IMCA Lift Planning in the New Offshore Environment – Report 2023

Lifting & Rigging Seminar
26 October 2023

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Lifting & Rigging Seminar – **Version History**

Date	Reason	Revision
23 November 2023	First issue	

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Foreword

IMCA's Lifting & Rigging Seminar is put together by a workgroup, comprising people involved in IMCA's Lifting and Rigging Committee work. They are IMCA members and have vast experience and in-depth knowledge of offshore lifting activities within our industry.

These events are primarily a discussion forum for members and non-members alike covering key technical and operational topics. Bringing a mix of presentations and workshops allows attendees to focus on the specific topics during the day, identifying the actual state of the industry and its future requirements.

Output from this seminar, the thirteenth in the annual series, helps guide the IMCA Lifting and Rigging Management Committee in defining its future work scope on codes and guidance. The output from past seminars has influenced and shaped key areas of our industry and this one is set to perform just as useful a task.

This year's theme focused on the technical side of offshore lift planning, along with presentations and discussions on the tools, training and technology in the new offshore environment.

Thank you to our sponsors.

1 Background and Setting the Scene

1.1 Introduction & Welcome – Laura Lombardi, Usha Martin Italia, and David Cannell (Chair)

The Chair of the event, David Cannel of Technip FMC, introduced himself and welcomed everyone to the event. David is also Chair of the Lifting and Rigging Seminar working group.

David then introduced Laura Lombardi of Usha Martin Italia and Chair of IMCA's Lifting and Rigging Management Committee to officially open the 13th Lifting and Rigging Seminar. Laura said that the focus of this year's seminar was on Lift Planning. Laura thanked the Committee and the working group that developed the programme and arranged the speakers for this year's seminar. She said we have a great lineup of speakers today and wished everyone a great seminar.

Figure 1 – David Cannell

David said this seminar was part of a series of events that started in 2012 and focused on high-value offshore ropes for the first 5 years. The seminars have proven to be an excellent platform for the subsea contractors to discuss their issues and concerns with the various equipment suppliers, for the suppliers to share their developments and ensure academia was involved in preparing solutions for the future. Over the years, we have had great discussions and seen significant changes in the approach taken to the care and maintenance of high-value ropes within the industry. This included preparing for high-performance fibre rope operations.

Figure 2 – Laura Lombardi

In 2018, we decided to "Return to the Offshore Cranes". Looking wider at the complete lifting systems utilised offshore. The workshops within the 2018 seminar were used to identify the industry needs and hot topics related to offshore cranes. From this, we identified training of personnel, offshore lift planning, digitalisation of offshore cranes and general crane technology requirements.

In 2019, we covered Training and personnel competencies.

In 2020, we were hit by COVID. However, IMCA still ran a webinar equivalent – covering Crane Systems and Offshore Lifting.

In 2022, we returned to our face-to-face event, which focused on Lifting Technology in Offshore Renewables. We again brought industry professionals together to discuss the ever-increasing challenges of lifting wind turbine components in offshore environments.

David presented the programme for the event and emphasised that engagement at the event was necessary to ensure that any concerns and solutions were captured.

David thanked the event's sponsors and introduced the first Slido warm-up session.

1.2 Warm-up Workshop

The first question was for the audience to say 'hello' in their language, followed by a word cloud on where delegates were from.

Figure 3 – It was great to see an international attendance

The next question put to the audience was, 'How many relevant years of experience do you have?'

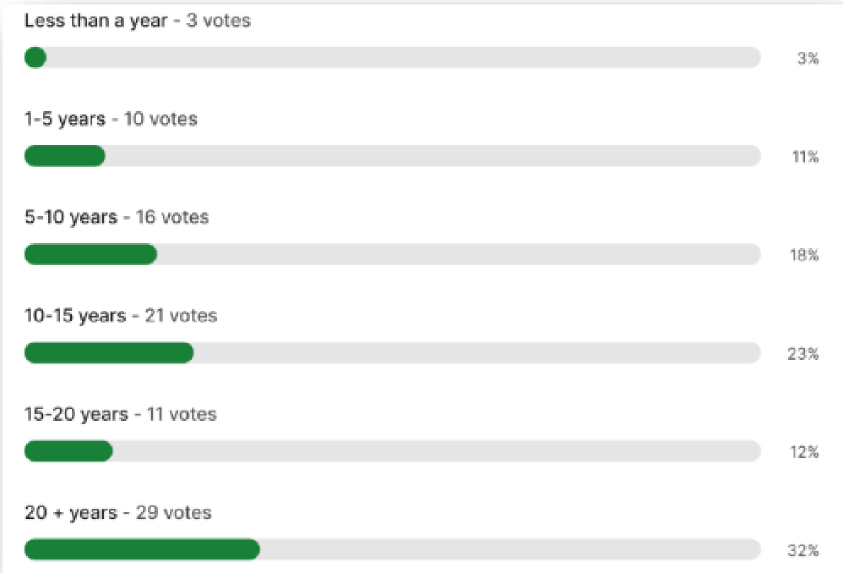


Figure 4 – 55% under 15 years' experience, but overall, a good spread

David thanked everyone for participating in the Slido questions and introduced the next speaker, Mark Ford, Marine and Quality Manager of IMCA.

1.3 Setting the Scene to Planning a Lift – IMCA's Recommended Practice, Mark Ford, IMCA

After the introduction, Mark presented a video of IMCA's 'Be Prepared to Work Safely' on Lifting Operations. He mentioned that the video was free to view on the IMCA website or YouTube.

Mark then discussed IMCA's Lifting Recommended Practice document LR006 – Guidelines for Lifting Operations. He further explained that the document had been developed by the Lifting and Rigging Management Committee (LRMC) and that it highlighted the essential elements that should be included in company lifting procedures.

He mentioned that it has also been endorsed by the G+ and the Lifting Equipment Engineers Association (LEEA).

Focusing on the document, he said that for a lift to be carried out safely, it should be:

- completed within an appropriate safety management system;
- properly planned and risk assessed;
- adequately supervised; and
- performed by competent personnel using the proper certified and maintained equipment.

Figure 5 – Mark Ford

Mark then turned to Safety Management Systems and said that all personnel involved in planning and executing a lift should do so in accordance with the company's safety management systems, which should contain, as a minimum, the following:

- commitment of senior management to provide clear policy objectives;
- corporate QHSSE procedures for lifting, hoisting and communications in the appropriate language;
- provision of adequate and appropriate personnel and equipment;
- provision of trained and competent personnel;
- requirements for inspection, maintenance, and removal of unsuitable equipment accompanied by the appropriate record keeping.
- management of change process (see IMCA HSSE001, Guidelines for Management of Change.)

Complacency was presented as a threat that everyone should recognise and constantly combat. Another quote that Mark mentioned was from Intel's founder, Andrew Grove; his guiding motto was:

"Only the Paranoid Survive."

Familiarisation was the next topic, and Mark said that before using lifting equipment for the first time, it is fundamental that new operators receive appropriate familiarisation for the specific equipment from a competent person. New tools are being developed, and familiarisation of them is critical. This should cover at least:

- instructions for use;
- any operating limitations and restrictions;
- pre-use check routines;
- emergency stops;
- equipment risk assessment;
- safety systems/guards fitted, etc.

Mark highlighted the differences between a lift plan and a lifting procedure. To summarise, a lifting plan is a broader, more strategic document that sets the stage for lifting operations and should be able to be understood by all of the lifting team. A lifting procedure is a detailed, operational document that provides specific instructions for executing a particular lift safely and efficiently. Both documents are essential for ensuring safety and compliance in lifting operations, with the lifting plan guiding the overall approach and the lifting procedure detailing the specific steps to follow.

It was followed up with an example lift plan document that looked at the following sections from the example in the recommended practice:

1) Starts with the high-level information, then progress onto the load details and crane details. Include the references to other documentation associated with the lift.

2) This covers crane-specific operational modes such as Active Heave Compensation (AHC), Constant Tension (CT), and the setup and changeover points. AHC, especially if used for a long time, will be detrimental to the crane rope.

3) Load control – will crane tuggers and deck winches be used, how many, and what is their operating mode?

4) Crane block control: Some crane blocks are heavy (55 tonnes), so they need their own methods of control.

5) Stability – the crew should ballast the vessel so that the vessel remains in a stable condition in the event of a loss of load. According to the International Code on Intact Stability (2008 IS Code), vessels using counter-ballasting during lifting operations need to withstand the case of a sudden loss of hook load.

6) Communication methods, which are critical to ensure clear and effective communication in a common language for every lift between all parties involved. What is the contingency if the primary method fails?

7) The rigging and lifting equipment list. It can be documented elsewhere, or a sketch can be attached to the lift plan.

8) A step-by-step high-level summary of who is in charge of the lift and any handover points. E.g. subsea lifts

Finally, Mark mentioned that when things are correctly planned, risk assessed, using competent personnel with the right equipment and a proven and robust SMS, why should the lift not go smoothly?

2 Session 1 – Lift Planning – Operators' Experiences – Lift Plans and Training/Testing

2.1 How Routine is Routine? – Russell Craig, TechnipFMC

Russell Craig was introduced by David Cannell and started by saying that the point he'd like to get across is that having a process is key to carrying out lifts safely. A question will arise early on when a decision is made within a lift plan process. In the case of a lift plan process, this can be the 'What category of lift does this fall under?' This sets the scene for the work required to plan and execute the lift safely – however, the process should be robust enough that even if the category is incorrectly assigned, the lift can proceed safely. Routine should not mean we reduce the level of scrutiny or that this will be an 'easy' lift.

Figure 6 – Russell Craig

Russell mentioned that TechnipFMC carries out hundreds if not thousands of lifts annually within the fleet, most of which will likely fall into a 'routine category'. He mentioned that it's the small things that can change a routine lift into a non-routine lift. Routine lift plans must be regularly re-visited. A routine lift on one vessel or work site may not be routine on another – each should be taken separately. Russell stated an excellent quote from Warren Buffett: ' *It takes 20 years to build a reputation and five minutes to ruin it. If you think about that, you'll do things differently*.

Russell explained why we plan lifts and listed the following as being key items:

- Safety of Personnel
- Statutory Compliance
- Risk Mitigation
  - Determine the suitability of the lifting appliance
  - Define the lifting configuration
  - Protection of assets
- Define lift criteria (for example. environmental limits)
- Professional reputation

Another essential element was that the process needs to include those carrying out the task. The process should allow for feedback and review and allow for any change that improves the lift plan.

The lift plan is for the end user, not for the engineer to show off his work.

For a good lift plan process, it needs to be:

- Easy to understand – global users
- LEAN – the Goldilocks approach
- Mitigates risk
- Considers complacency
- Quantitative rather than Qualitative
- Allows for change – even encourages change
- Encourages review

We need to ensure that all can implement the lift plan process. This means making the process easy to follow and understand and ensuring the correct steps are taken.

Lift plans will be used on the back deck of a vessel – therefore, we need to ensure the content is just right. If there is too much information, there is a chance that the plan may not be fully read; if too little and with assumptions made, an essential step may be missed.

We are looking to reduce the risk to as low as reasonably practicable.

Routine, non-routine, straightforward, difficult, engineered, complex – it doesn't matter what they are called, but the process to define and have a definition is vital.

A lift plan process should consider the level of risk and complexity – a quantitative approach.

By defining different categories, we can become efficient in planning whilst ensuring the correct mitigations are in place.

Having the means to assess properly at the beginning of a lift plan is key. However, the process should ensure that even if incorrectly categorised, the lift can take place safely due to the checks in place. Russell said that calling lift categories cat 1, 2 and 3 would be a better way as this, for example, removes any bias from complex or routine wording.

BE AWARE OF BIAS

Russell then provided an overview of what a lift plan process looks like.

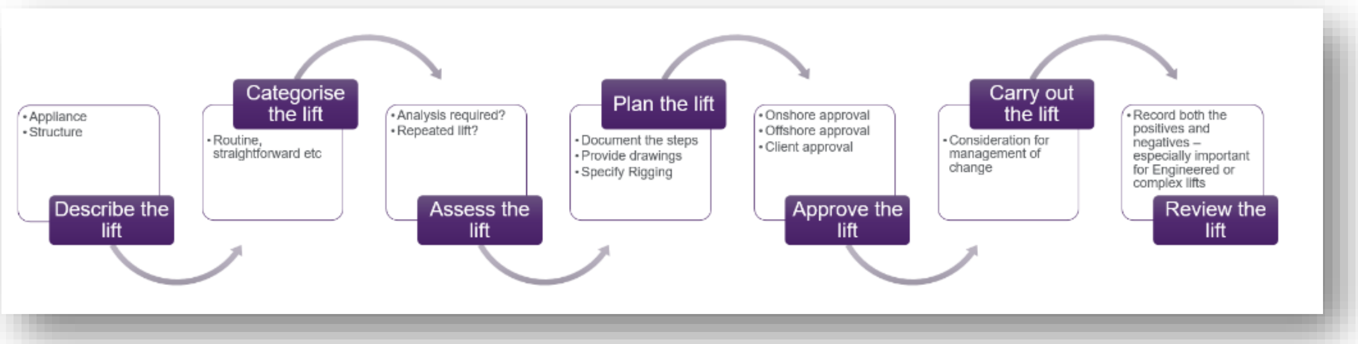


Figure 7 – Lift Plan Process

Finally, Russell summarised his presentation in his last slide.

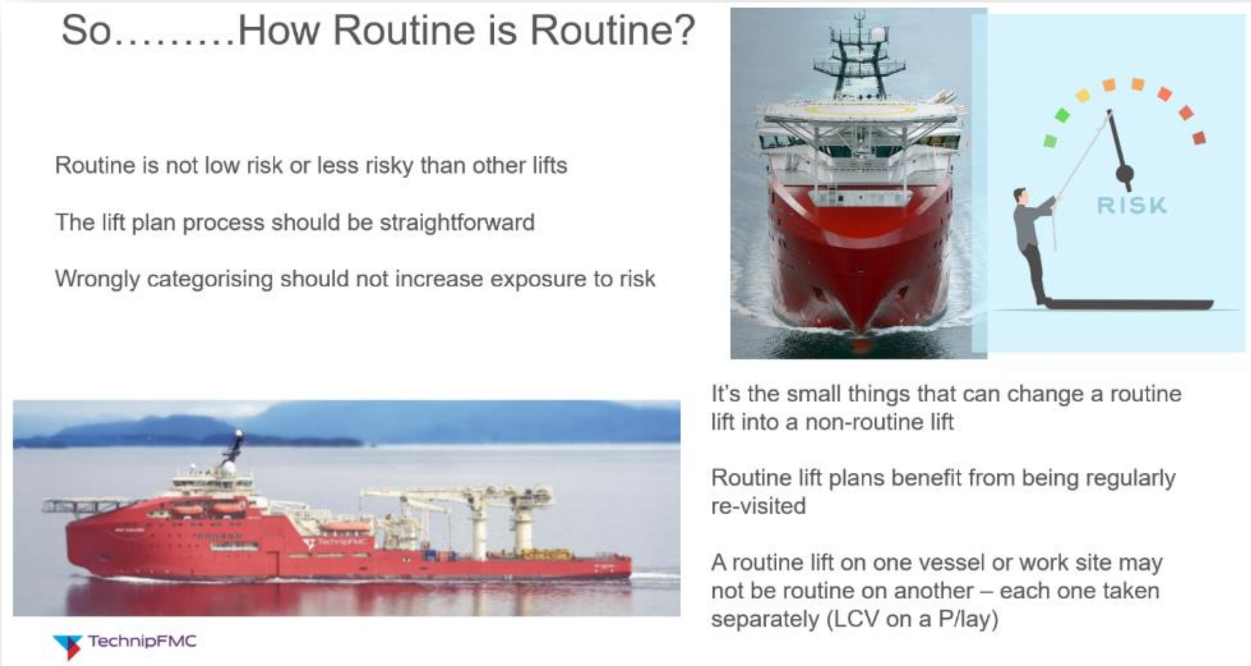


Figure 8 – Presentation Summary

2.2 Operation Simulator – Development and Crew Training – Jeroen Regelink, Seaway7

David Cannell introduced Jeroen Regelink of Seaway7, who commenced his presentation by highlighting the importance of including crew (training) in newly developed installation methods and tools.

He said windfarm installation was a production process, where the cycle time is key in assuring the number of foundations installed per season. This cycle time also determines the likelihood of a foundation being installed in acceptable environmental conditions. He emphasised that there are high consequences when the installation of a foundation has delays. This leads to delays in cable and turbine installation. The delays can be caused by unexpected soil behaviour, environmental conditions being worse than anticipated or equipment failure.

Figure 9 – Jeroen Regelink

Jeroen provided an example of an improved Monopile (MP) installation method using Dynamic Positioning (DP) to keep the vessel on station, which was adopted in 2019. Until then, only floating vessels on anchors or jack-ups were used. Approximately 40% of the cycle time per MP installation was reduced on DP. This led to less dependency on the weather and the installation of more MPs. Currently, Seaway7 has installed approximately 200 MP using DP. Jeroen asked the question, how did we manage?

He said that the approach was to gather as much data as possible on active projects and develop a simulation model based on the DP characteristics of the vessel in the offshore environment, such as hydrodynamic vessel motion models and control system models. The models were then validated using an offshore test pile. Jeroen said the modelling techniques were realistic and reliable when correctly applied. He provided an example from a recent project where they encountered regular pile runs. They then validated the numerical model that calculates the motion of the components and the vessel in case of a pile run. The validated hydrodynamic models were combined in the physics engine and, together with the actual control systems of the gripper and DP system, have been the basis for developing the training simulator set up in the office in Zoetermeer.

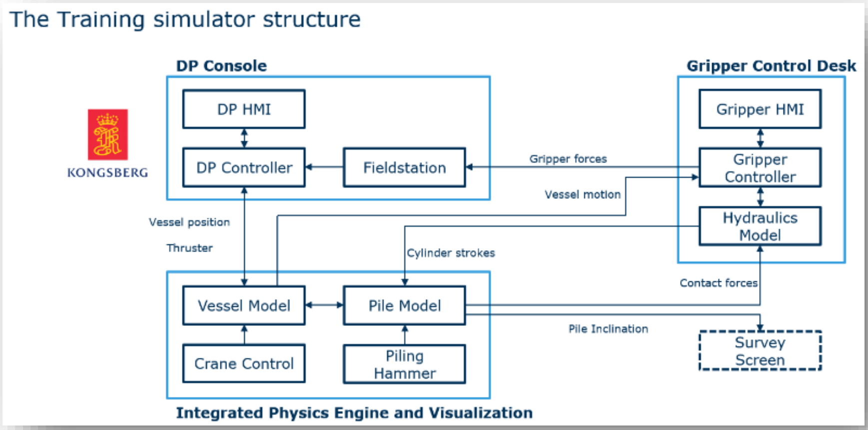


Figure 10 – Training Simulator Structure

The benefits of the operation simulator were stated to include:

- DNV-approved control system can be tested onboard before installation
- Safe and low-cost environment for the operators to familiarise themselves with the equipment
- DP system and Gripper responses can be tested in the simulated physics environment
- Operational procedure can be verified and improved, especially with the new communication between the Gripper Operator and the Dynamic Positioning Operator (DPO)
- Without damaging equipment, failure of systems and extreme (contingency) scenarios can be used in training the operator's desired responses
- A good communication tool between office and offshore personnel.

Jeroen then showed side-by-side videos – one showing the simulation, the other showing the actual view onboard the vessel.

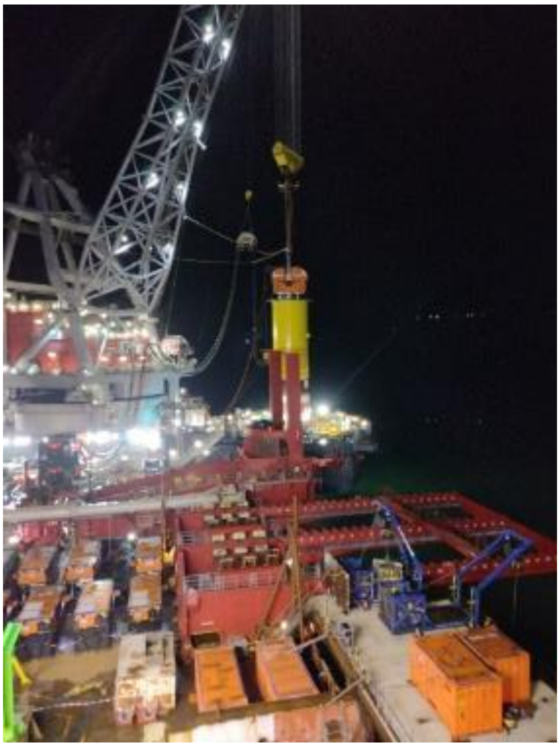


Figure 11 – Simulator and Real-time View

It was mentioned that the crew were exposed to various scenarios using the simulator, such as:

- Normal operation in different environmental conditions:
  - Move pile in gripper
  - Rotate the pile to the correct heading
  - Place pile on seabed
  - Place the hammer on the pile
  - Drive pile to final penetration.
- Goals
  - Refine Operational Procedures and Communication Protocols
  - Get crew familiar with control desk and DP-gripper interaction
  - Practice operation to speed up the process and improve communication
  - Change the sea state to experience the difference in the behaviour of the system
  - Change soil stiffness to experience the difference in the system
  - Experience the effect of changes in control system settings.

Once the above steps were understood, the crew were then put through some operational incidents to ensure the boundaries of the vessel and equipment could be found, in addition to providing the crew with confidence in the equipment and their performance.

The crew training scenarios included:

- Soil-related incidents:

  Incidents may occur at any time before stable penetration.

  - Dropfall/Running pile:

    The pile falls into the soil rapidly; hammer weight is reintroduced in the crane, causing the vessel to roll.

  - Unstable/non-uniform soil resistance.

    Soil stiffness is different over the diameter of the pile, causing the pile to tilt when not adequately supported by the gripper.

- Operational Incidents:

  - Environmental conditions

    Seastate changes in time outside standard operational limits

  - Hammer Impact

    Hammer bumps into the pile in an attempt to place it on the pile

  - E-stop Activation

    E-stop is activated, causing the arm to freeze in place. This may happen at any point in the operation.

Jeroen stated that all participants said that the training sessions were realistic with respect to the actual situation. Additionally, with every training session, we can improve the simulator.

Finally, it was said that on past projects, installing Monopiles on DP has become the standard, with approximately 200 piles installed to date.

Figure 12 – Pile installation on DP

2.3 Non-routine Lifting Plans – Jack Spaan, Boskalis

David Cannell introduced Jack Spaan of Boskalis, who commenced his presentation on Non-Routine Lifting Plans.

Jack started by quoting the meaning of the word 'Plan' from the Cambridge and Oxford dictionaries:

Cambridge – a method for doing or achieving something, usually involving a series of actions or stages or something you have arranged to do.

Oxford – a detailed proposal for doing or achieving something.

Figure 13 – Jack Spaan of Boskalis

Jack said that for an engineered lift, there are 10-15 different documents involved and recalled from his own experience when a lift wasn't planned well. He said the lift path was not depicted, and the barge position was vague, resulting in the crane radius, slewing angle and lifting capacity.

He mentioned the importance of having a formal organisational organogram showing all the personnel (onshore and offshore) included in the project and the lifting operation. He said this should be made available and discussed at relevant toolbox talks.

Jack stated, 'Do we still have an eye on the people involved?'

He said that requirements in the Master Document Register meant that the deliverable matrix was a tick box exercise, and the matrix was designed for management and clients and not the people who perform the work offshore. He said that, at best, the Offshore Construction Manager was consulted, not the rigger(s). The office staff were to facilitate the work offshore by providing the physical tools/equipment and instructions, i.e. what, how and any limitations. He said the formal organisation is assumed where the vessel bosun typically runs the lifting preparations.

Jack closed by saying that documents are the drivers other than ensuring that the people informed of the operation were informed. Quality assurance has evolved from what used to be common sense to electronic systems filled with references to 800-page operating manuals. He said that just because you, as an engineer, academic or senior mariner, can see things as obvious does not mean the rigger will. There needs to be better support for the management of change review onboard with completions on the vessel. Checks and verifications that are required for engineering lifts become routine. Introduce a buddy check system during the execution of the lift.

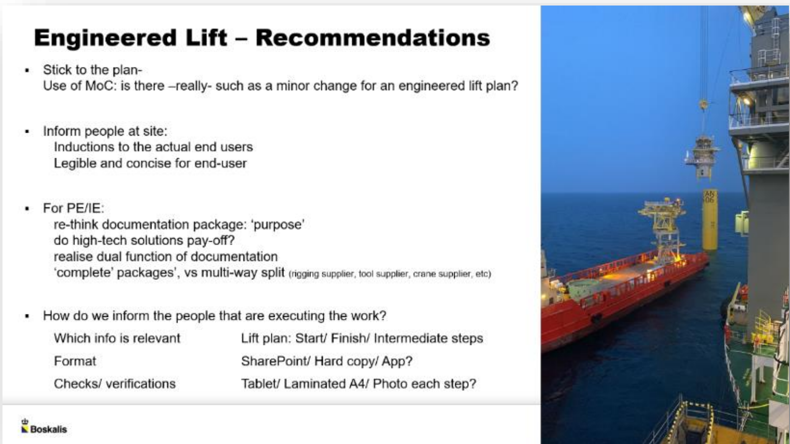


Figure 14 – Engineered lift recommendations

2.4 Workshop 2

David Cannell introduced the next audience interactive workshop, which used Slido.

There were four questions based on their initial thoughts on lift plans.

2.4.1 What should be included in a lift plan?

The audience provided feedback on their thoughts, and a word cloud was produced.

Figure 15 – Workshop 2

Figure 16 – Lift Plan items

2.4.2 List the top 6 priority components from the word cloud

The top six results of the word cloud were captured, and audience members were asked to rank their order of preference.

The following priorities were displayed:

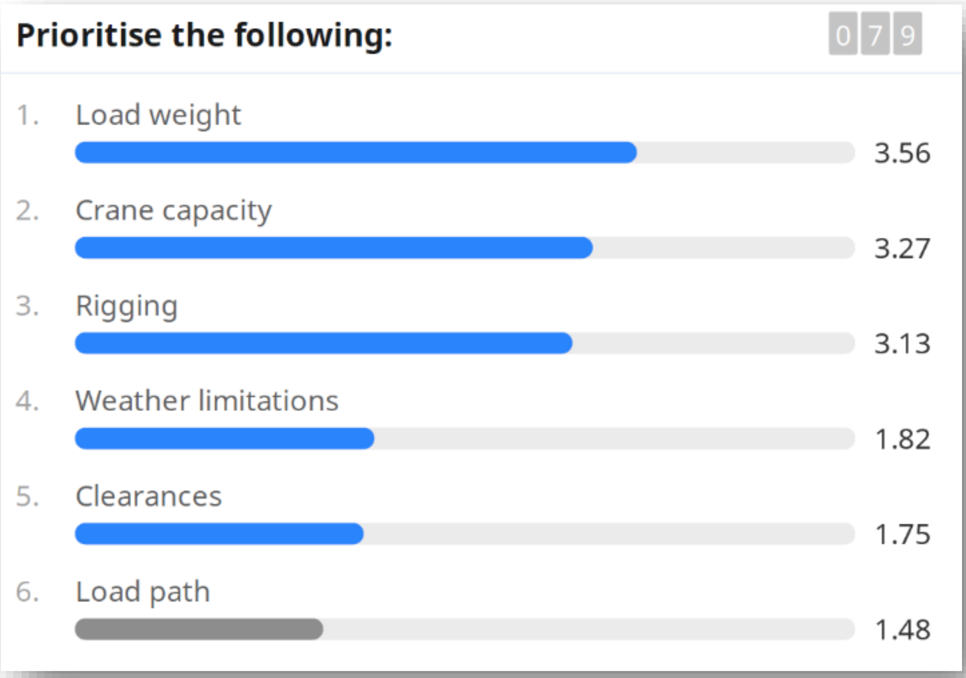


Figure 17 – Top 6 priorities for a lift plan

2.4.3 Are current lift plans fit for purpose?

It was clear that 48% of the attendees did not know if current lift plans were fit for purpose, and 14% said they were not.

Clearly, more work needs to be done on lift planning.

On a more positive note, 38% said that lift plans were fit for purpose.

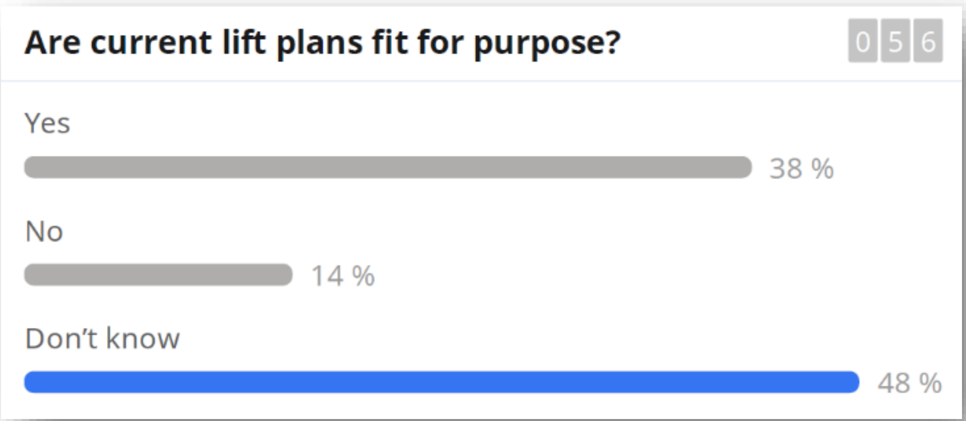


Figure 18 – Are current lift plans fit for purpose?

2.4.4 If not fit for purpose, why not?

Feedback primarily fell into the following categories:

Theoretical	Clarity	Complication	Other
Typical desk work	Missing information, focus on wrong elements	Technically difficult to read	User complacency
There should be a difference between practice and theory	Not specifying the roles of the lifting team	Too complicated	Generic lifting plan
Not keeping up with technical changes.	Purpose not clear	Too complicated for the crew	Not in accordance with regulations / Standards
Theoretical	Insufficient details	Too complicated or not relevant	
Lifting accessories not correctly designed	Not the correct information was provided	Too complicated at times	
Not made for end user	Missing information		
Not aimed at the lifting team	Rigging mismatch		
Not on point enough for deck personnel	Excessively wordy		

Figure 19 – Why lift plans are not fit for purpose.

It was clear from the collated feedback that lift plans were thought to be too theoretical and not aimed at the end user.

Lift plans should not be an exercise for the lifting engineer to showcase their academic skills, but need to be easily understood and provide clarity to the end user on what needs to happen, how it happens and what contingencies are put in place should things change; remember your management of change policy.

Avoiding complications was a good place to start. Ask the deck foreman/bosun what they think about the plan. Involve those at the coalface.

Always follow industry-recommended practices and standards to assist with the lift plan.

3 Session 2 – Operational Technology

David Cannell introduced session 2, which was focused on operational technology, and introduced the first presenter, Bas van Wuijckhuijse of TWD.

3.1 Lifting the Future of Monopiles – Bas van Wuijckhuijse, TWD

Bas presented the view of TWD concerning the challenges of future monopile installations.

It was stated that to date, there are approximately 80 GW of offshore wind turbines bottom fixed, with more than half of those being monopiles. To meet ambitious targets, the installation rate needs to increase by a factor of 4.

Turbine capacity was increasing, which means stronger and heavier monopiles were required, with some up to 3,000 tonnes and speculations of even more. Additionally, with the move to deeper waters, these monopiles will be heavier and longer. The diameters of these monopiles were increasing up to 12 metres.

Figure 20 – Bas van Wuijckhuijse

With this, it is a fact that there will be only a limited number of vessels capable of installation. Even though new vessels were planned to be built or upgraded, there would not be enough vessel capacity to meet the anticipated installation targets.

Simply scaling up vessels and equipment would not be sufficient to meet the targets.

Secondly, looking ONLY at the challenge and upgrading the process steps leads to expensive and inefficient solutions and equipment. Inefficient solutions meant that the steps in the process would differ quite a lot in workability. So, in that sense, we must not only focus on scaling up but challenge the methods holistically.

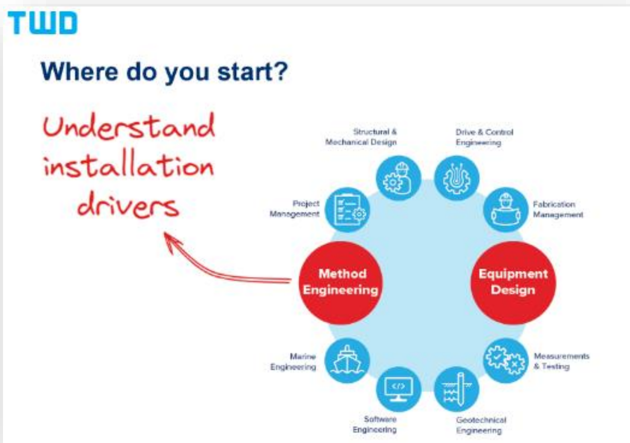


Figure 21 – Understand the installation drivers.

Bas then turned to the monopile upending and lowering using a jack-up and floating vessels.

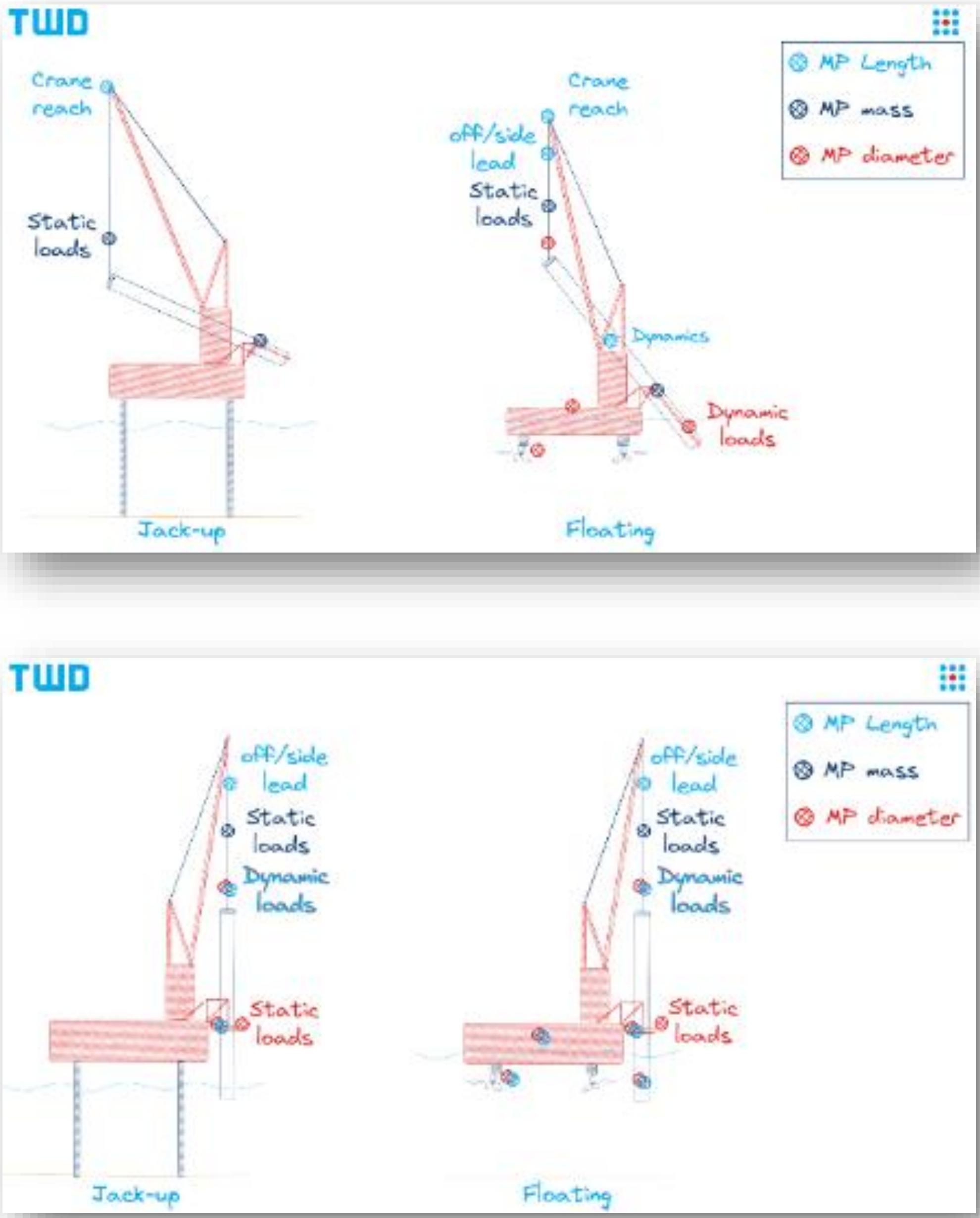


Figure 22 – Monopile upending/lowering – Jack-up/floating

To summarise, Bas said that installation targets were rapidly increasing. There are more monopiles which are heavier, longer and have bigger diameters. This directly affects the vessel, crane and the equipment. There are not enough vessels, so this requires project-specific drivers, not just one solution. To meet these aspirational installation targets, we shouldn't scale up the vessel and the equipment but innovate to utilise the existing supply chain.

3.2 Lifting Upending Tool for Monopiles – Alberto Pegurri, Remazel

David Cannell introduced Alberto Pegurri of Remazel, who commenced his presentation on the monopile lifting and upending tool.

Alberto provided the audience with a recap from last year's seminar and the progress made since then on the tool.

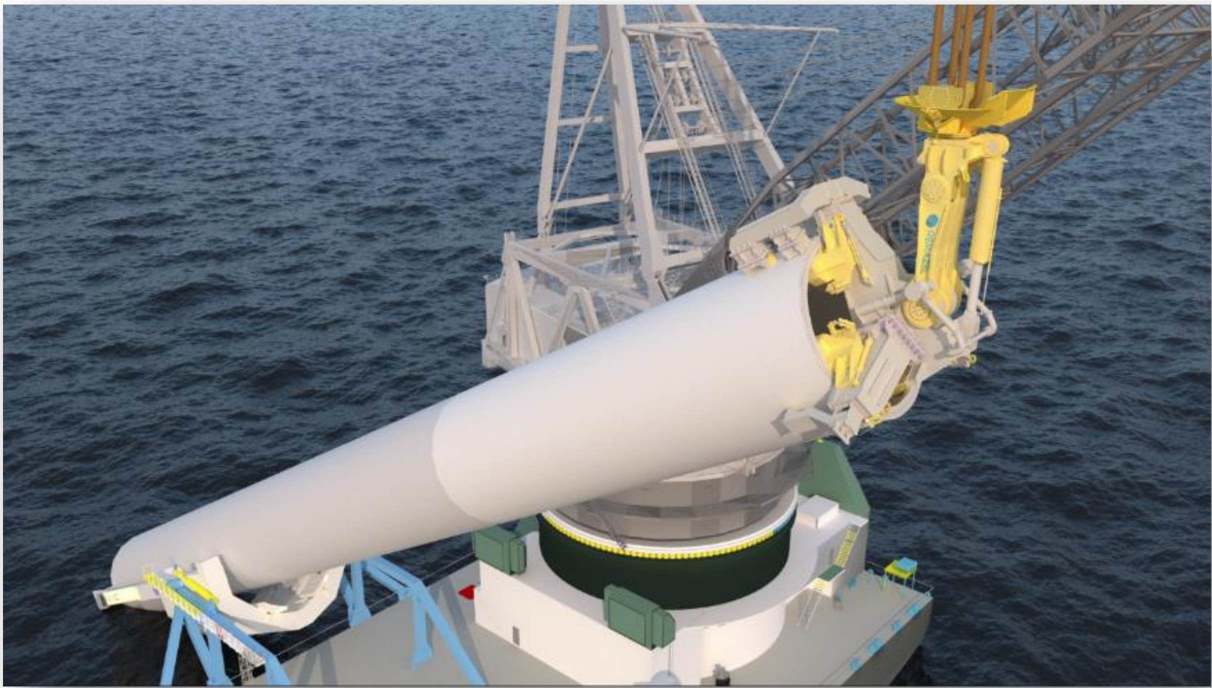


Figure 23 – Monopile upending and lifting tool

Alberto mentioned that the tool had the following key points:

- adjustability for different flange diameters and designs
- DNV certified DNV-ST-0378 & DNV-ST -N001
- a failsafe design
- redundant and emergency release systems
- tuggers interface for damping and steering
- wireless power and control
- a monitoring pack: cameras, survey eqp, MP heading sensors
- guides for offshore stabbing into MP.

Figure 25 shows the load on the crane and the tool's hinge loading throughout the lift from horizontal to vertical.

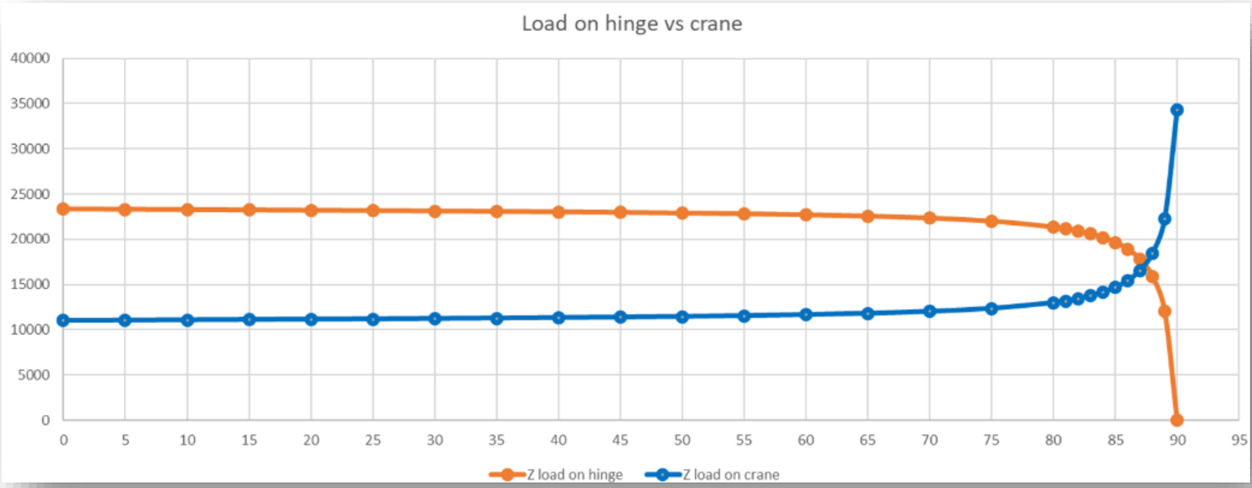


Figure 24 – Load on Hinge Vs Crane

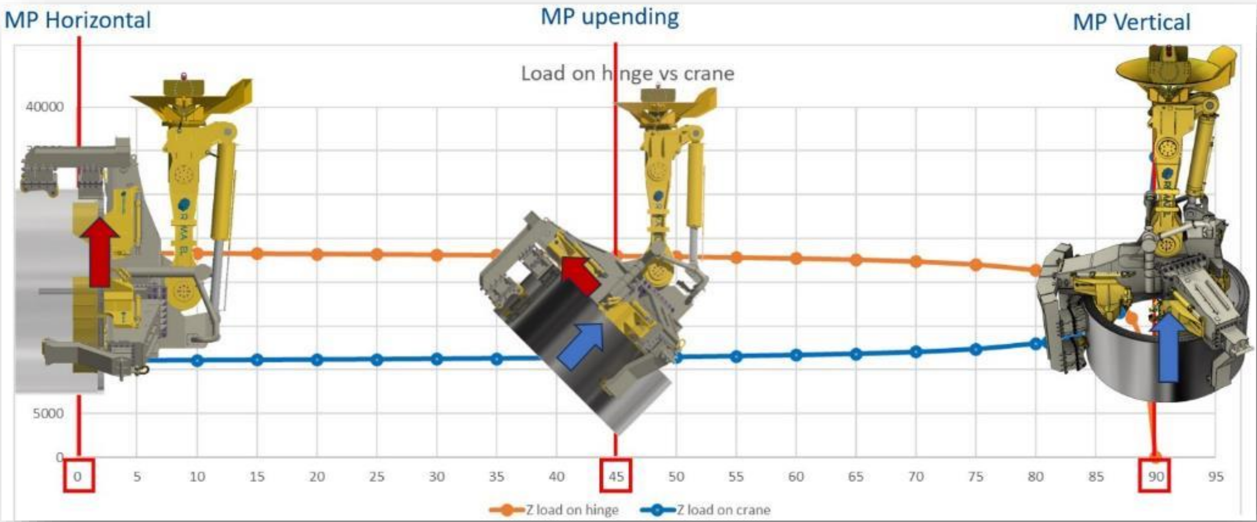


Figure 25 – Tool position during upending

The tool was noted to be quickly adjustable to fit monopiles of varying diameters and flange sizes. The tool was battery-powered with a fully redundant system should there be a battery failure. Cameras were also fitted in addition to wireless control.

Alberto summarised by saying that the tool could accommodate flange diameters of 6 to 9 metres and a weight of 3,600 tonnes.

Figure 26 – Upending tool.

3.3 Shock Absorption for Pile Run Protection – Sondre Gonsholt, Cranemaster

David Cannell introduced Sondre Gonsholt of Cranemaster, who commenced his presentation on shock absorption for pile run protection.

Sondre commenced by saying that the increasing use of pile hammers and the related risk of pile runs have created an opportunity for shock absorbers to be of great benefit to reducing the dynamics imparted into the crane and the vessel.

A video of a pile run incident was shown, and Sondre explained that the installation of piles was an act of balancing the pile driving force and the soil's resistance to driving. He said that you wanted to overcome the soil resistance to be able to drive the pile, but you also wanted to be in control of the driving process.

Sondre said that the risks associated with a sudden drop of the pile hammers included:

- overloading of the crane, the rigging and the connection to the hammer
- if it's not a pile hammer breakdown, there may be a need for inspection and recertification
- loss of operational time and project delays.

The calculated dynamics associated with a 780-tonne pile hammer falling 750 mm resulted in a dynamic hook load of 2700 tonnes (see Figure 27). Hence, using a shock absorber in the rigging ensured that potential dynamics were kept within acceptable limits.

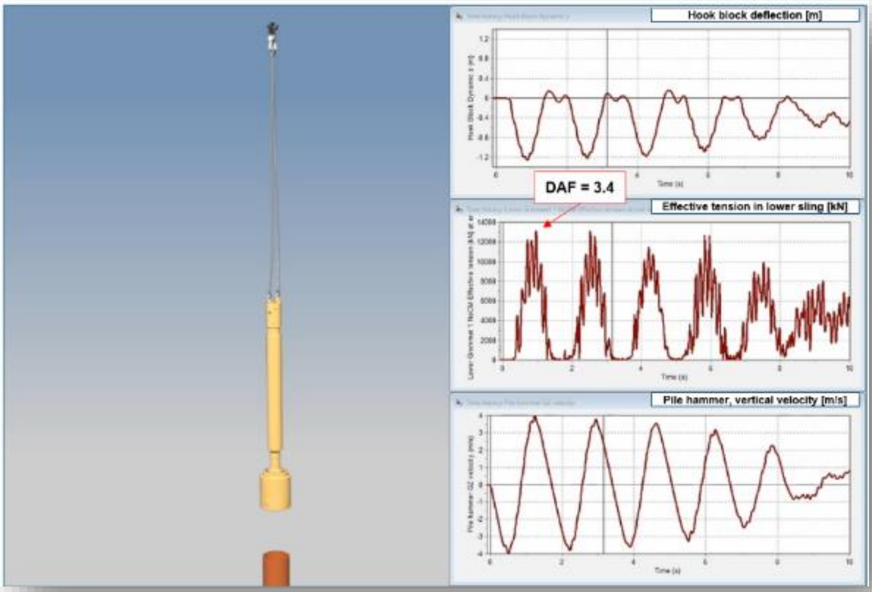


Figure 27 – Pile run; no damping

The calculated dynamics associated with a 780-tonne pile hammer falling 750 mm with a shock absorber resulted in a reduced dynamic hook load of 1100 tonne (see Figure 28).

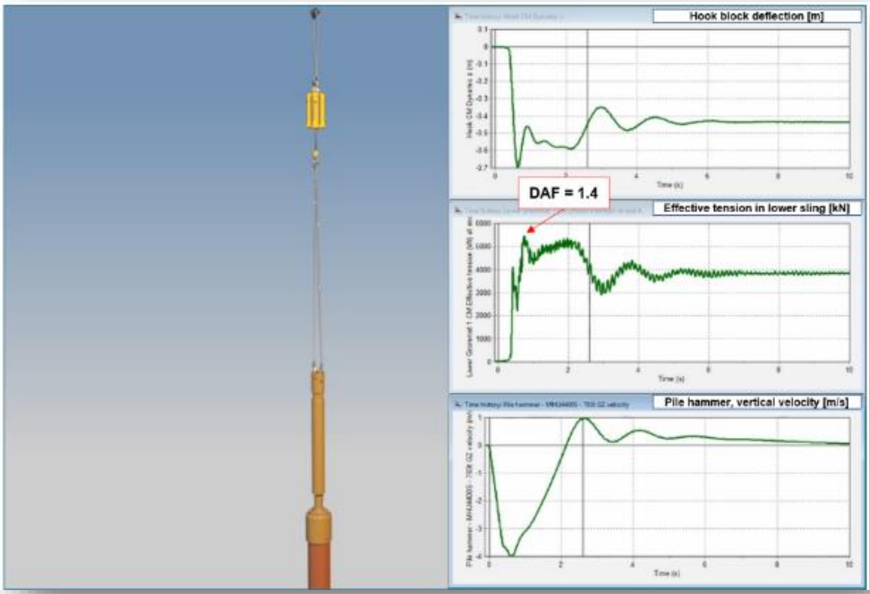


Figure 28 – Pile run with damping

In summary:

- Pile driving involves the risk of severe dynamic overload.
- Ignoring the risk can be costly.
- Shock absorption can be used as risk mitigation.
- Early assessment and planning is important.

3.4 Workshop 3

David Cannell introduced the next workshop session, which comprised six groups using the flip charts to capture the feedback.

The following questions were asked:

3.4.1 What is the future of lift plans? For example:

a. Content and requirements (e.g. greater use of visuals)

b. Greater use of technology (e.g. digital task plans)

3.4.2 How do we improve competence and training for the lift?

a. What are the barriers

b. Who makes the ultimate decision to halt a lift?

c. Should we bring the inclusion of augmented reality and digital twins into training? If so, how?

3.4.3 Should there be some form of CPD for lift planners?

Feedback from the six groups covering the above questions was as follows:

Group 1

1. The potential to digitalise and include some animation in the lift plans

   It was felt that involving the deck crew at an earlier stage would be helpful to ensure that there was deck involvement rather than just the engineering of onshore personnel.

   People needed to be better trained for doing lift plans, and far too much documentation was created concerning a lift plan.

   Offlead and side lead control stops should be included in lift plans.

   The lift plan should clearly indicate the location of the safe zones and escape routes.

   It is imperative that risk assessments are clear.

   A tested communication system must be in place.

Figure 29 – Group 1

2. All the responsibilities for the lift are made clear with one person in charge of the lifting process.

   Anybody involved in the lift must have the facility to stop it if they see anything going wrong.

   It was strongly felt that one of the significant dangers we have today is the issue of complacency.

A suggestion to combat this was job rotation amongst the deck crew and getting personnel practically trained.

Simulators are seen to be extremely useful, but there still needs to be more development work in that area.

There should be a focus on training rather than qualification. Training needs to be standardised.

3. It was fully supported that lift planners should have some form of Continuous Professional Development (CPD).

Group 2

1. There needs to be common standards that everyone works to.

   Oil and Gas lifting remains different from lifting in renewables, which still retain the onshore civil engineering elements.

   The lift plan should contain the right amount of details. The lifting plan should be separate from the lifting procedure (instructions).

   Artificial Intelligence (AI) can be further explored – a load path programmed and a 'helicopter view' of the lift could be beneficial.

   The client's expectations are mostly on certification and not so much focus on competence or personnel.

   Training should ensure proof of competence, not just course attendance, i.e. Practical, assessed training.

2. Everyone should have the decision to halt a lift; however, in some cases, the level of understanding of what was happening can be an issue.

   Re-commencement of the lift should be the decision of the person in charge of the lifting operation.

   Simulators can be a good tool to use for practising the lift. This should include the involvement of the lifting engineers, riggers and deck crew, crane operators, dynamic positioning operators and Offshore Construction Manager.

3. There should be some form of CPD. It takes around two years to progress to a Technical Authority and about five years to a lift planner. CPD can assist with raising the competence level.

   Training for lift planning should be standardised globally.

   The sharing of lifting planning between different companies would help.

Group 3

1. The lift plan should be a dual-purpose document containing the customer's engineering and regulatory aspects. It should also have the operational aspects for the deck personnel who will be performing the lift.

   In the future, we can anticipate paperless planning utilising the likes of Google Glasses with augmented reality with the potential for AI assistance. This would be useful for showing the simulated lifting operation for familiarisation purposes and identifying potential lift issues.

   Look at the potential for a modular lift plan that can be reused for other lift plans.

Figure 31 – Group 3

   The large size of some lift plans makes it feel as 'Non-Routine' even when it is a 'Routine' lift.

   Simulation can be beneficial to potentially prevent accidents.

2. The following were seen as challenges to a lift plan:

   - Language – overcome by using augmented reality.
   - There are different procedures for different companies.
   - Comfort zone – leading to complacency – working for years in the same way.
   - The older generation tends to be less familiar with computerised tools than the younger generation.
   - Due to the complexity of the operations today, it makes training much more challenging to do. There's no chance to accumulate experience, and simulation is not enough.

   Anyone can stop a lift; everyone can make the ultimate decision.

   The costs associated with training can be a barrier to some companies.

3. There should be CPD for lift planners. It is helpful for the customers. Keep in mind that the marine authority is not always up to date with current practices and methods.

Group 4

1. Lifts must be planned, so there will always be a future for lift plans.

   There needs to be a balance in the details that should apply to a lift plan. Too much detail, then the user can become confused by the information. It was proposed that a filter be used for the different types of users of the lift plan. Another challenge was to standardise the lift plan, which could be problematic under all the different circumstances.

   Three-dimensional simulations were another tool to enable the lift to be viewed from all angles.

Figure 32 – Group 4

2. One of the barriers identified was the lack of experience of some offshore operators, with a potential solution being more automation and training in the operation and accumulating 'on the job' hours of experience.

3. This group felt there should not be CPD for lift planning. It should be a company policy due to the various number of different situations that arise. It was suggested that introducing something like a minimum number of hours per year would be required to obtain sufficient experience.

Group 5

1. Augmented reality was thought to be a helpful tool to support lift plans using videos during toolbox talks.

   Lift plans should be able to be understood by a changing/new crew.

   There needs to be a focus on quickly adapting the lifting plan to the real-life situation.

   The relevant information needs to be included for any lifting accessories/tools in the rigging plan, an example being the use of shock absorbers.

   Associated standards need to be user-friendly.

Figure 33 – Group 5

2. This is a fast-growing industry, and it is challenging to keep up with competency and personnel training.

   There is a risk in managing expectations versus the technical risks, such as:

   - monopile increasing size
   - time pressures.

   Simulator training is valuable.

   A simulator onboard the vessel greatly assists.

3. There should be some form of CPD introduced. It could be company and activity-specific, which makes it challenging to develop a generic CPD programme.

   Training and familiarisation with new equipment is essential and should be part of a company CPD programme with the responsibility of the competent person.

Group 6

Figure 34 – Group 6

1. Utilising a virtual environment was mentioned, along with toolbox talks being more innovative. Crew exchanges need to be addressed to ensure that sufficient handover is carried out.

   The communication loop when a lift plan is sent out electronically was not good. The feedback that it has been received onboard and is understood by the relevant persons. Any feedback on areas that require further clarification.

2. There can be language barriers concerning native speech, and the background of people who work together should be considered, i.e. academics versus mariners or riggers. They may speak the same language, but the understanding can be different.

   The exchange of people from the office to the vessel and vice-versa was mentioned as a potential way to combat complacency.

   Augmented reality can warn personnel of potential hazards, e.g. loads overhead and approaching wind conditions.

4 Session 3 – Supplier Sessions

David Cannell introduced session 4, the supplier session, and introduced the first presenter, Terence Vehmeijer of Huisman.

4.1 Travelling Load Stabilising System – Terence Vehmeijer, Huisman

Terence commenced his presentation by showing a good example of the type of challenges encountered during a blade installation when the wind induces motion in the blade.

Figure 35 – Terence Vehmeijer

A conventional tagline system is commonly used to reduce wind-induced turbine blade motions during installation. This system uses pretensioned wires to position the tugger sheaveboxes, resulting in a large displacement when a force is applied due to the elasticity of the wires. This results in quite a significant movement (excursion) of the blade, as shown below.

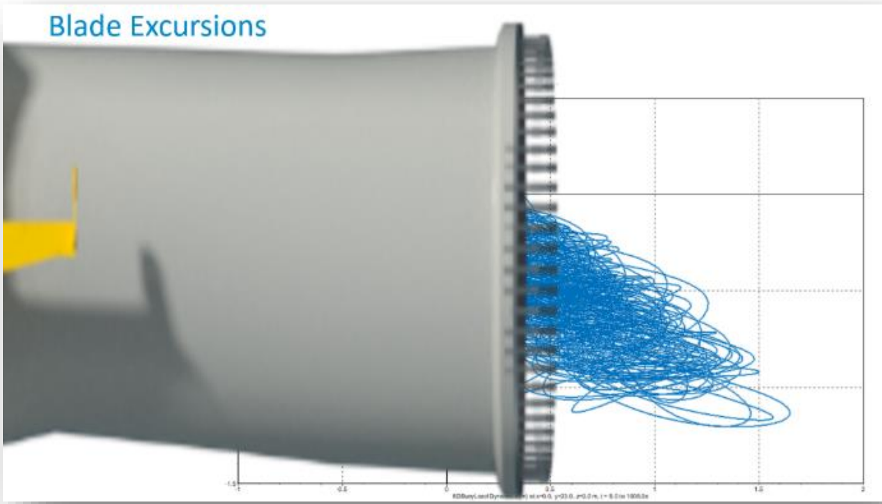


Figure 36 – Blade excursion using tuggers

Huisman's solution was to use a travelling load stabilising system whereby the load was restrained with two pairs of tuggers with position control as follows:

- Horizontal Plane – One pair travels along the boom for an optimal position relative to the load.
- Vertical Plane – One pair is deployed from the crane tip.

Figure 37 – Travelling load stabilising system

For rotation in the horizontal plane, the tuggers were commonly set to tension control mode to avoid damage due to overload. Tension control would allow some motion of the blade. The Huisman system uses position control on the horizontal tugger winches, which effectively restrains the rotation of the blade.

For rotation in the vertical plane, the tuggers were commonly set to tension control mode to avoid damage due to overload. Tension control will allow some motion of the blade. The Huisman system uses position synchronisation on the vertical tugger winches, effectively restraining the rotation of the blade.

For both planes, in the case of an overload, the winches will render and return to their initial position when the load is below the threshold.

The travelling load stabilising system was said to reduce the blade root motions by 20-60%.

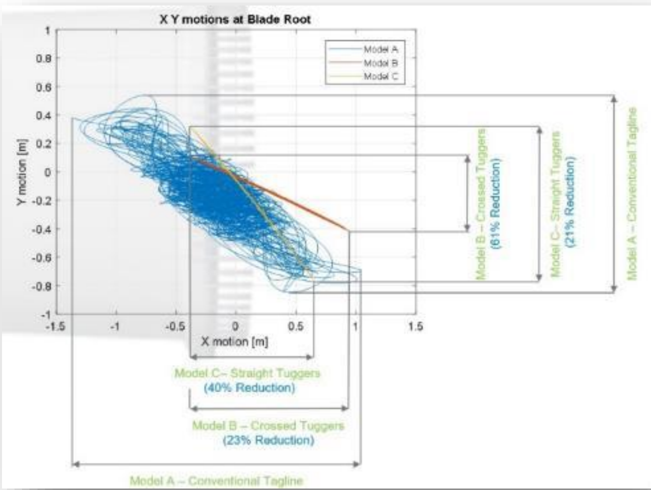


Figure 38 – Reduction in blade root motions

Another mode was stated to be 'Block Follow Mode', where more accurate positioning of the lower block can be achieved, and the crane operator can focus on the position of the lower block without worrying about the tugger control. It was also stated that the travelling tuggers could be used for man-riding operations.

4.2 Motion Compensators for Floating Crane Operations – Elvira Jansen, Bargemaster

David Cannell introduced Elvira Jansen of Bargemaster, who commenced her presentation on motion-compensated feedering.

Elvira provided a summary of the background as to what the problem was with transferring load offshore and the solution of using a motion-compensated pedestal provided by Bargemaster.

Figure 39 – Floating crane operation

It was said that presently, the Wind Turbine Installation Vessel (WTIV) cycles back and forth from the marshalling ports to the offshore site with the turbines, which is very inefficient. Especially when the wind farms are sited further offshore, and turbine sizes are increasing.

Using a feeder barge was said to be the solution, as this means the WTIV can remain offshore and local barges can transport the turbines offshore. Additionally, it meant that smaller marshalling ports could be used. With the use of motion compensation, the average workability of the WTIV increased to 87%.

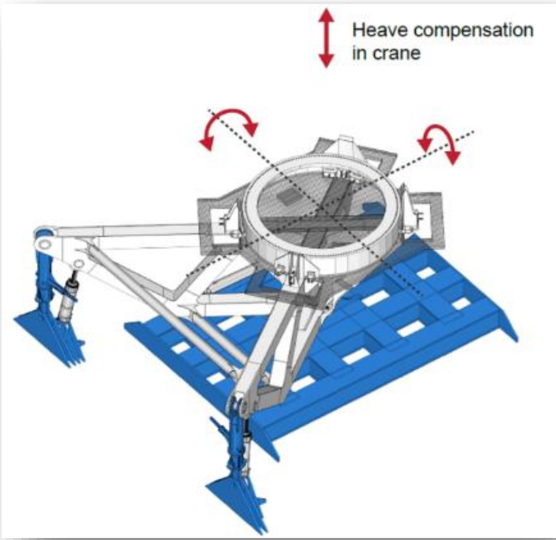


Figure 40 – Motion compensated

Elvira provided information on a current example of the system being used for the Vineyard Wind 1 project. The capacity for the BM-feeder 'Heavy' with roll and pitch compensation was 1,500 tonnes with an overturning moment of 22,000-tonne metres. The system was fitted with a quick-release tower locking system, which meant that it was mechanically locked in transit, but when it needed to be released, it could do so in 5 seconds.

To close, a short video demonstrated how the system was used in the field.

4.3 Weather Prediction in Offshore Construction – Benjamin Coulmier, Vaisala

David Cannell introduced Benjamin Coulmier of Vaisala, who commenced his presentation on Weather Prediction in Offshore Construction.

Benjamin ran through a high-profile case study in which the weather became severe and was not predicted due to the vessel's connectivity problems. The reality on-site was that the wind speed increased to as high as 80mph and capsized the vessel. This incident enforced that weather observation capabilities were essential.

The Lidar device was presented as being of great assistance to crane operations. Crane operators were said to rely on local wind forecasts and in-situ wind measurements performed by cup or sonic anemometers installed on top of the crane. This information was said to be insufficient and not accurate enough.

Figure 41 – Lidar range

The windcube scan and forecast was introduced. It was stated that this can identify wind change from 10-15 Km and provides alerting capability of 5-15 mins before an oncoming wind threat. In collaboration with Huisman, the Wind Gust Buster was said to measure approaching wind speed and direction up to 10 Km. Sudden changes in the wind speed could be detected in advance, thus allowing the person guiding the blade into the nacelle to be informed. The position of this device provided an unobstructed measurement of the wind speed as the sensor was placed on the top of the boom and avoided unnecessary downtime by inaccurate wind speed measurement due to sensor shielding.

Figure 42 – Huisman Wind Gust Buster

Lightning strikes were presented as a significant risk to personnel and operations. The prediction of a lightning strike was shown using the GLD 360, a single network covering all wind farms and offshore construction sites. The software was said to improve situational awareness by visualising storm tracking and forecasting movements in real-time.

4.4 High-Speed Cameras – Conforming to ISO – Cristiano Bonetti & Joseph Karedan, Bridon Bekaert

David Cannell introduced Cristiano Bonetti of VisionTek and Joseph Karedan of Bridon Bekaert. VisionTek was stated to be part of Bridon Bekaert. They commenced the presentation on a Digitised Rope Condition Monitoring Solution.

The technology was a 3D optical measuring system designed to measure and monitor moving ropes continuously. The measurement process involved 20 HD pictures per metre (360°), 100 million points analysed per metre and 100 thousand points measured per metre.

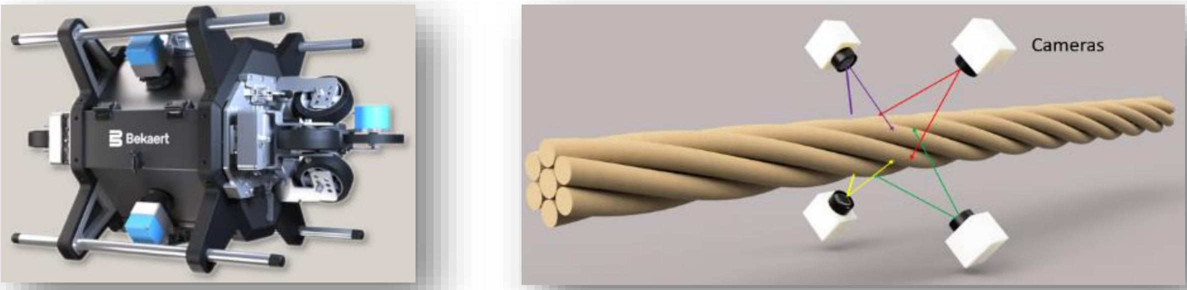
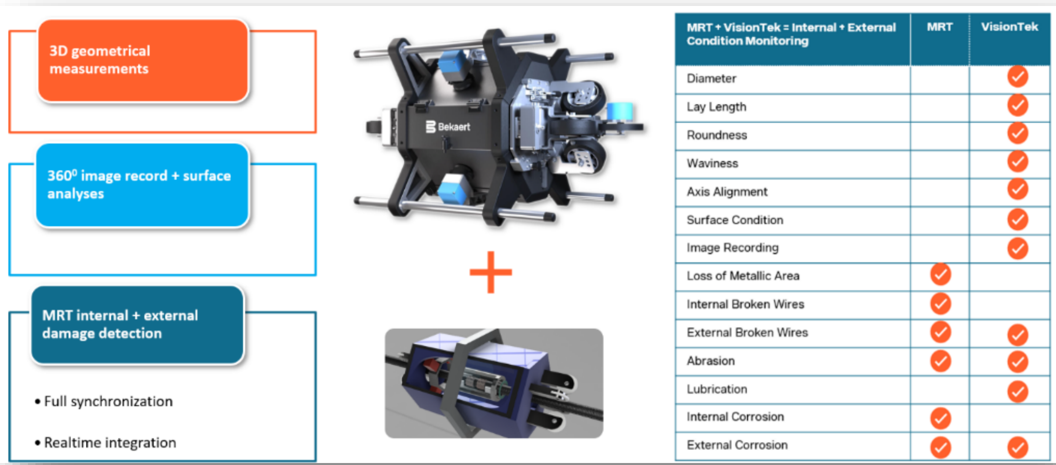


Figure 43 – Measuring system & process

The solution provided a comprehensive steel rope monitoring system when integrated with magnetic rope testing (MRT) technology.



MRT + VisionTek = Internal + External Condition Monitoring	MRT	VisionTek
Diameter		✓
Lay Length		✓
Roundness		✓
Waviness		✓
Axis Alignment		✓
Surface Condition		✓
Image Recording		✓
Loss of Metallic Area	✓	
Internal Broken Wires	✓	
External Broken Wires	✓	✓
Abrasion	✓	✓
Lubrication		✓
Internal Corrosion	✓	
External Corrosion	✓	✓

Figure 44 – Digitised rope monitoring solution

The presentation then turned to the field application of the technology. Use in environments with rain, snow, ice and dust were stated to have delivered excellent results, with apparent defects identified.

Figure 45 – Defect identification

A more challenging application was in the offshore environment where deep water lifting occurred. The rope was subjected to water depths that exerted pressure, which forced the lubrication out. The measurements obtained over three months showed that reliable 3D measurements can be taken.

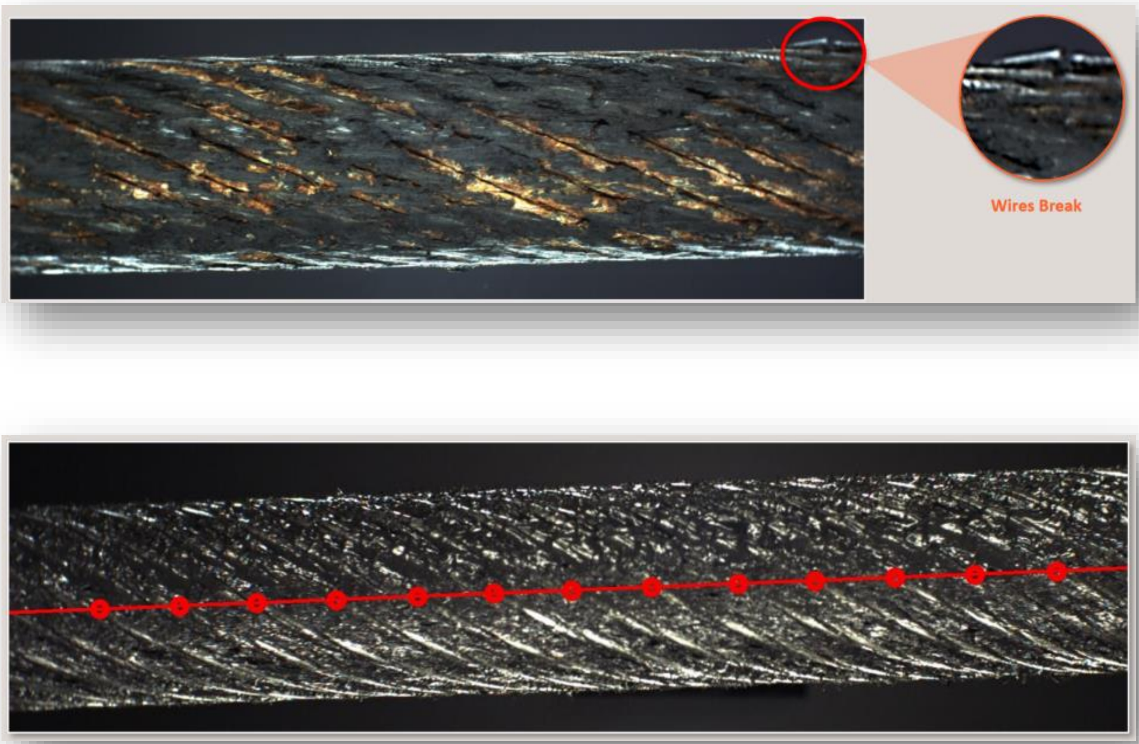


Figure 46 – Lubricated ropes field experience

Lastly, the research and development highlighted the real-time monitoring of fibre ropes with immediate visual feedback. The software was said to be able to detect progressive rope deterioration.

The conclusions and outlook were presented as follows:

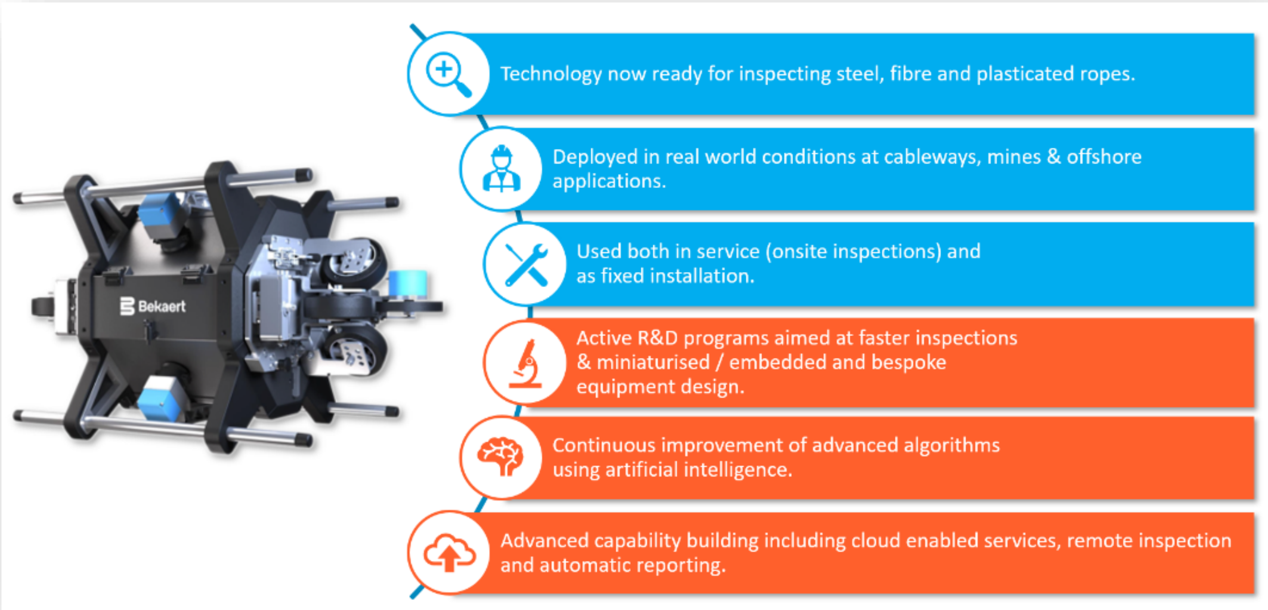


Figure 47 – Conclusions and outlook

4.5 Panel Session – Suppliers Q&A

David Cannell and Mark Ford commenced the supplier's Q&A sessions.

The following is a selection of some of the questions that were asked via Slido and the audience:

Q: Bridon Bekaert – What is the position of classification societies about this technology?

A: The technology is currently being pitched to various Classification Societies. Either the technology can be classed with one or more of the class societies, or there is the potential to partner with a class society for the automatically generated report approval.

Figure 48 – Supplier Panel Session

Q: Huisman – Can the system be operated by several operators, or does it need a second operator?

A: It can be operated from the crane cab or by a second operator using a mobile box. All the parameters can be monitored remotely via a tablet.

Q: Bargemaster – How safe is the mooring of the feeder barge?

A: Bargemaster do not provide the mooring system for the barge, but everything in the operation has been tested and certificated.

Q: Bargemaster – What is your take on feedering in Europe; is this something that could be pretty big?

A: Yes, we believe so; there are a lot of benefits to feedering in general. The Jones Act is forcing us to showcase this in the USA. But it is a viable solution as smaller ports can be used; it could also be used in the Far East where a similar law is in place to the Jones Act.

Figure 49 – Audience participation

Q: Vaisala – Does the Lidar have any blind spots?

A: It does, anywhere below 40m. You also cannot see at very short distances. Some lidars are adapted for short distances, but they are susceptible to interference from high humidity, for example. These types are not ideal in the maritime industry.

Q: Vaisala – Do you think the Lidar system could potentially decrease the necessary weather windows for installation?

A: Yes, we believe that if you are in a grey weather area, it will allow you to reduce your margin of error as you can detect weather that could cause an issue.

Q: Bridon Bekaert – Can the MRT system be used on large-diameter cable-laid slings?

Figure 50 – Audience participation

A: Yes, it can be used on cable-laid slings, but there are limitations when the diameter becomes too big. Around 110mm diameter is currently the limit.

Q: Huisman – is the boom paint coating damaged with the system?

A: No, as we use a particular type of paint that can withstand the loadings of the wheels.

Q: Vaisala – How is the wind Lidar data interpreted, and what user interface do you offer? Is data real-time? Can it integrate with other systems?

A: The wind data is real-time. Depending on the type of Lidar, it can provide similar data to an anemometer, except you get twenty readings at different locations. The data can be integrated into an HMS (Hardware Meets Software) or EMS (Enhanced Messaging Service) software, which combines all the data.

Q: Has DNV accepted Lidar and wave radar as equivalent to weather buoy? This is with respect to Alpha factor.

A: Vertical lidars for the wind industry have been entirely accepted to replace anemometers and an offshore met mast.

Q: Bridon Bekaert – Can you measure the level of lubrication and recommend any excessive lubrication levels?

A: Yes, lubricant thickness on the rope can be measured. However, it is important to understand that the lubrication levels will differ along a long rope length. So you can point to areas where there is excessive or a lack of lubricant. This can be used to address your rope lubrication strategy.

Q: Bargemaster – with the combination of crane lift, quick lift and the quick release system from Bargemaster, how is the decision to lift taken?

A: The actions do not occur simultaneously; first, the tower is released, then the quick lift is used, followed immediately by the vessel's crane.

Q: Bridon Bekaert – Is visual inspection completely unnecessary with this technology?

Figure 51 – Answers from the floor

A: We would say it is getting close to where the inspector can sit in more comfortable conditions and inspect the rope. Currently, you have the camera system, the MRT system, and the inspector standing close by. The convenience is that you do not need the inspector to look at the rope; the camera does that for you. The advantage is that you can review different sections of the rope back in the office to have further checks carried out.

Q: Bargemaster – If we take one of the monopiles off a barge using the crane, what happens with the ballast in the barge?

A: The vessel is pre-ballasted before the lift, which makes the effects manageable. The quick lift rapidly compensates for the vessel's movement during the initial phase of the lift, and then the vessel's crane continues with the lift.

5 Session 4 – Advancing Technology

David Cannell introduced session 4, the academia session focusing on advancing technology, and introduced the first presenter, Professor Apostolos Tsouvalas of Delft University of Technology.

5.1 Environmental Vibrations and Noise Emission from Offshore Pile Installation – Apostolos Tsouvalas, Technical University Delft

Apostolos commenced his presentation by stating the issues surrounding environmental vibrations and noise from offshore pile installation.

He said he would cover the noise and vibrations from impact piling, vibratory installation and noise mitigation measures using air-bubble curtains. A graphical slide showed the frequency noise levels for the different pile installation methods.

Figure 52 – Apostolos Tsouvalas

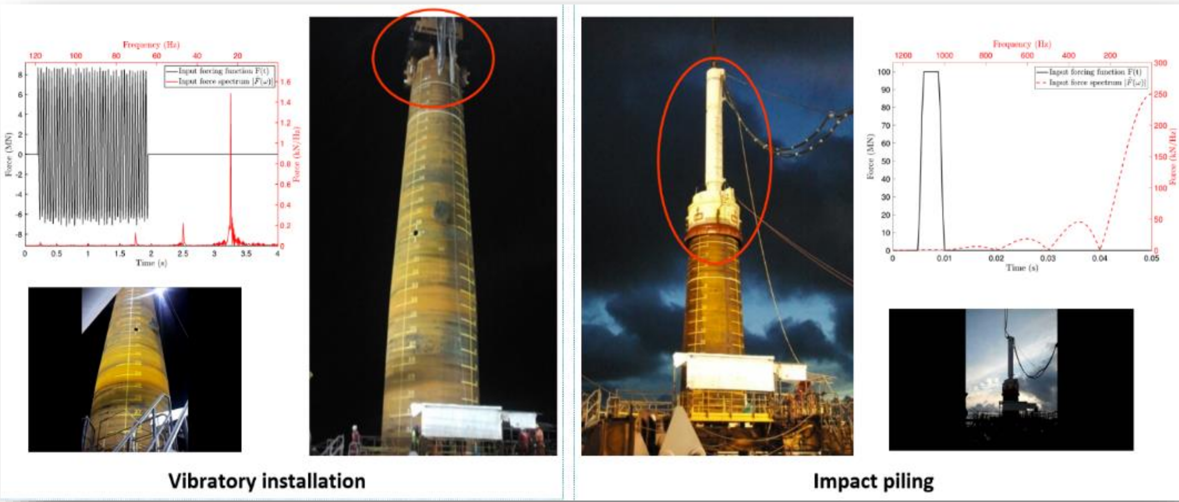


Figure 53 – Noise from vibratory and impact piling

Apostolos presented the existing global noise regulations and piling thresholds.

The wave emissions from impact piling showed the stress wave in the pile following hammer impact and how the sound in the water column radiated from the vibrations of the pile as the primary noise path. Noise then leaked back into the water from the soil as the secondary noise path and, finally, the noise that propagated along the seabed-water interface.

The effect of diameter on the noise spectrum was mentioned, and how large monopiles greater than 7m diameter radiate acoustic energy below 250 Hz, which was challenging to mitigate. The effect of soil composition on emitted noise was also presented.

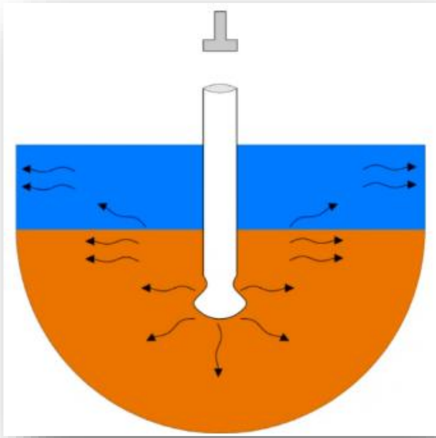


Figure 54 – Wave emissions

Next, the noise by vibratory piling was looked at. It was determined that the noise generated was significantly reduced if a GDP shaker design was induced in the pile during driving.

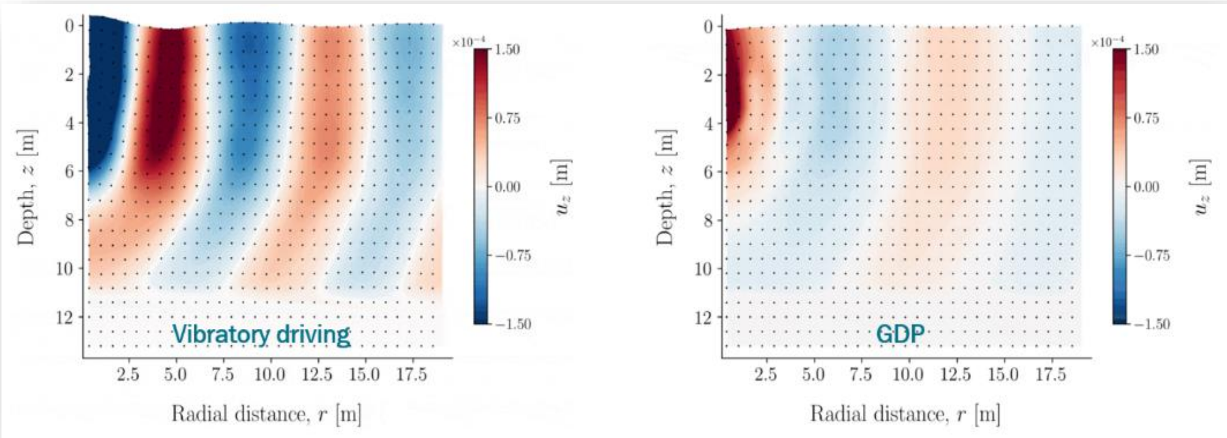
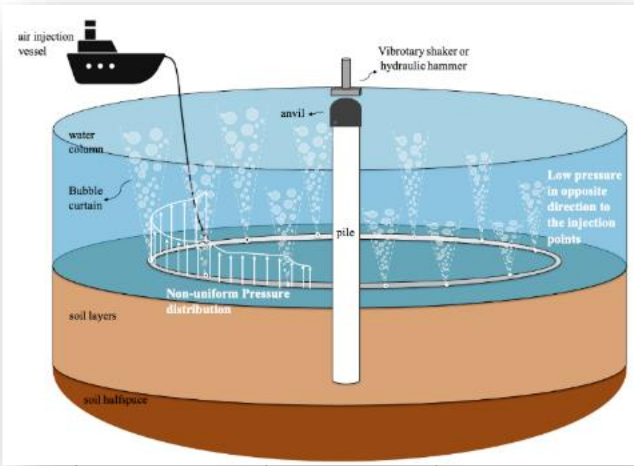


Figure 55 – Vibratory Driving Vs GDP Shaker

Finally, the use of an air-bubble curtain (BBC) was presented. It was shown that when the air was injected into the subsea hoses to generate the bubbles, there was a pressure drop from the point of entry of the air pressure to the opposite side of the curtain ring, which needed to be accounted for. It was incorrect to assume that the larger the radius of the BBC, the better its performance, as operational constraints may limit the air circulation through the hoses when pipes are too long.



The optimisation exercises involve the following:

- seabed modelling and energy flux analysis

- geometrical configuration of BBC
- main hose parameters: nozzles size and spacing
- mechanical equipment (air compressors, air-feeding lines)
- operational constraints.

5.2 Response analysis and onboard decision support tools – Karl Henning Halse, Norwegian University of Science & Technology (NTNU)

David Cannell introduced Professor Karl Henning Halse of NTNU, who commenced his presentation on response analysis and onboard decision support tools.

Karl said that his presentation is based on the findings from an eight-year research project funded partly by the Norwegian Research Council and partly by the industry participants in the project.

Figure 57 – Karl Henning Halse

SFI MOVE – Centre for Research-driven Innovations – Marine Operations in a Virtual Environment. The main contributor to this part of the project was Equinor, particularly the installation challenges for their Hywind concept.

The objectives were presented as follows:

- all year operations installation & service
- safer and more cost-efficient operations
- support innovation in existing and emerging ocean industries.

Next was how the objectives would be achieved:

- improved understanding of complex physical phenomena
- modelling and virtual prototyping
- simulation and virtual prototyping as an industrial standard
- remote and onboard decision support systems
- online environment monitoring
- improved crew performance through training.

Using a digital twin, real-life scenarios could be simulated as one single tool covering the process from engineering to handover, operation and de-brief. Cost reduction could be achieved by making decisions based on actual responses, reducing waiting on weather and reducing manning on-board. Safety was said to be improved by using remote operation centre technologies, visualising the operation beyond what you could typically see, and access to experts for the 'what if' scenarios.

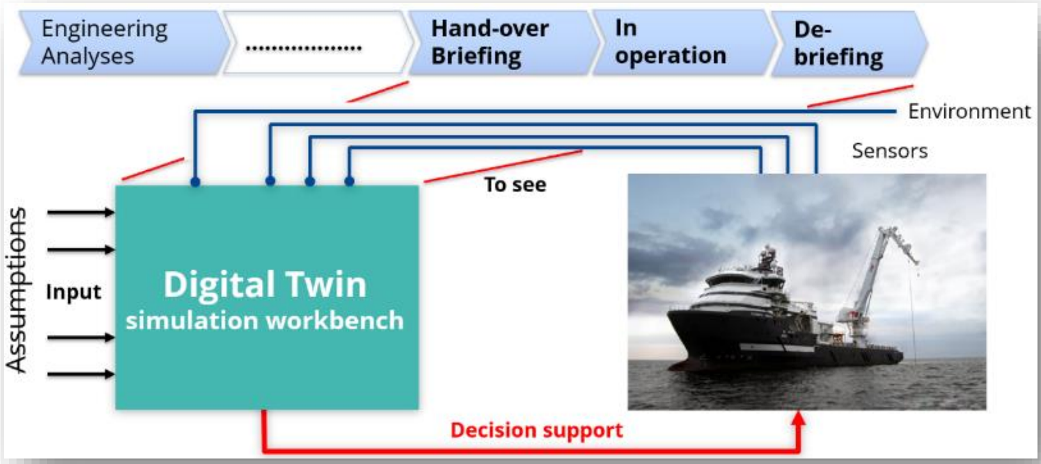


Figure 58 – Digital solution from engineering to de-brief

The benefit when the vessel was in position was that model tuning could be undertaken, resulting in a more accurate model. When in operation, there was the capability to predict responses at a short time horizon of minutes and predict future responses in hours and, in some cases, more than 72 hours. The 'what if' scenarios were changes in weather conditions and the simulation of failures with accurate results. The actual operations can also be stored for feedback and learning opportunities.

Finally, the method of determining the forecast of waves to open short weather windows was presented. Using a physics-based model and data-driven correction, the potential to calculate wave-induced motions for the next 60 hours was possible. This data could be used to determine the favourable weather conditions for the next few days.

6 Session 5 – Review of the Day

6.1 Review of the Day and Final Comments/Questions – David Cannell, Chair

The Chair of the event, David Cannell, presented a brief overview of the day covering some comments and quotes of the day as follows:

Comments	Quotes of the day
Lifting Operations are Inherently Hazardous	Complacency is caused by the very things that should prevent accidents.
Continuous stretch of capability, experience, vessel capacity	Only the paranoid survive
IMCA LR006 – Guidelines for lifting operations • Commitment of senior management to it • Lifting plan – a broader, more strategic document sets the stage for the lift • Lift procedure – detailed operational document	It takes 20 years to build a reputation which can be ruined in 5 minutes
How routine is routine • Routine does not mean "easier" – small things can change a routine into a non-routine	Listen to the crew
Lift plans need to allow for change	Expect the unexpected
Reliability of installation focus is important to minimise schedule risks	If you label something – you set expectations
Be aware of bias (use of language)	Look at the size of the crew and not at the equipment
We need to keep an eye on the people involved	There is a lot of detail in this – if you were a rigger and were handed this……..
What is routine in a windfarm that has over 100 installations	Engineered lift – the paper trail unravelled – Do we still have an eye on the people involved?
Training scenarios performed before going offshore • normal operations, equipment failure, different soils, environmental	By sharing our knowledge, we can come to truly innovative solutions.
Being a lifting authority – the mistakes become my own mistakes. I learn from my mistakes, but it is good to learn from other's mistakes.	Words have different meanings to different people
Documentation tends to be created to obtain client / MSW approval – Need to ensure it is relevant to the offshore crew.	Monopiles – more, heavier, longer, thicker

Comments	Quotes of the day
Holistic approach vs. Devil in the detail	Scaling up – will not reach our installation targets.
In the next six years, 4 x number of monopiles will need to be installed	The pile is deforming like a pear.
Monopile weights increasing to >3000Te, diameters >12m • leading to a shortage of installation vessels • twin crane barge lifts • buoyancy assisted upending	Our lifting tool is not much different to a Tesla; a Tesla with a remote control
A monopile installation is a balancing act between weight/momentum and soil resistance.	No game over – if you make a mess, you are left with a mess
If we are to meet all our expectations – marshalling ports are going to be a big factor	If you are installing wind turbines – you should expect wind.
Wind Lidar – invisible vertical wind tower (systems used in airports) 10-15km range = 5-15 minutes in advance of a threat	Unfortunately for us, it was an absolutely flat sea.
Slow, tedious, and you can only see a 180-degree plane–wire rope visual inspection.	There is not just one solution.

The Chair thanked IMCA for hosting the event and thanked the speakers and the sponsors. Finally, all attendees were thanked for their participation and input into the event.

David informed everyone that the next IMCA lifting and rigging seminar would take place in autumn 2024 in Amsterdam and hoped to see everyone again. With that, the event was closed.

Figure 59 – David Cannell summing up

Stand-out quotes

"Complacency is caused by the very things that should prevent accidents."

"It takes 20 years to build a reputation which can be ruined in 5 minutes."

"By sharing our knowledge, we can come to truly innovative solutions."

"There is not just one solution."

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International Marine Contractors Association

T: +44 (0) 20 7824 5520

E: imca@imca-int.com

W: www.imca-int.com