MAXIMISE BUSINESS VALUE FROM OFFSHORE SURVEY DATA IN THE OIL AND GAS INDUSTRY

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SUMMARY

The Oil & Gas industry is facing a challenging business climate, therefore we need to be competitive yet innovative and show value year on year. This paper, and subsequent presentation, will give an insight in to the type of surveys acquired, how competitive scoping is performed, new technology is applied and how (hydrographic) survey data is managed internally.

Efforts are being made to identify ways to further reduce costs for seabed survey projects; Workscopes are reduced, competitive rates are achieved by re-tendering or mini tendering contracts, combining surveys where possible by continuously engaging with assets and projects and working in collaboration with other operators for seabed surveys where feasible.

Surveys can be acquired more competitively by applying affordable new technology; as a result, survey requirements have been updated to account for high resolution multibeam echosounders and side scan sonar and survey methodologies have been implemented to fit the area of interest. Additional deliverables such as multibeam backscatter are being used to help to make correct business decisions.

Survey deliverables are shared through the Seabed Survey Data Model (SSDM). The SSDM reduces the dependency on hard copy mapping and CAD deliverables and leverages the use of GIS and web based mapping and as result, the acquired hydrographic datasets can be integrated with corporate data holdings.

1. Introduction

Oil & Gas companies spend millions each year conducting pipeline inspections surveys. However, the Oil & Gas industry is under pressure to reduce cost significantly due to lower oil prices. A sustained lower oil price is expected and the business is bracing itself for a "longer for lower" prospect. This has a direct impact on the seabed surveys which are acquired by the Geomatics operating units within SHELL. This paper is focused on annual returning surveys with respect to acoustic pipeline inspections. In this paper an insight is given as to why it is important for SHELL to follow the innovations and make use of the hardware and software products which are developed in the Hydrographic Industry.

2. Cost reductions

One of the key items to bring costs down with respect to annual inspections is the reduction of the scope of work. Previously all pipelines in an asset where inspected on an annual basis as agreed internally and with the responsible government bodies. Nowadays a risk based approach is adopted where only (parts) of pipelines with a potential integrity risk are inspected. This can be either high, medium but also low risk. When a pipeline is buried to a certain depth for several years the annual inspection frequency can be brought down for example from annually to once every 4 years. Spot dives may still be acquired. However, to have this approach tested and approved internally and by the responsible government bodies, different deliverables are required where survey data is to be reviewed and analyzed more thoroughly. SHELL is always looking at smarter and more innovative ways of acquiring and handling survey data. Therefore, SHELL selects and works with vendors which are able to acquire quality data safely and have excellent capabilities to process, interpret and report towards a constructive end product.

3. Acquisition

SHELL operates globally, however, every operating unit works in a different environment (i.e. deep water towards shallow water) and fit for purpose survey methodologies need to be implemented. Therefore, SHELL has access to vessels which are able to work in different water depths and carry different survey sensors. In deep water larger vessels with Remotely Operated Vehicles (ROV) and Autonomous Underwater Vehicles (AUV) are used. In mid-water medium sized vessels with hull mounted deep water multibeam echosounders and side scan sonars fitted on Remote Operated Towed Vehicles (ROTV's) are used. Advantage of an ROTV is to be able to steer the vehicle and keep an optimum position and altitude and stable heading parallel to a pipeline to avoid distortion in the side scan sonar data. In shallow water smaller vessels with hull mounted shallow water multibeam echosounders and towed high frequency side scan sonar are used to achieve maximum resolution. The advantage of smaller vessels is their maneuverability and impact risk around offshore Oil & Gas platforms. In this paper comparisons of data examples in shallow water inspections will be shown.

Historically acoustic pipeline inspection data have been acquired with a single head multibeam echosounder, providing approximately 250 depth solutions (beams) per ping. Side scan sonar data were typically acquired from an ROTV using a dual transmitting frequency of 100/500kHz. From which only the 500kHz frequency was processed and used for interpretation. Two passes of the pipeline were usually made, one on each side, to ensure full insonification of the whole exposed portion of the target pipeline, facilitating improved detail and accuracy in the data interpretation.

To reduce the time taken to survey a pipeline it is key to acquire sufficient information in a single pass along a pipeline and thus operate multiple sensors at the same time keeping a steady (5 knots) survey speed.

3.1. Improved Data Acquisition Methodology

3.1.1. Multibeam Echosounder

In the southern North Sea (depths between 5- 40 metres) currently data is acquired along a pipeline with a dual head high resolution shallow water multibeam echosounder delivering up to 1024 depth solutions per ping. The increased number of soundings is a result of the narrower across (receiver) and along (transmitter) track beam widths. The large number of narrow receive beams provides the best opportunity to detect a feature. To allow for a single pass, and thus the multibeam echosounder and side scan sonar to be operated at the same time, the multibeam uses a pipe tracking algorithm [1] with the ability to steer the beams of the multibeam to be centered on the pipeline route. The vessel does not need to keep the pipeline at nadir below the vessel and can sail with a slight offset from the pipeline, towing the side scan sonar fish behind the vessel with approximately 20 metres offset from the pipeline. Being able to sail with an offset from the pipeline opposed to having to sail more or less directly over a pipeline and still keep sufficient coverage on both sides of the pipeline. Another great benefit of this feature is that it allows for greater data density directly over the pipeline route (Figure 2). As a result, greater detail of the pipeline and the surrounding seabed is obtained, allowing for example spans to be identified with greater confidence and measured more accurately. Of particular interest for pipeline integrity assessment is span length and the span height, and this is something that previous datasets from both multibeam echosounder and side scan sonar failed to deliver in sufficient detail. This improvement reduces the potential need for more expensive visual surveys utilising an Remote Operated Vehicle (ROV).

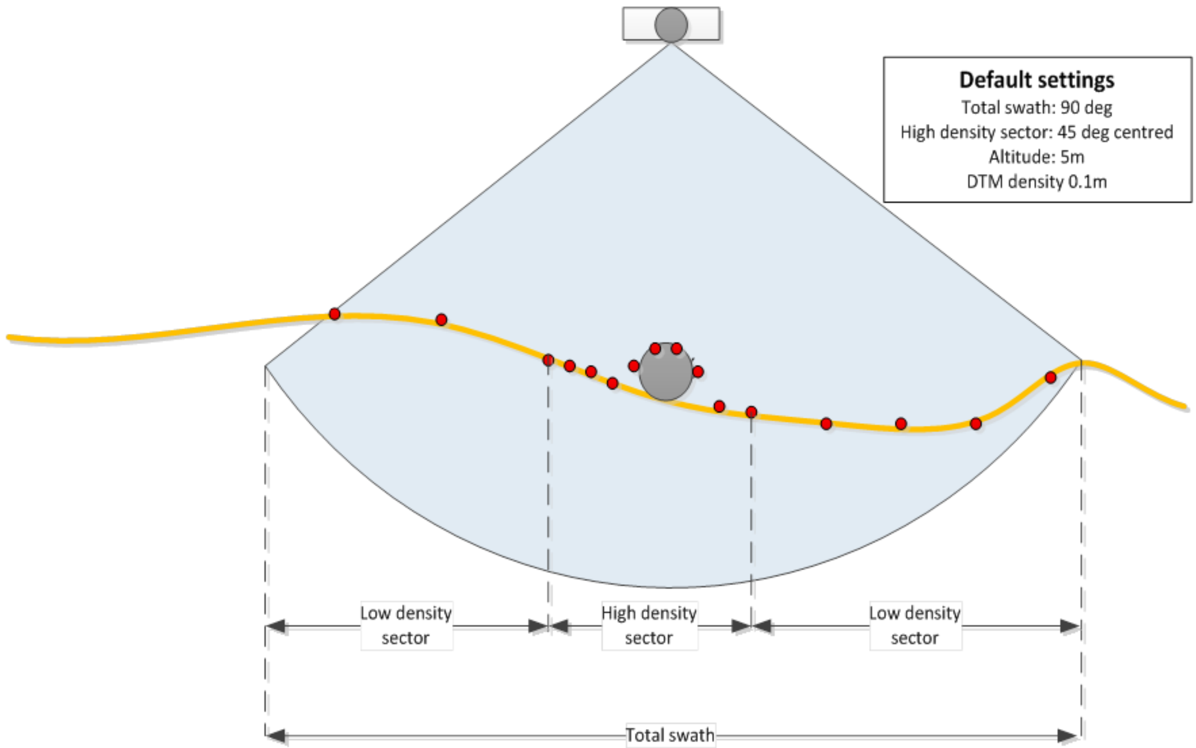

Figure 1: Graphic Illustration of FlexMode (Seabat, Teledyne RESON) [2]The figure shows an increased number of soundings over the pipeline and decreased number of soundings in the outer swath. A survey vessel does not need to sail directly above a pipeline but can also sail with an offset and the high density sector will be steered over the pipeline route.

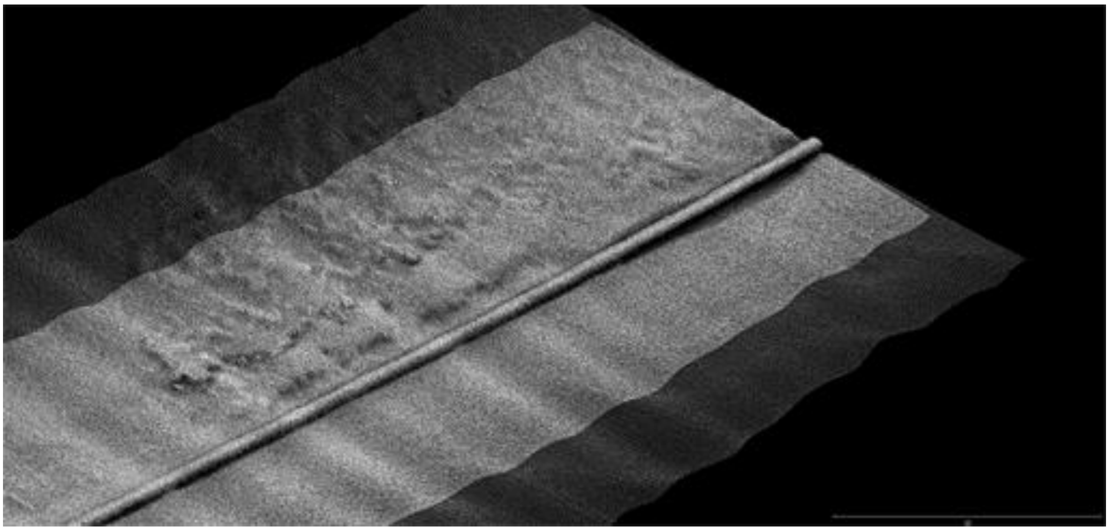

Figure 2: 3D perspective image of a high density sector around an exposed and spanned 24 inch pipeline. A span becomes clear at the right side of this image, where also soundings are apparent below the pipeline.

3.1.2. Side Scan Sonar

Complementing the hull mounted multibeam echosounder, a towed side scan sonar with an increased dual transmitting frequency of 300/600KHz is utilized with a 50 metre range setting to maximize detail resolution. The pipe tracking algorithm allows the vessel to be steered for optimal offset of the side scan sonar towfish from the pipeline, allowing an acceptable data coverage without resorting to a comparatively more bulky and expensive ROTV. The challenge however with using a standard non-stearable side scan sonar towfsh, rather than an ROTV, is maintaining the required offset to the target pipeline in frequently strong across-track currents.

Although higher frequency side scan sonar data is able to resolve greater detail (at the expense of data range), lower frequency data are also required to delineate changes in seafloor sediments and seabed ‘roughness’, as these types of features (amongst others) are often more easily identified on lower frequency data. Further side scan sonar data resolution improvements can also be realized during acquisition through using a narrower data swath width. This simple change improves both along track and across track resolution (Figure 3).

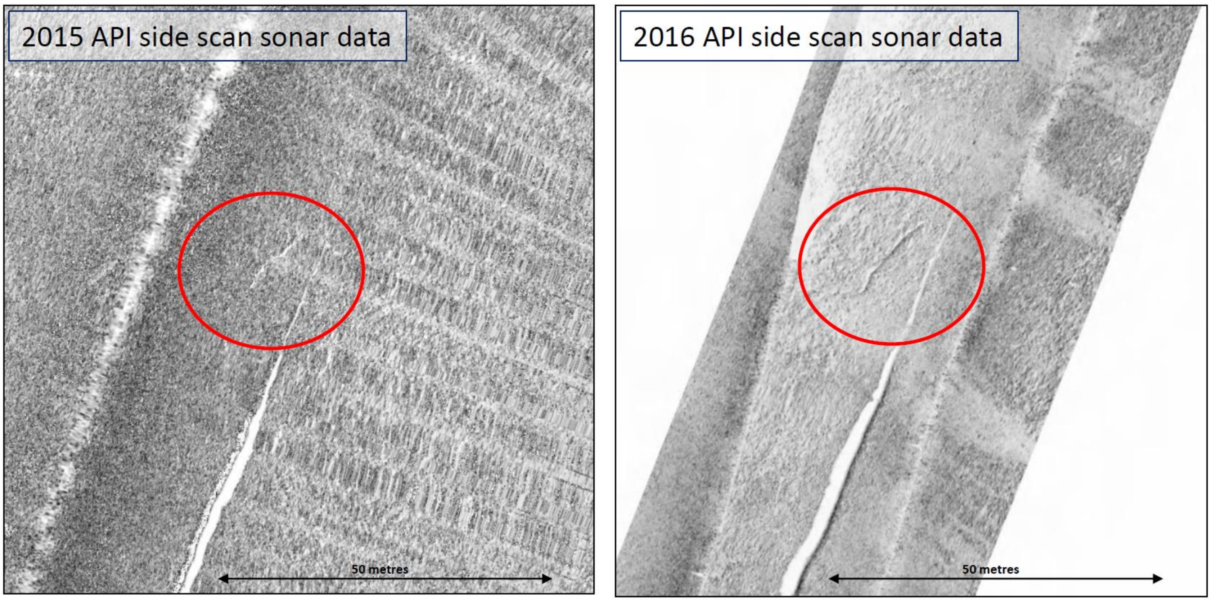

Figure 3: Data example of improved Side Scan Sonar along and across track resolution. On the left image only half of the swath width is already >50 metres. On the right image the total swath width is ~50 metres showing increased detail.

4. Processing, Interpretation and Reporting

Data processing, interpretation and reporting is usually performed by the survey contractors who acquired the data. Quality Assurance of final end products are performed by a 3rd party contractor. Further review of raw survey data is typically not being performed in-house. Geographic Information System (GIS) software and other acoustic data processing/ imaging software are however used to review and analyze survey data or to create more detail by viewing processed 3D point cloud data opposed to a regularly gridded file.

Traditionally typical survey deliverables where hardcopies of charts, alignment charts and reports. In addition pipeline events where delivered in propriety SHELL IBIS format. IBIS is a pipeline inspection database used for the inspection of sub-sea pipelines. In the Southern North Sea alone approximately1000 km of pipelines were inspected annually, delivering up to 720 paper charts per year.

More recent deliverables consist of digital copies of charts, alignment charts and reports in PDF/CAD and word format. Pipeline events were still delivered in SHELL IBIS format. At that time about 360 pdf charts where delivered per annum.

Today however, there is a much reduced requirement for hardcopy charts, CAD or PDF files and acoustic pipeline inspection data is routinely delivered through the Seabed Survey Data Model (SSDM).
The Seabed Survey Data Model (SSDM) is developed by the International Association of Oil & Gas Producers (IOGP) and is standard for seabed survey data in geographic information system (GIS) format. The SSDM is based on a Geodatabase format consumed via GIS software [3]. The SSDM includes survey outlines, Multibeam bathymetry, Multibeam Backscatter and Side Scan Sonar mosaics and metadata. There is a survey data management workflow in place to load data directly from the SSDM to a server that can be accessed through ArcGIS or SHELL corporate web maps. The workflow automatically creates additional products and metadata is added. As required pipeline route and depths can be provided. To have several datasets ready at hand digitally makes it far easier to perform analysis and compare year-on-year data.

Obviously the removal of a requirement to create hard copy charts, has realised a significant time and cost saving in itself. Not to mention the reduction of processing time to deliver these data.

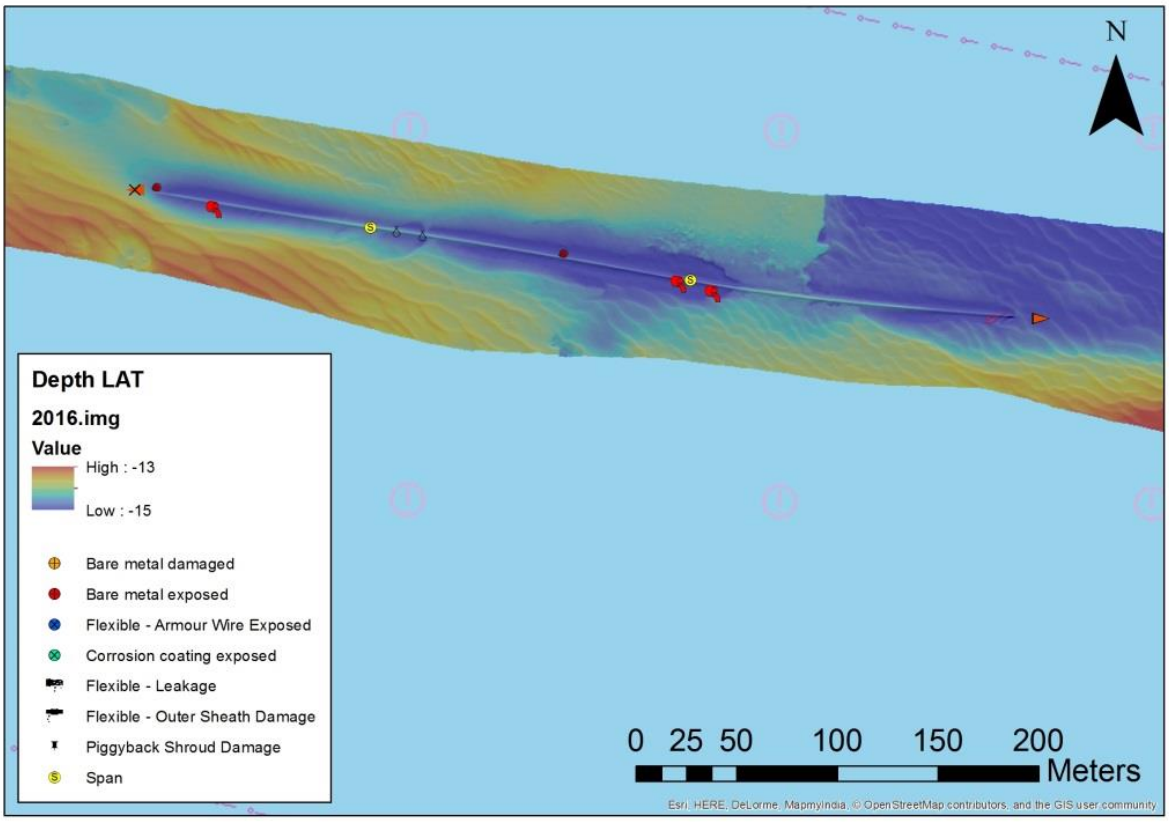

Figure 4: Example of bathymetry pipeline inspection data in ArcGIS.

Figure 5: Example of pipeline inspection data in a corporate web map.

5. Future

On the processing side we expect to make more use of multibeam backscatter in shallow water, where it has already become a standard tool in deep water. In shallow water multibeam backscatter is acquired and processed, but not yet used for analysis in shallow water to its full potential. We hope that this product becomes more known in the Oil & Gas industry and is accepted internally and by the government bodies as a useful addition to the existing products.

Currently multibeam echosounder data is typically delivered as a regularly gridded dataset or DTM (Digital Terrain Model). Gridding of these data can result in a reduction in the absolute detail available, and therefore delivery as a 'point cloud' or irregular dataset can aid in resolving fine details that might otherwise be missed. Visualisation of these point cloud datasets has historically been difficult due to computational and software limitations when dealing with potentially very large data files. Modern computers and visualisation software have largely overcome these problems however and it is now possible, though not routine, for point cloud data to be delivered and viewed directly, together with more traditional complimentary datasets such as raster images and DTMs. Current workflows will however need to be updated, and software further developed, to keep pace with the greater resolution now available from modern survey sensors and survey practices.

6. Conclusion

Since the landslide of the Oil Price we need to be more competitive. In recent years new survey sensors have been developed and multibeam echosounders and side scan sonars continue to show year-on-year improvements in data resolution and quality. Data has become "cleaner" and processing algorithms have been automated through which processing times have been reduced. Hardcopy deliverables are (largely) consigned to history and digital deliverables have become the norm.

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Links:

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BIOGRAPHICAL NOTES

Auke van der Werf graduated with a MScEng in Ocean Mapping from the University of New Brunswick, Canada and a BSc in Hydrographic Surveying from the 'Maritiem Instituut Willem Barentsz' on Terschelling, the Netherlands. After working as a product consultant for CARIS and project manager for Rijkswaterstaat (Ministry of Infrastructure and the Environment) he is currently working as senior surveyor for SHELL at the Nederlandse Aardolie Maatschappij responsible for the Southern North Sea. Next to his professional career Auke has been chairman of the educational fund of the Hydrographic Society Benelux and is contributing editor for Hydro International.

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