeroplane-based photogrammetry. The labour-saving benefit was regarded as an important advantage, since there are only six employees to carry out all the mapping responsibilities at Umhvørvisstovan. Three of them work on surveying and mapping on land, whilst the other three work on nautical charts for ships and ferries (see below).

Another benefit is that clear skies are not essential when using drones. In fact, the result is sometimes better with some cloud cover, as long as the drone can operate under the clouds. Having said that, however, poor weather earlier this year meant that Umhvørvisstovan was unable to collect any data using drones until the second half of May 2021. Even in calmer conditions, fog sometimes posed an issue –

especially when it was hanging low at around the flying height of the drone. Fog can trigger the ground sensor, thus setting off the drone's safety system, not to mention the fact that images collected while flying in fog are unusable.

So in 2015, the Danish company COWI, who already had wide experience with drone mapping, sent a drone pilot to the Faroe islands tasked with collecting images of the capital (Tórshavn) and the second largest city (Klaksvík). This project successfully convinced the Faroese of the capabilities of UAVs for mapping applications, and less than a year later the team started looking to acquire drones for themselves. After some research, they ended up buying two FX-61 fixed-wing drones with Pixhawk installed, from the Danish company Nordic Drone. Later, in 2020, an [eBee X](#) was purchased to supplement the fleet.



A hiker admiring the Drangarnir rocks – the iconic sea-stack with a hole in it – on the Faroe Islands. (Courtesy: Shutterstock)

Flexibility and other benefits

For Umhvørvisstovan, the key benefit of drones is their flexibility. Another major benefit for the Faroese surveyors is the fact that UAV mapping entails a relatively short workflow, from collecting the data to the finished products. This means that the images are rapidly available, plus the surveyors appreciate being in control of every step of the process. Now, in the case of any errors or unreliable data, the surveyors can either correct the errors or quickly collect new data themselves, without being dependent on others.

Ease of use and high-quality results

In a place as unique as the Faroe Islands, situated in the middle of the Atlantic, aerial mapping of the islands is far from a run-of-the-mill survey project and it involves a lot of pioneering. In order to complete challenging missions effectively and safely, it is important to know the capabilities and also limitations of the drone and how it will react in different circumstances. Umhvørvisstovan's use of drones has not been without mistakes, but they have ultimately enabled the team to gain a lot of valuable experience.

The main objective is to map all urban areas on the islands, and the maps that are created from the captured images are used mainly for land planning and for the national register. The municipality of Tórshavn even has its own drone to enable it to map the town at a higher rate than the agency is capable of. Since 2017, Umhvørvisstovan has collected 117,130 high-resolution images, which is an average of approximately 30,000 per year. The UAV-based maps have an average ground sampling distance of 3cm, which is considerably higher than before.

Both drones in the Umhvørvisstovan fleet – the Phantom FX-61 fixed-wing drone fitted with a Pixhawk camera, and the senseFly eBee X with an Aerial X camera – have worked really well for the various projects. There are pros and cons to the two systems, the team noticed; the senseFly ecosystem is very robust and user-friendly, whereas the Pixhawk and Mission Planner setup has the advantage of quick repairs and maintenance, such as in the case of a hard landing or when changing a servo. Both drones have also demonstrated that they are capable of coping very well with the often windy and turbulent conditions above the Faroe Islands.

For processing, the team have used Pix4D ever since they started working with drones. They have found it to be very effective and robust photogrammetry/mapping software which delivers high-quality results combined with ease of use.



A detailed and clear point cloud output of a UAV survey of the Faroe Islands.

Mapping a tiny island

Recently, Umhvørvisstovan mapped the tiny island (measuring just 2.34km²) of Svínø. The data collection mission was split into three flights that gathered a total of 1,997 images based on careful flight planning to save the pilot's time. The wind was, certainly by Faroese standards, gentle during the flights. Although there was some turbulence and the layout of the terrain was challenging, the eBee X was able to take off and land safely on some flat spaces on Svínø.

The captured data was processed in Pix4Dmatic, which took just over ten hours to crunch the whole dataset. The final map was then edited and annotated to add important details, such as coastlines, housing – including road names and addresses – as well as fields and agricultural plots. The resulting map [is available for free download](#) as an open-access resource.



A comprehensive view of Svínø rendered in Pix4Dmatic software.

Keeping pace with the state-of-the-art in mapping

One important lesson for Umhvørvisstovan has been that sharing experiences with other drone pilots is an effective way to learn and stay prepared for unforeseen challenges. In this context, the small team of geospatial professionals of the Faroe Islands have close relations with other drone pilots – especially in the Nordic countries. Within this network of drone pilots, they meet up to discuss challenges, help one another with issues and share how their country works in terms of mapping and other matters.

The Umhvørvisstovan team are keen to keep pace with the possibilities that new technology brings, and they regard participation at conferences within the mapping and GIS industry as another valuable way of learning about the latest trends and developments. Despite the isolated location, the Faroe Islands' communication infrastructure is very modern. Therefore, in today's technological era in which information travels at lightning speed, it is relatively easy for the team to stay up-to-date on the state-of-the-art in mapping, and they will no doubt perform many more successful mapping projects in the future.

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Hydrography of the Faroe Islands

As the Faroe Islands are situated in the Atlantic Ocean, coastal and hydrographic mapping is also an important pillar for the authorities. The responsibility for the hydrography and charting was devolved to the Faroese authorities from the Danish authorities in January 2020. The Faroese seabed covers 300,000km², and can reach depths of up to 3.6km in the north. Being a small country can sometimes be an advantage, however. The Hydrographic Office and the Land and Surveying Office in the Faroe Islands are actually in the same department at Umhvørvisstovan. This means that land and sea are right next door to each other, which presents some great collaborative opportunities.

The Hydrographic Office within Umhvørvisstovan comprises just three members of staff who focus on hydrography, charting and administration. The responsibility covers eight nautical paper charts and 21 electronic navigation charts. Furthermore, Havstovan (the Faroese Marine Research Institute) recently launched a new 54m-long research ship, which houses a Kongsberg EM712 multibeam system. Umhvørvisstovan is responsible for the operation of this and gathers medium-to-deep water data. Landsverk (the Faroese Roads Authority) is responsible for gathering both surface data and bathymetry data to monitor changes in the ports and harbours.

Mobile mapping with... sheep!

A couple of years ago, the Faroe Islands archipelago was one of the few places not available in Google Street View. As Google seemed to have no intention of mapping the Faroe Islands for the foreseeable future, an employee of the Visit Faroe Islands tourist board came up with her own solution. Instead of 'Street View', she arranged for a local shepherd and his sheep to produce 'Sheep View 360' by attaching cameras to the sheep to capture the environment as they moved around. Since the islands are populated by more sheep than people, this mobile mapping solution was brilliant in its simplicity.

Upon hearing about the Sheep View project, Google responded enthusiastically and supplied the Faroe Islands with a Street View Trekker and 360-degree cameras. This enabled residents and tourists to assist the sheep in capturing images of the beautiful archipelago. Thanks to those efforts, Google Street View now includes the Faroe Islands.

For more info, [see here](#).

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The island of Borðoy as seen from a drone's perspective. The image shows a sunny view of the town of Klaksvík in the summer.