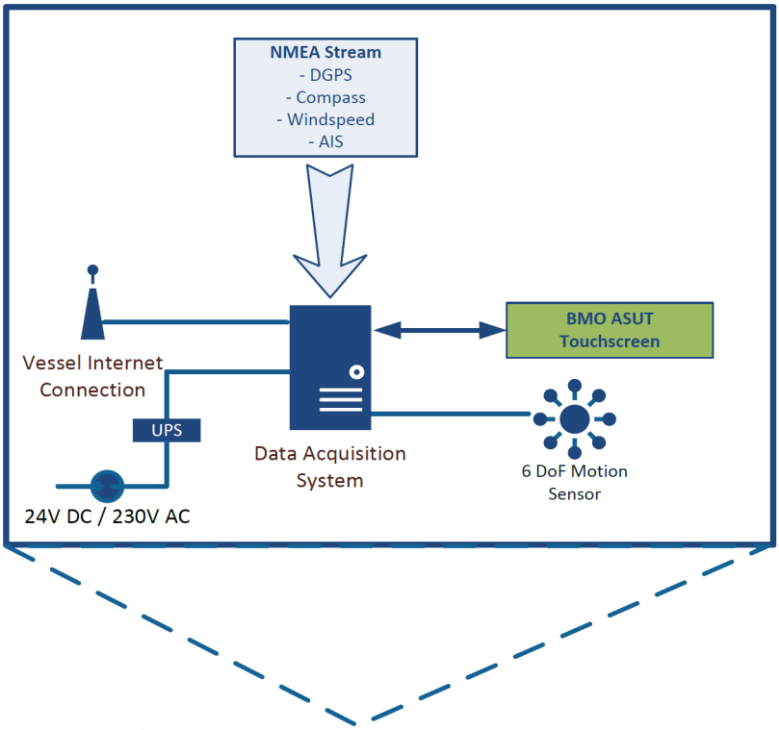
Access System Utilization Tool

Motion compensation for offshore wind projects



Reference: BMO_ASUT
Project title: Access System Utilization Tool
Project number: TEHE116053
Project partners: Acta Marine Wind Services BV, Ampelmann Operations BV and BMO Measurement Solutions BV

BMO OFFSHORE

Acta Marine Wind Services B.V.

AMPELMANN

Project title:	**Access System Utilization Tool**
Mini summary:	The development and demonstration of an innovative access system utilization tool which will increase the safe access from moving vessels to static offshore wind platforms.
Focus:	Reduce the costs of renewable energy as mentioned under SDE+ (Offshore Wind Energy).
Location:	The Netherlands; Rotterdam/North Sea.
Project coordinator:	**BMO Measurement Solutions BV**
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Summary

The application of large (90m+) purpose built vessels with robotic gangway systems is a new step in the maturation of offshore wind farm construction and operation. However the application of these new tools also poses the challenge of effectively using these expensive tools to their maximum effect. Since Gangway and vessel are not integrated by design additional information is needed to streamline their operation in marginal conditions.

BMO has in cooperation with Acta Marine and Ampelmann developed, tested and demonstrated the BMO ASUT (Access System Utilization Tool) which facilitates optimal this cooperation of the gangway and vessel, by advising the DP officer on which are the vessel motions limiting access system deployment. This allows the DP officer to take effective mitigating action and bring the access system back into its operational envelope.

Additionally the ASUT technology allows further analysis to improve existing procedures afterwards, and create a continual improvement of these complex operations.

BMO has designed and tested the system in actual conditions on Gemini windfarm during 2016 and developed continual improvements to is algorithms, analytics and user interface based on both operational feedback and the end clients views.

The result is a tool which creates transparency and has great potential, and both partners have indicated the wish for BMO to further develop the tool and deploy it into a large base of operations. Additionally other market parties have shown interest in applying the tool to their gangways and specialist vessels.

The development, improvement and demonstration of the ASUT concept was executed successfully within this project.

Contents

1 Introduction

1.1 Objectives

With the execution of this project the objective was to bring the ASUT concept to TRL level 8 where BMO's Access System Utilization Tool is tested in an open water environment on a Acta Marine vessel (Acta Orion) and a Ampelmann gangway (installed on the Acta Orion). The main purpose of this project was to measure and prove with a demonstration that the Access System Utilization Tool can actually perform under relevant (offshore) meteorological conditions and will increase the operational window of offshore crew transfers within the offshore wind-energy sector. The project shows that the Access System Utilization Tool provides the missing link between the dynamic positioning (DP) system of the vessel and an on-board motion compensated access system by providing information on the actual motion limits.

The project objective as stated above was realised within the project. During project execution the objective did not change.

1.2 Method

The system was designed to be an improved version of the existing VBB (Vessel Black Box) technology by BMO offshore.
The first step was to incorporate the new inputs into the system and write the quality controls to guarantee consistency. Second step was to analyse the behaviour of the operations and motions to see if the measured values create the context for evaluation. Third step was the design and testing of the bridge interface. Last step was to develop the analytics to allow improvement of operations in real-time and post hoc and demonstrate the ASUT concept. A number of revisions of this basic process have been completed in the full project cycle.

2 Results

2.1 Project results

The project has resulted in an integrated measurement setup suited to create transparency of performance of SOV and access system operations and a display which clearly informs the DP officer of the limit states of the access system. The system created performance data which has let to further optimization of operations of the vessel, the access system and its support craft.

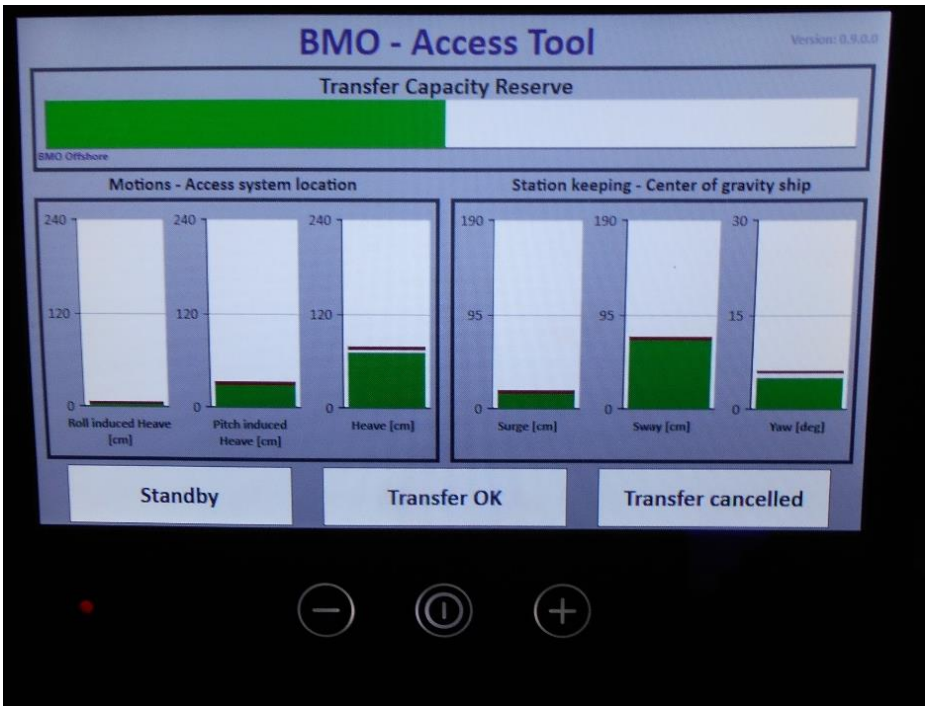

Figure 1: Display as installed on the Orion during operation

One benefit of the project is that we were able to utilize low cost Motion reference units (MRU's) manufactured by Xsens (Dutch supplier) with our own designed filtering and conditioning software instead of very expensive MRU's costing 20x as much. This has enabled us to create a viable business case for selling the system in the future as it is a very cost effective solution compared to traditional logging solutions. Furthermore the application on different kinds of MRU's will generate the expected impact on the Offshore Wind O&M activities enabling the expected discount on the kWh prices/SDE+ subsidy expenditures.

2.2 Post project activities

Both Acta Marine and Ampelmann have expressed interest to purchase units for commercial application and to further develop the potential of the solution within their own application(s). The first step will be the trial of adding advanced x-band radar based wave conditions measurements by Nextocean BV to the system to further increase the decision support of the DP officer and post-hoc analytics.

Second step will be to redesign the bridge user interface to allow projection of wave data and landing advice (for structures with multiple landing options) this will increase the application to the oil and gas platform crew change market where helicopters are increasingly replaced by fast vessels.

Next to the application during operation the data has shown to be valuable in the contracting stage of wind projects where mitigation of weather risk and correct estimation of logistic cycles is paramount. As such OEM wind turbine suppliers and EPC contractors have shown interest in using the data generated by the ASUT in the contracting stage for risk mitigation and performance based contracting.

3 Discussion

This start of this project has been a difficult one where a lot of methods and sensor types had to be evaluated to record the ships motion effectively and enable translation to the position of the access system on deck. The support of Ampelmann in sharing their operational data and access system operational envelope has been crucial for success. Equally the support of Acta marine allowing us to connect and test various types of sensors to critical equipment has been an enormous benefit and reduced the time needed substantially. Lastly the access to the sensor data from the Octans motion data from Van Oord survey to validate different filter methods was an unexpected benefit and enabled us to make the leap to a much cheaper (Dutch) MRU.

The design and testing of the User Interface (UI) was a difficult one as it needed to show complex data without making it dumb. Further discussions with the bridge also showed that clear understanding of the current limits of the system (DP Drift) are essential and need to be added to the procedure handbook. This is an area which may need to receive additional attention of a specialist interface designer at a later stage to make the information easier to understand in an intuitive way.

One of the findings during the project was that the understanding of the environmental conditions needs to be expanded (in other words wave data is needed, preferably real-time and forecast) to facilitate the decision making process as the decision is also impacted by the assessment by the Captain and DP officer of the ability to extract the technicians from the turbine.

A second finding was that the gangway has the option of not full compensating for some of the motions, (for instance compensate rotations but not all linear motion) and this can add to the performance envelope of the system. Determining beforehand what level of residual motion is acceptable for the client is essential for proper calibration of the bridge display.

DP position stability turned out to be difficult to detect as this is a slow transient phenomenon similar in time base to the deliberate position changes, in contrast to the faster ship motions which we were able to identify very effectively.

4 Conclusion and recommendations

The design objectives have been realized as the solution has been proven to be technically and commercially viable. The bridge interface has shown to be useful in assisting in determining mitigating action during operationally difficult motions. Next to the real-time information value, the post-hoc data analytics of transfer times , workability envelope and match with support craft has shown to be valuable for improvement of the vessels new operations, sales and contracting. Also end-clients such as OEM turbine suppliers and EPC contracts have shown great interest in the data to improve their logistic models.
The discussion of how to market the ASUT is to be determined as not all parties benefit equally from the transparency created and not all parties would like to disclose this data to their end-clients. Finding parties who deliver beyond expectation and seek a way to demonstrate this are the logical parties to be interested in the data gathered. The current project partners can be counted among these companies and the product can be applied effectively for them, but this may slow down initial acceptation as not everyone performs as promised in this immature market.

The same holds also for the display side of the ASUT where the willingness of the crew to use the tool and the inclusion of the tool into the operational procedures is essential to create lasting improvement effect. Therefore the vessel owners cooperation is essential in this process as he is in charge of the procedures used during operation.

As recommendation we see the already mentioned extension of the current system with spectral wave data to generate wave direction, height and period information as these can be very hard to determine effectively and are key in the evaluation of the ability to retrieve technicians after a near limit initial transfer to the turbine structure.

5 Execution of the project

5.1 Project difficulties

During the executing of the project we encountered a number of difficulties:

1. Consistency of inputs due to IT issues, the vessels has a complex IT system with multiple subnetworks, v-lans and user groups. As we needed data from the ships systems, a one way pipeline through the firewall separating the bridge IT systems from the rest of the ship had to be created, this proved challenging initially.

2. Definition of access system operational boundaries turned out to more complex as there is not a single cut-off point , but a grey area of reduced operational effectiveness. This has been resolved by using the lower limit as a boundary and introducing an orange transitional area. We used more budget than expected: It turned out we had to engineer our own heave/surge /sway filtering and processing. Sensors with this logic on board are commercially available but still very expensive (10 to 30 times more expensive) this consumed much more time than anticipated.

3. Because of the increased calculation load on the display, the display had to be upgraded to a better processor and memory specification. The initial unit overheated and shutdown during longer operations.

4. Because at this time a connection to the DP system is not available the DP set point cannot be determined so drift cannot be easily observed. In some extreme conditions this led to the system declaring fit for transfer while long term (>5 min) stability could not be guaranteed.

During the execution of the project the above mentioned difficulties were all solved, resulting in a working final ASUT concept that can and will now be marketed.

5.2 Project deviations

The project was well planned and executed. Main deviation was that execution was somewhat more intensive than planned resulting in more hours spend on the activities.

The project was executed with the following planning:

PLANNING TKI WoZ project Access System Utilization Tool				2016								2017			
WP	Activity	Participants	Category	May	June	July	August	September	October	November	December	January	February	March	April
1.	**Testing and validating**	**BMO, Acta, Ampelmann**													
	a) Testing of set-up	BMO, Acta, Ampelmann	IO	■	■	■	■	■	■	■	■	■	■		
	b) Validating of measurements	BMO, Acta, Ampelmann	IO	■	■	■	■	■	■	■	■	■	■		
2.	**Implementation of the measurement system**	**BMO, Acta, Ampelmann**													
	a) Implementing the ASUT	BMO, Acta, Ampelmann	EO	■	■	■									
	b) Implementing the display on the bridge	BMO, Acta, Ampelmann	EO	■	■	■									
3.	**Application and optimization of the system**	**BMO, Acta, Ampelmann**													
	a) Application of the measurement system	BMO, Acta, Ampelmann	Demonstration			■	■	■	■	■	■	■	■	■	
	b) Optimization of the measurement system	BMO, Acta	EO				★								
4.	**Operations analysis / pilots**	**BMO, Acta, Ampelmann**													
	a) Developing an operational profile	BMO, Acta, Ampelmann	Demonstration					■	■	■	■	■	■	■	
	b) Creating a ranking of causes not deploying	BMO, Acta, Ampelmann	Demonstration											★	
	c) Analysis the positioning and maneuvering time	BMO, Acta	Demonstration											■ ★	
5.	**Project management and evaluation**	**BMO, Acta, Ampelmann**													
	a) Monitoring and supervision	BMO, Acta, Ampelmann	EO	■	■	■	■	■	■	■	■	■	■	■	■
	b) Project evaluation	BMO, Acta, Ampelmann	EO											■	■

Figure 2: Planning R&D Activities ASUT

The project planning that was followed consisted of five work packages, consisting of 11 main activities from which two are defined as industrial development, five are defined as experimental development, and four are defined as demonstration. The project started directly after the proposal was accepted, within May 2016 with the implementation of the ASUT measurement technology and display on the Acta Orion vessel. Subsequently, BMO and Acta Marine continued the project with the testing and validation work package. Afterwards the implementation of the measurement system work package did start as planned. Next, the application and optimization work package was executed. An operation analysis is performed in the fourth work package. The project is completed by an evaluation on the ASUT demonstration as well as on the project itself.

The original project planning was followed throughout the project. Main deviation on this planning was that we were able to finish the project one month earlier than expected. The tests we executed on board of the Acta Orion Vessel offered enough data to further improve the ASUT concept as expected.

Furthermore during the execution of the project we realized that we were able to further improve the ASUT concept by also adding wave scattering data. This option is now researched (beyond this project scope) by BMO and might result further improvement of the ASUT-technology and will broaden the scope in which the ASUT can be used (e.g. ship-ship transactions).

5.3 Knowledge dissemination and intellectual property

Project results as well as the final product will be presented on the company website (www.bmooffshore.com).
The project's public summary will be published on the RVO/TSE/Wind op Zee website as public information. BMO will publish the project results and already published on the technology within relevant magazines such as "Offshore Industry" to further increase exposure of the ASUT concept, disseminating the project results to the sector. These publication will also market the solution and are expected to generate demand of interested parties.

Marketing will be conducted worldwide as the use of the concept is not limited to The Netherlands. More countries have major investments planned in Offshore wind Energy. Acta Marine and Ampelmann are the first users of the technology, if this project is executed successfully. BMO is already active on the crew transfer market with their products and services. This market will also be targeted for the ASUT-concept. BMO knows this market and has good access to it. Dissemination of positive project results will be part of BMO's marketing strategy.

5.4 Publication plan

Publicity is an important part of BMO's strategy to market the developed ASUT technology.
Two publications were already done before the execution of this project;
A publication in February 2016 titled "BMO Offshore's Access Tool" (www.offshore-industry.eu). Another example of a publication on the Vessel Black Box was published in a relevant magazine targeting the Offshore industry; ("Zwarte doos" op zee levert meer transparantie op; Offshore Visie, nr. 2 , 2016).

Furthermore the project was presented at the TKI wind op zee seminar that was organized in 15th of February 2017 in Amersfoort. The concept was presented there to a number of interested companies all active within the Offshore Wind Industry.

Figure 2: impression of publication "BMO Offshore Access Tool"