Lillehammer Claims Conference

A Game of Drones – (The next generation in surveying?)

02 March 2018

Question No 1.

- How long has the Game of Drones been running for?

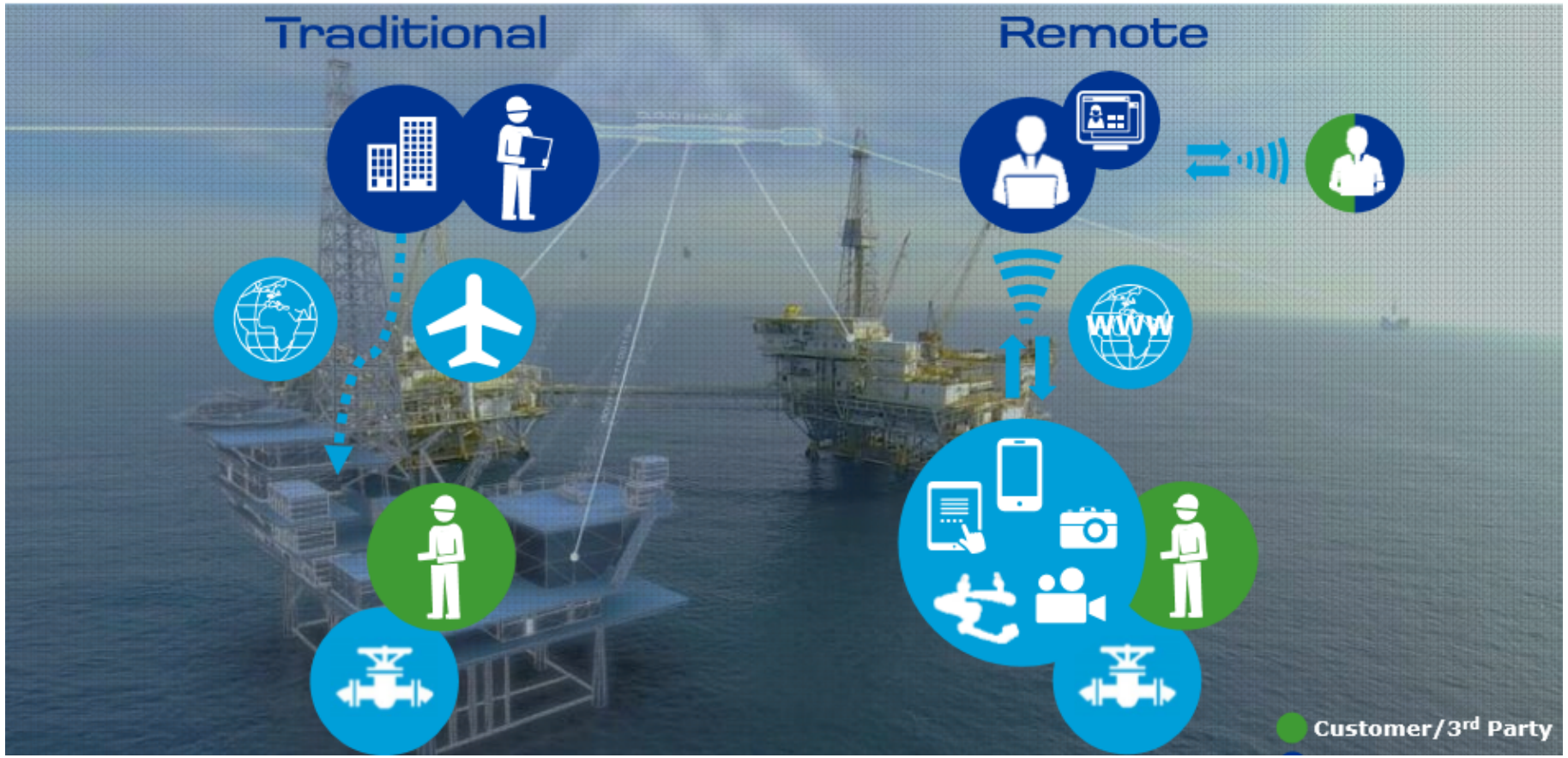
1. 1782
2. 1849
3. 1945
4. 2001
5. 2009

History of Drone Technology

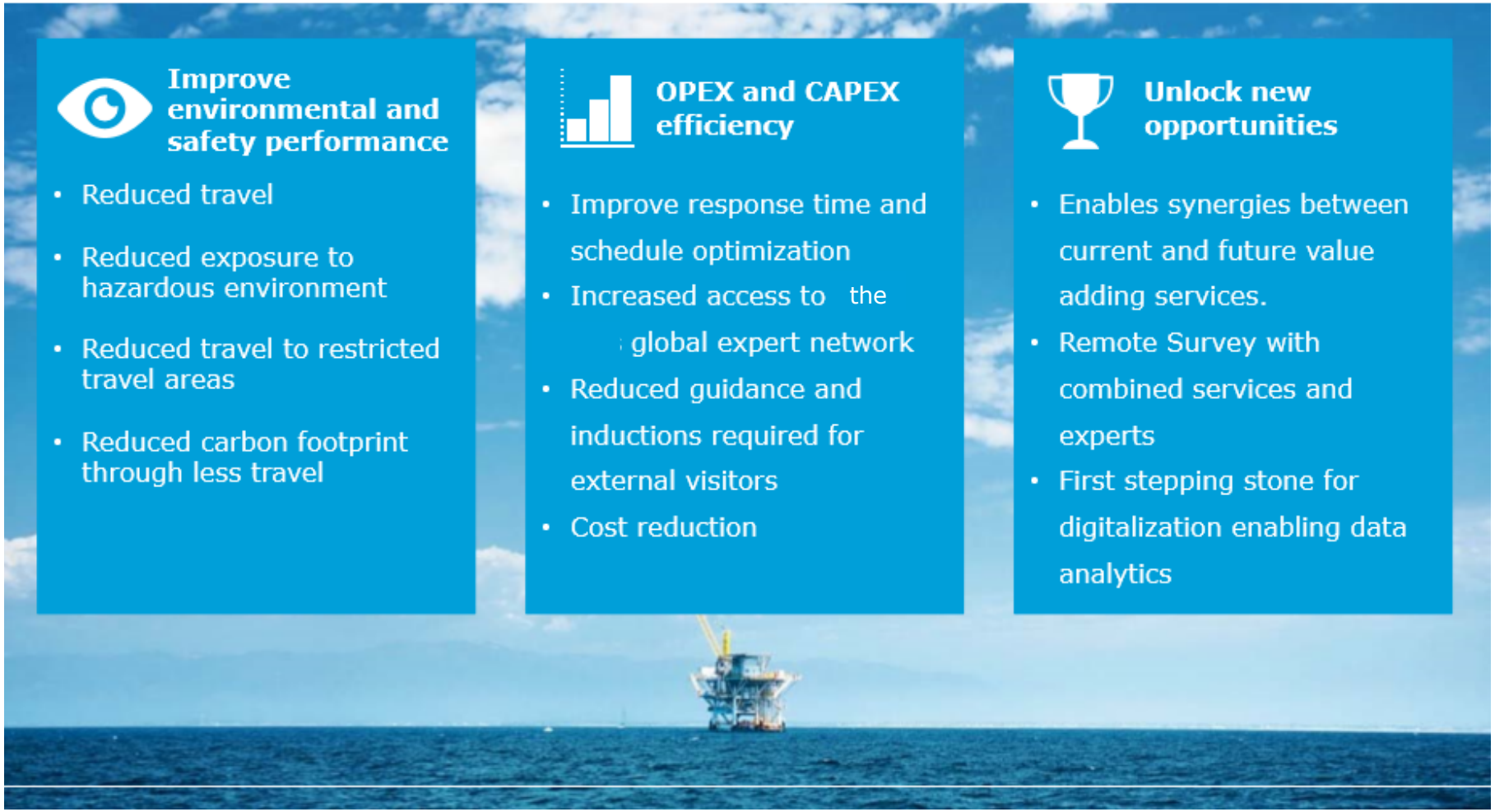
- Growth of Remote Technology – Historically through Military Requirements
- Unmanned Aerial Vehicles (UAVs) or Unmanned Aerial Systems(UAS) are increasingly used in warfare, for survey, by emergency services and in industry.
  - Commonly referenced as Drones, but a Drone technically "guides" itself
- Commercially they are typically used where there is desire to inspect structures or conduct tasks that are deemed risky for traditional manned surveillance.
  - Increasingly they can be equipped with high-definition cameras to capture live pictures along with an increasing number of additional sensors.
- In our industry there has been question over of whether classification societies would accept inspection data generated by UAVs.
- Throughout recent years drone companies have been working closely with the societies to help certify inspection techniques and the data they collect.

Remote Survey

Remote Survey is the use of technology to replace the need for a technical expert to visit site



Benefits of Remote Technology



Vessel Surveys - IACS

- When permitted remote inspection technique may be used to facilitate the required external and internal examinations, including close-up surveys and gauging.
- The methods applied for remote inspection technique are to provide the survey results normally obtained for/by the Surveyor. The results of the surveys by remote inspection techniques when being used towards the crediting of surveys are to be acceptable to the attending Surveyor. Inspections should be carried out in the presence of the Surveyor.

Class society interaction

- Numerous Class societies are providing full services related to UAV Inspections or working on pilot projects to support their use. Two man routes:
  - Class society full drone survey provision
  - Certification of third-party independent specialist to handle drone inspections of classed assets while the Class Surveyor witnesses the inspection.

Key Generic considerations:

- Risk Assessment, Hazards identification within the SMS – ongoing live process and gap analysis between UAV and Operator SMS
- Operator and Pilots have hazard analysis and understanding of events that may change the risk matrix and have appropriate PTW in place.
- Level of Pilot training, environments that they have operated in, conditions, understanding of hazards, moving objects, increased wind, near to flames, noise, water etc.
- Regulatory and IACS acceptance.

Risk review

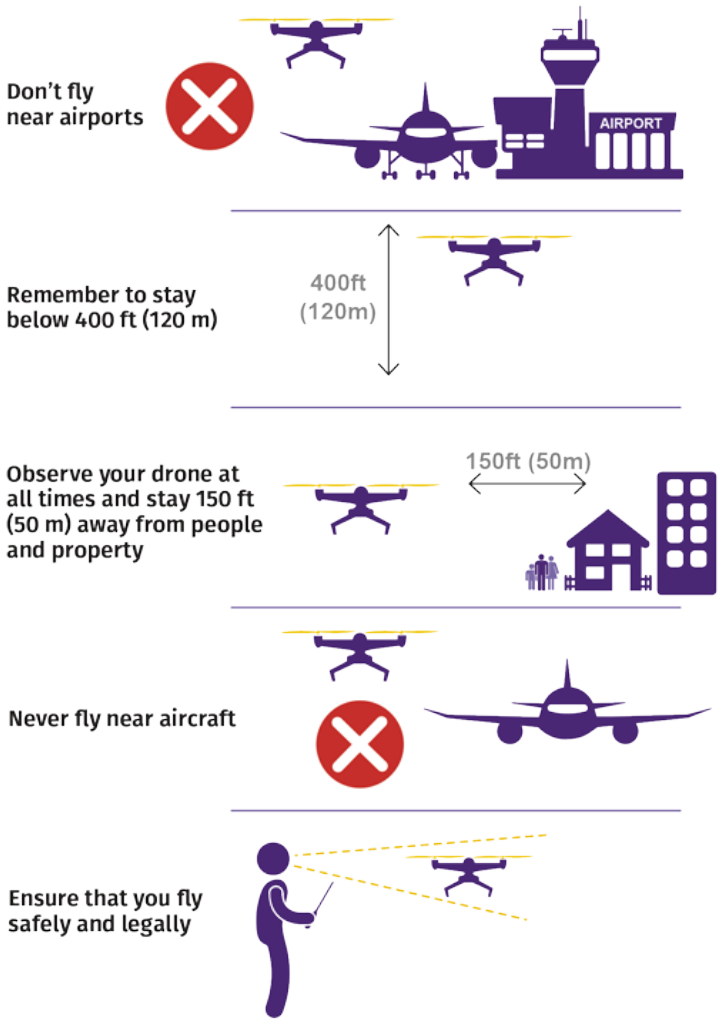
- High
  - Components are very critical. Offshore condition are not suitable for remote witnessing by UAV (loud noise, lack of data connection, available technicians). Deep experience is required
- Medium
  - Components are critical, but offshore conditions are suitable for remote witness and localised inspection by UAV.
- Low
  - Verification of the components is rather simple and ‘scriptable’. This can be done by a technician. Asynchronous recording is suitable to gather the necessary evidence

Key considerations in using remote technology

- It is important to use a change management perspective for implementation of remote survey technologies.
  - Humans Factors are key to address:
  - Field operator needs to be confident and feel safe instead of being watched / recorded
  - Surveyors need to be highly skilled in remote social interaction to make field operators at ease

  It is also incredibly important to develop accumulated knowledge during field experience. A risk based approach is recommended to ensure the feasibility of UAV surveying. This will be a collaborative approach with the Operator and Regulator
  - Completed projects have demonstrated outcomes of UAV surveys have higher value through retained digital knowledge records and comparable or improved quality of deliverables

Basic Key Considerations for UAV use



- Keep Clear, Keep Down, Keep in Sight, Keep out of the Way, Keep Safe, Keep in line with the relevant law
- Multitude of guidelines and regulations both for use and licensing depending upon which countries they are being operated in.
- Particular sensitivities over flying close to military or commercially sensitive installations.
- When reviewing the potential for Drone Surveys all of the above have to be taken into consideration.
- Drones are weather restricted.

Source: An extract from Thames Water's Essential Standard Number 28 – Working with Drones

Question No 2.

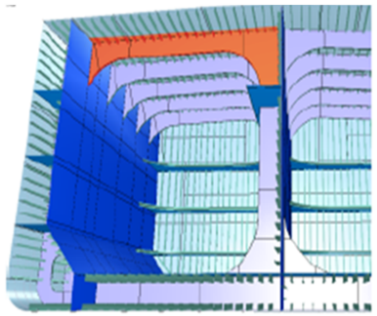
- *Probably the key trend in the Oil & Gas, Maritime and Shipping sectors is cost reduction. With the change in complexity of vessels and assets, increases in size of vessels and a changing landscape of capacity and competence are Drones a solution to maintaining standards:*

1. *Yes*
2. *Yes but competence and boots on the ground cannot be replaced*
3. *No, I have seen what happens in the terminator*
4. *Jurys out*

Traditionally - How to get up there?

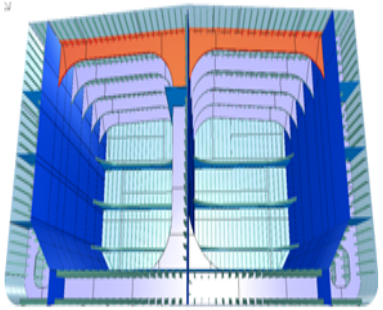
- Staging
- Rafting
- Cherry Picker

Surveys are time-consuming, costly and dangerous.... - but necessary



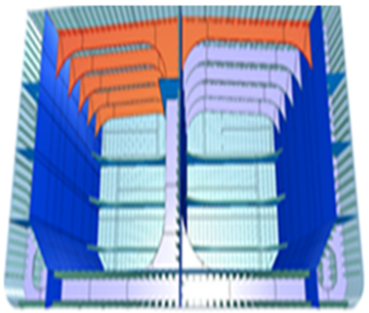
1st Renewal

Deck Girder



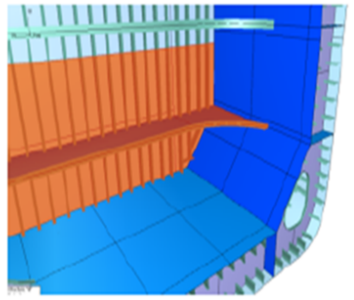
2nd Renewal

Deck Girder



3rd Renewal

Deck Girders



1st Renewal

Bulkhead

Example of staging cost (China)

Tower staging, unit rates: Approximately 3 USD per m3.

Example 3rd RCH tanker for oil (VLCC)

Approximately 57500 m3 of staging required

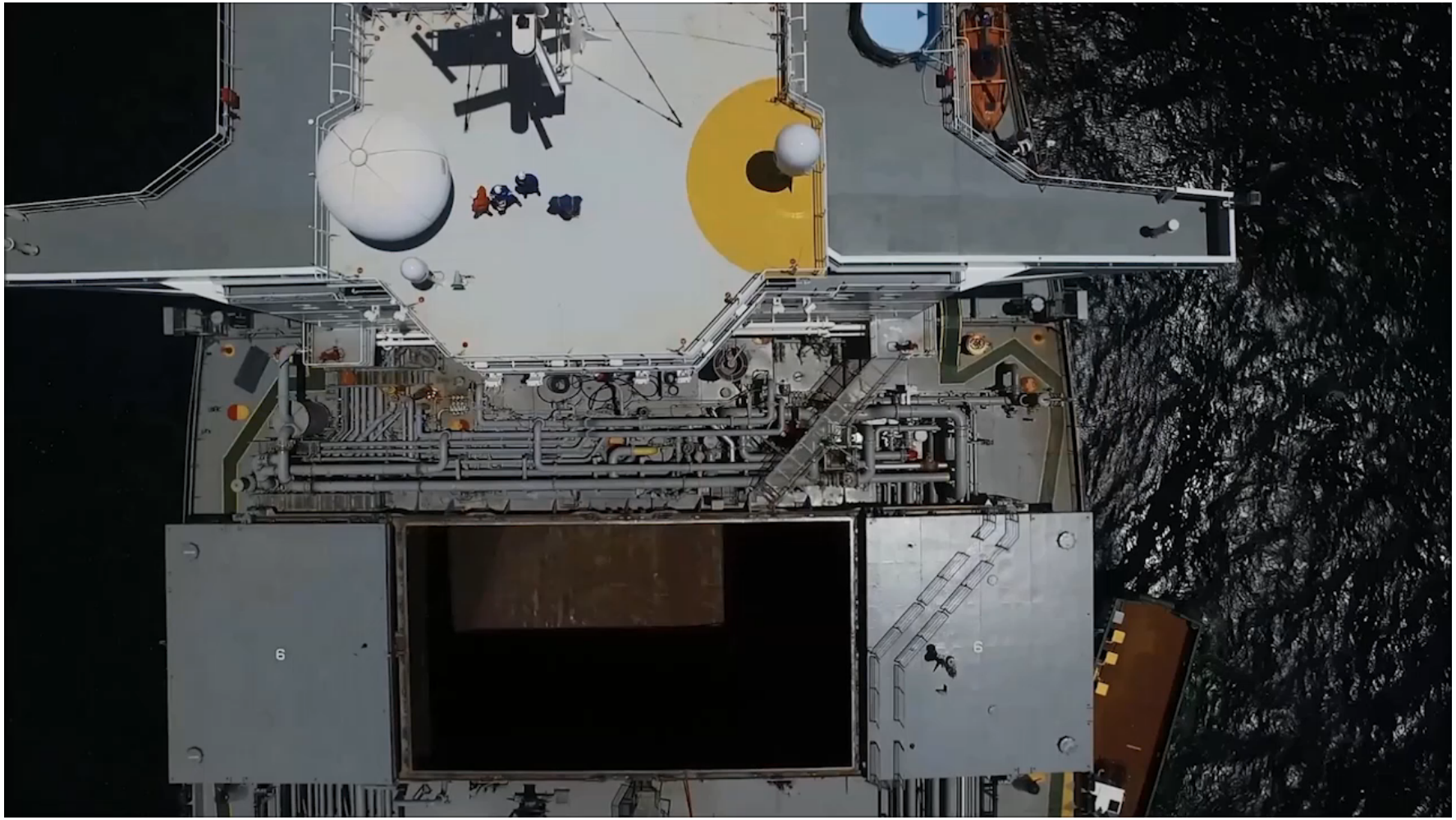
TOT cost: 173,000 USD

Ungraded

Or by a drone!!

There are challenges when using drones in confined spaces, these include lack of proper light condition, colour nuances, reflection of radio signals and propeller turbulence.

Drone Survey Footage

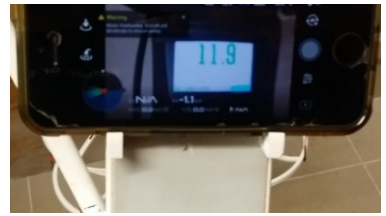


Ungraded

Drone Survey Development Programme - Timeline

First reviews looking at feasibility of using UAS (drones) for close-up surveys	First test survey onboard oil tanker	First production drone survey onboard chemical tanker Apollo, Bremerhaven	First drone test survey of jack-up unit in Dubai	UTM by drones Autonomous flight inside hull comp. Automatic recognition of coating and corrosion patterns
June 2015	**November 2015**	**June 2016**	**January 2017**	**Ongoing development**

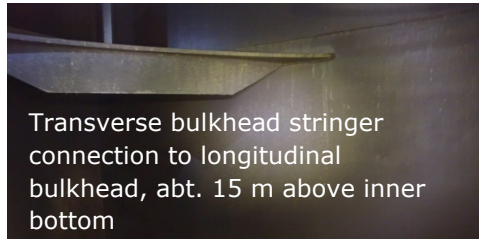
- Tests surveys onboard different ship types (oil, chemical, gas, bulk).
- Training of surveyors as drone pilots.

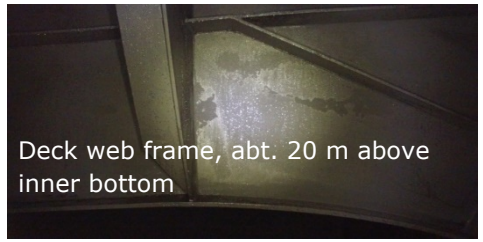


Ungraded

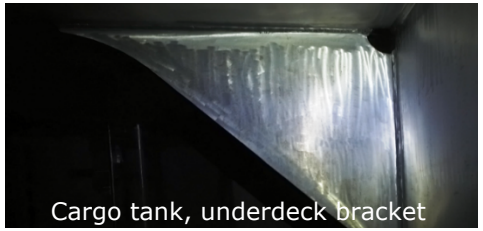
Tested on different vessel types

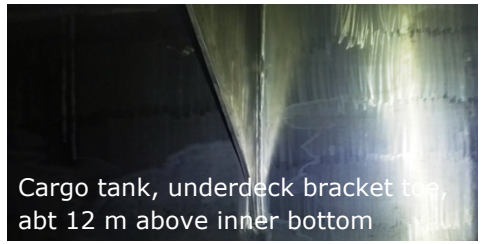
Tanker for oil



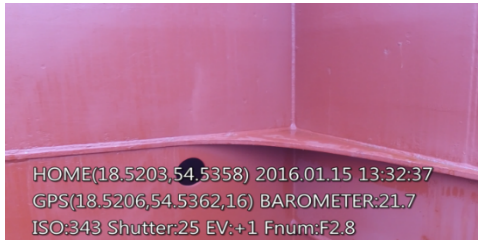


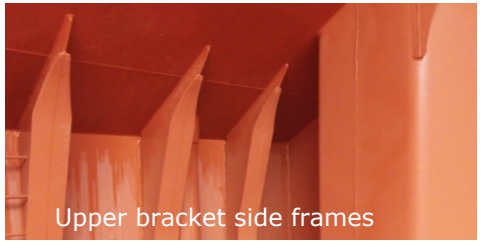
Tanker for chemicals

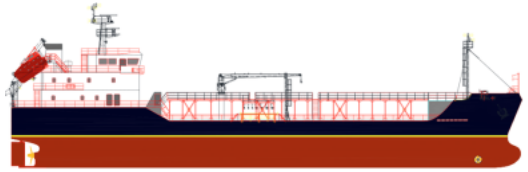




Bulk Carrier

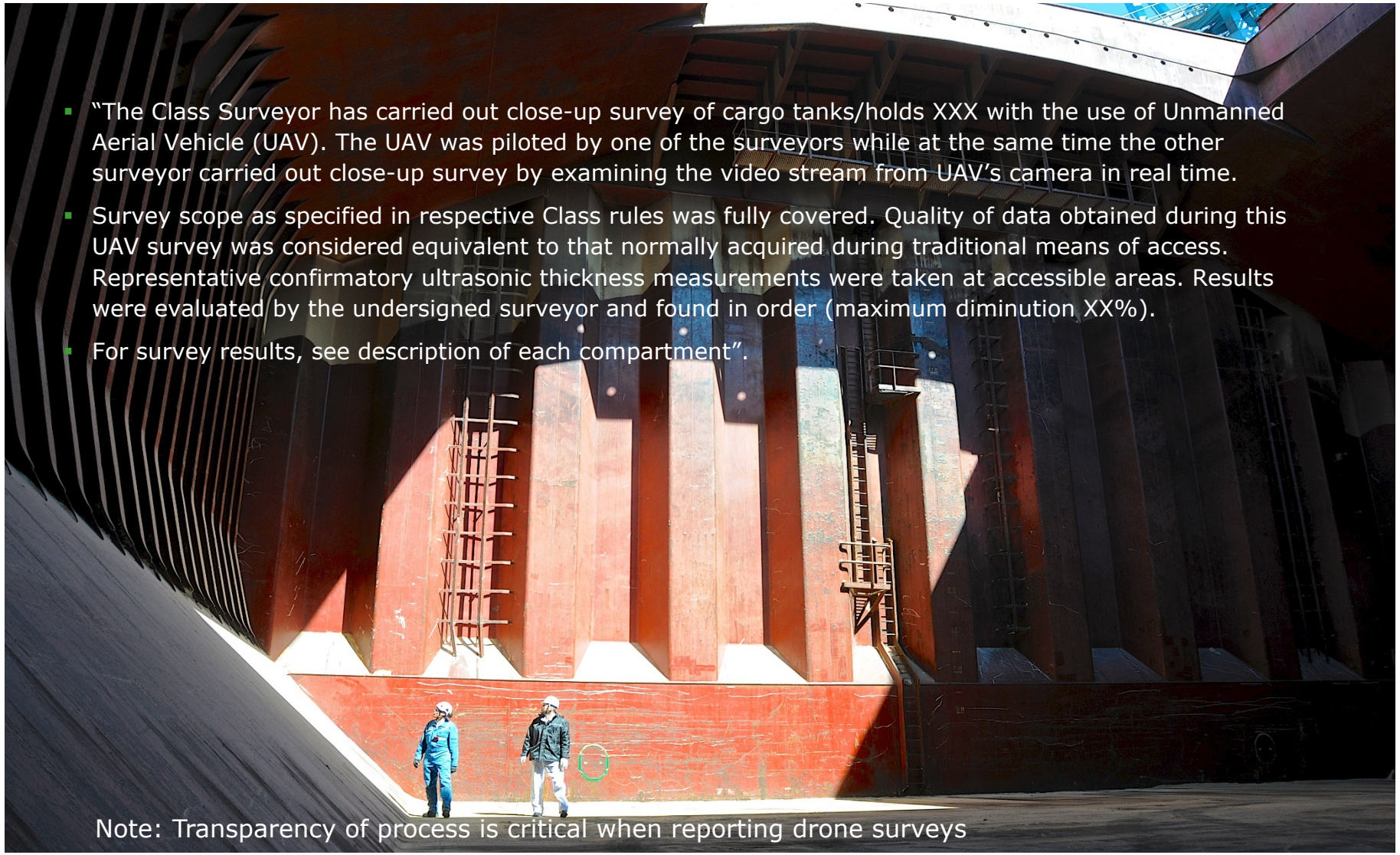






LPG

Typical Survey Statement – Example of standard text



- "The Class Surveyor has carried out close-up survey of cargo tanks/holds XXX with the use of Unmanned Aerial Vehicle (UAV). The UAV was piloted by one of the surveyors while at the same time the other surveyor carried out close-up survey by examining the video stream from UAV's camera in real time.
- Survey scope as specified in respective Class rules was fully covered. Quality of data obtained during this UAV survey was considered equivalent to that normally acquired during traditional means of access. Representative confirmatory ultrasonic thickness measurements were taken at accessible areas. Results were evaluated by the undersigned surveyor and found in order (maximum diminution XX%).
- For survey results, see description of each compartment".

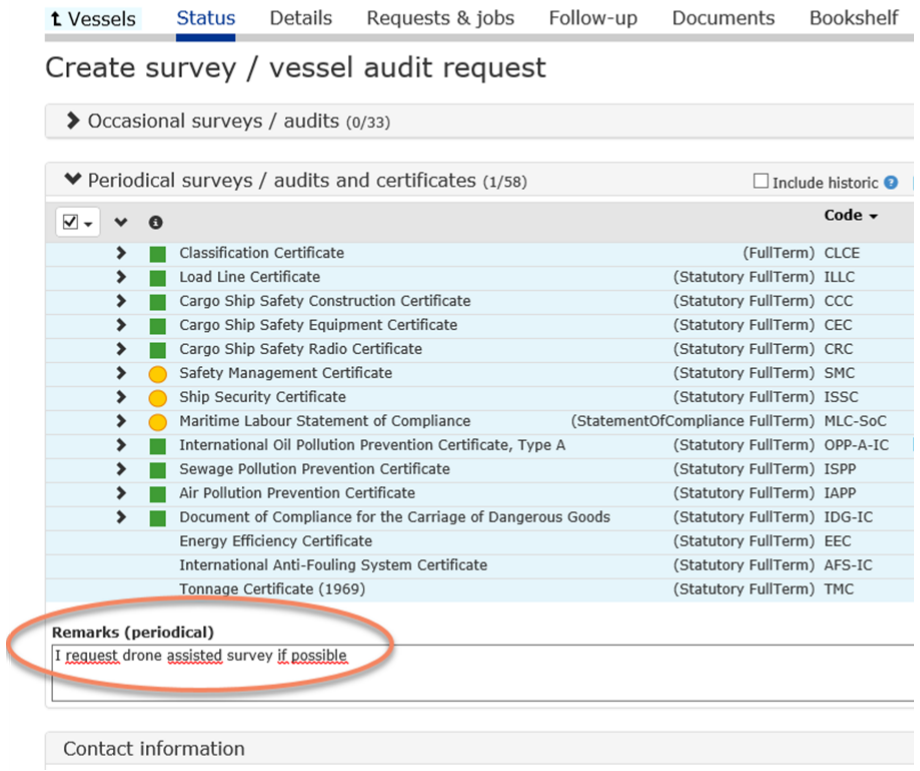
Note: Transparency of process is critical when reporting drone surveys

Value for shipowners/operators

	Safety impact	Financial impact
 Significantly shorter time for preparation of close-up survey access		✓
 Eliminate rafting costs (filling up cargo tanks with sea water, discharge of oil poluted water from cargo tanks, running time for cargo pumps etc.)	✓	✓
 Eliminate staging costs	✓	✓
 More flexibility in choosing survey location (no access to shore facilities, cranes, cherry pickers etc., is needed)		✓
 Eliminate potential risk of coating damages due to construction of staging inside ship compartments		✓
 Improved safety of surveyors and owner's personnel	✓	

How to engage a UAV Survey

Typically drone assisted surveys can now be requested through a number of Class Societies by adding a comment in the Remark field for periodical surveys (see below).



Drone-Assisted Pilotage

Internal use

Conventional Pilotage

Conventional pilotage involves:

- Pilot boat conveying pilot to vessel in open sea
- Pilot boarding the vessel (vessel to adjust heading, pilot transfer through ladder)
- Pilot being introduced to the master, discusses characteristics of the vessel, then takes over manoeuvring control of the vessel to bring it safely alongside at a preselected berth
- Pilot using the assistance of port tugs to assist in the manoeuvre, communicating via radio to tugs and mooring attendants

- A pilot has local knowledge of the waters and the tools within the port to safely berth or sail a vessel
- Pilotage governed by local and customary international marine law
- The Pilots platform to conduct pilotage service is from the wheelhouse or a bridge wing.

Challenges with conventional pilotage

- Pilot visibility can be limited by cargo from the ship's bridge and on the bridge wing, rendering manoeuvres difficult.
- Ships size has increased over the years

> *"Ship size has grown astronomically in recent years and ports have not grown in proportion, remaining at levels designed for much smaller vessels. The margin for error has decreased and the reaction time and manoeuvring room needed for a vessel to recover from a failure of technology being relied upon to navigate in a restricted waters is simply not adequate"* Canaveral Pilots in the USA stated in a recent pilot seminar.

Challenge 1

Some ports cannot accommodate bigger ships due to risk involved in berthing and pilots refusing to perform manoeuvres.

Ports are being challenged to accept larger vessels or risk losing market share.

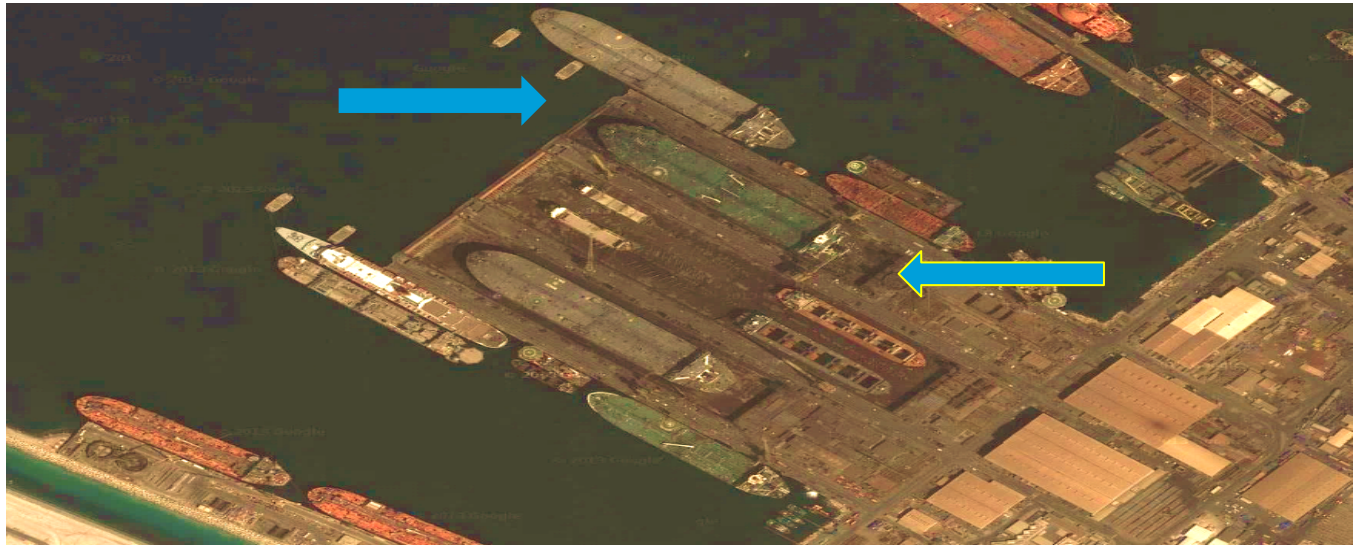
Shore Based Pilotage

- Safety could be improved through alternate pilotage method
- Shore based pilotage is the control of a vessel entering or departing ports from a remote control room
- Some studies have investigated feasibility of shore based pilotage since 2007; however, developments were stopped as there was no substitute for "vision" when manoeuvring vessels inside the boundaries of a port or terminal

Challenge 2 **Can Safety can be improved?**

"Plan view" pilotage

- In Dubai Drydocks (DD) , VLCC's approaching the dock had to be in line with the dock side before entering the dock.
- Limited side clearance left little room for error
- Limited vision from bridge wing of the vessel or from the jetty proposed many challenges in the very limited water space in and around the "dolphins" at the dock entrance. ……high risk of damaging ships side
- **The solution….**pilot vessel from a "man basket" hooked up to a DD rail crane positioned directly behind the vessel with an ability to get a plan view and to quickly observe both sides of the vessel…piloting from an "eye in the sky" platform was extensively utilised.

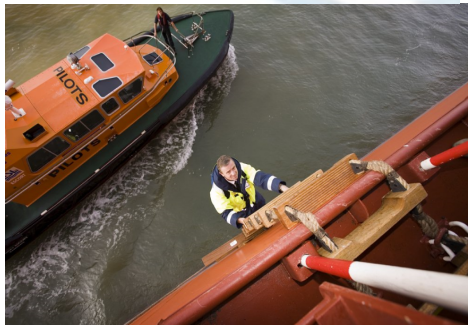


Drone pilotage assistance can help with the many of the following ISPO recognized pilot challenges

Challenges of a pilot

- **Communication & Culture**
  - Ability to communicate with the ship
  - crew
  - ultinational
- Different capabil
- Different shapes
- Different businesses
- **Substandard equipment**
  - Ships equipment
  - Terminal equipment
  - Marine support units
- **Port layout**
  - Environment prevailing conditions
  - Available Sea space for maneuverability
  - Berths allocations
- **Availability of resources**
  - Availability of suitable resources
  - Optimization (understanding the
  - irement)
  - Preventing
- **Port laws and regulations**
  - to ensure compliance and implementation.

Training & Competence



More pilots challenges:……SPACE PERCEPTION

- Vessel incidents. The 399-meter, 17,800 TEU containership Vasco de Gama grounded on the flat, sandy bottom on the western side of the Thorn Channel on its arrival to the Port of Southampton early on 22 August 2016. The ship, with two of the port's containership pilots onboard, ran aground after overshooting a turn, causing the giant containership to leave the dredged shipping channel.

- The report highlighted that "the increasing size of vessels within restricted waterways, is leading to reduced margins of operational safety, and therefore the importance of proper planning and monitoring of the passage cannot be overemphasized."

- Extra eyes/overview/training on the job in restricted waterspace areas , as provide by drone imagery, to provide crucial alerts, …….will help.

The Grounding of CSCL JUPITER

(courtesy of Felixstowe Docker blog and "Port Technology")

With orders for larger ships and their use in ports that have limited input over their usage, there is a growing concern over what is considered safe.

Question No 3.

- In the maritime and shipping industries there is a tendency to be reactive to incidents rather than proactive to advances in technology.
- Who will drone technology support best in the evaluation of a “Safe Port” or a “Safe Berth”?

1. What is a Safe Port?
2. The Master
3. The Owner
4. The Charterer
5. The Port

World Maritime News


Sjöfartsverket

“Eye in the sky” solution

Improving Pilotage with Real-time Drone Footage

Drones are being used to provide a real-time plan view of incoming vessels in support of traditional pilotage operations.

Development of the service requires:

- Production of a framework for the use of drones to support traditional pilotage
- Incorporation of these elements into the port’s existing pilotage procedures
- Identification of a suitable drone supplier and UAV training provider
- Monitoring of pilot training to ensure the system is adopted safely

“Eye in the sky” considerations

- Development of suitable procedures will require:
  - incorporation of weather limitations (based on rain, wind, visibility) and “drone days”/ “non drone days” being well defined.
  - Vessel/traffic density
  - Proximity to airports
  - Procedures for drone change over due to battery limitation to ensure coverage from breakwater to berth
- The drones need to incorporate 2 cameras to be able to maintain position relative to ship and provide live picture to pilot.
- Drone must be able to be controlled by the pilot in the control room. Heading of the drone must be displayed to show the pilot which direction the drone is pointing
- Pilot will be communicating to tugs, mooring attendants and Ships Master via headsets and a tested radio link

Assurance considerations of Drone Assisted Pilotage

"The system in place at any port should be sufficient to cope with the dangers posed to a given vessel entering the port at a given time. The result is that such cases tend to involve the examination of detailed expert evidence relating to navigation, seamanship, weather and a variety of other factors, so that the answer to the question ***"is the port safe?"*** *is often far from straightforward* ***(the Marine Advocate)"***

As a starting point, and (obviously) given the facts of the case, Charterers may argue that the incident was caused by an "abnormal occurrence", as Charterers will not be responsible for Owners loss if caused by a fact which is not a prevailing characteristics of the particular port…… *After an incident, a thorough examination of the safety of the port will usually be undertaken by owners. In some cases this investigation will uncover significant flaws in the port, particularly when measured against the standards of a sophisticated modern port – all useful defence with which owners can use against charterers……..* **(SKULD – unsafe port and charters defence)**

Ship Incidents in Ports can be extremely costly, having generated some of the largest loss claims in recent years. **(SKULD – unsafe ports and charters defence)**

Port Marine Safety Code - PMSC

The Safety Management System is integral to demonstrating safe operation of a port and the PMSC sets out the standard for port operations and reporting obligations to regulatory authorities. Simply put it requires a port to:

- Identify the hazards and the risks they pose
- Review current controls
- Decide if current controls reduce the risk to an acceptable level
- If not…….do something about it……..if OK keep it under review
- Learn from incidents…whether or not they occur in your port
- Employ competent people in key safety roles
- Have the SMS independently audited

"The above PMSC model is a pretty good template for all ports globally"
(International harbour master association)

Q. Legally does Drone assisted pilotage support the "due diligence" test and would the option of utilising new technology be considered a failing if not utilised?

What are the benefits to the Pilot?

Safer
Pilotage operations can be improved with the visibility drones provide

More Vision
Less chance of missing something during a manoeuvring operation

More Accurate
Helping pilots determine "drift", turning speeds and clearances earlier

$$

Cost saving
-Accuracy of pilotage
-Time saving for pilot
-Potential reduced insurance premium

Quicker
Time savings and boosted efficiency from the plan view perspective

Better Communication
Tugs will be able to anticipate their next orders and view operations

Better Training
Enhancing the skills of new and existing pilots by replay of operations

Improved Investigations
Respond effectively to near-misses and incidents with full recorded imagery

Not Reinventing

Drone-assisted pilotage is not reinventing pilotage or the skills required.

It is providing an additional platform to provide vision that eliminates many of the limitations and "blind estimations" that are associated with a pilot standing on the bridge wing of a vessel part of their role.

What are the benefits to a Port or shipyard?

Safer
Pilotage operations can be improved with the visibility drones provide

More Vision
Less chance of missing something during a manoeuvring operation

More Accurate
Helping pilots determine "drift", turning speeds and clearances earlier

$$

Cost saving
-Accuracy of pilotage
-Time saving for pilot
-Potential reduced insurance premium

Quicker
Time savings and boosted efficiency from the plan view perspective

Better Communication
Tugs will be able to anticipate their next orders and view operations. Tugs will also receive the live "stream"

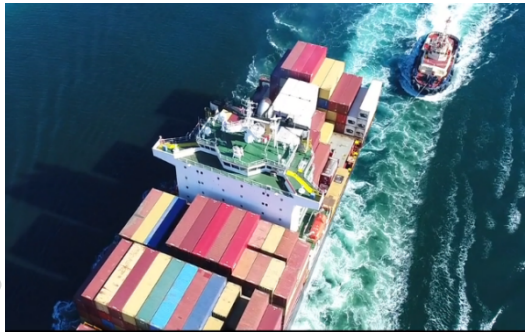
Better Training
Enhancing the skills of new and existing pilots by replay of operations

Improved Investigations
Respond effectively to near-misses and incidents with full recorded imagery

Not Reinventing

Drone-assisted pilotage is not reinventing pilotage or the skills required.

Estimations of distance and space are better understood, handling characteristics of vessels and tug interactions better, training, competence and claims handling can be utilised to defend against adverse claims.



Demo of Drone Assisted Pilotage

- https://dnvgl-15.wistia.com/projects/2wj5pkpw91

Offshore Operations

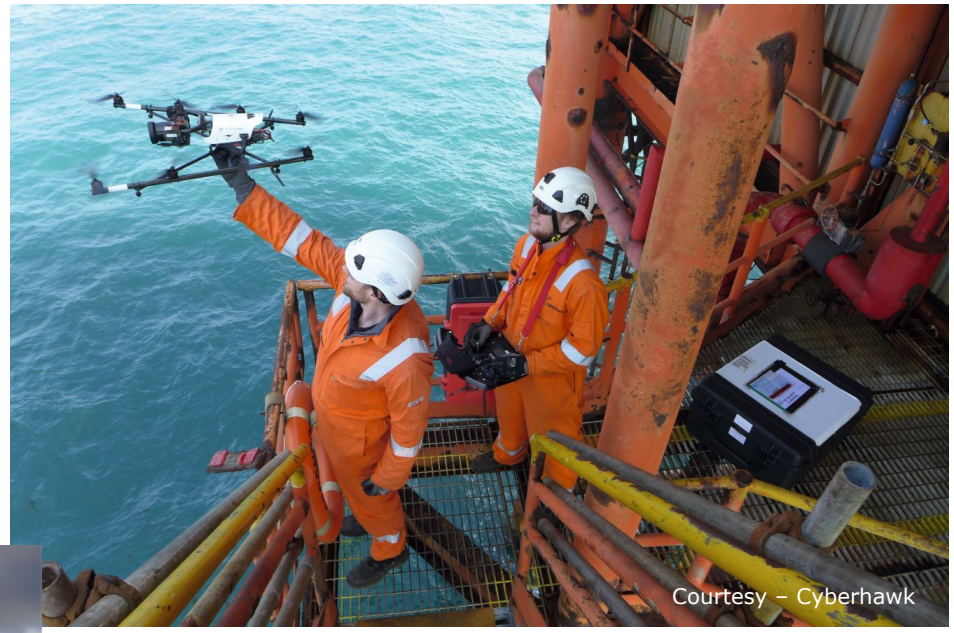
Offshore

- Requirements for compliance:
- ISO 9001 – Management System Standard
- CAP 722 – Guidance on UAS operations in UK Airspace
- CAP 393 – The Air Navigation Order (ANO)
- CAA Information Notice Number IN – 2016/073

- Additional considerations:
- Valid Training and HSE Certification (BOSIET, HUET, Offshore Medical), Environment, emergency plans, communications plans, familiarisation, SIMOPS (AUV and HELO Ops), Vessel Ops, Weather conditions and forecasts, Vessel/Platform movements, GPS denial, Deck space and congestion for flight paths, take off and landing, battery and DG transportation regulations, Battery recharge times, Magnetic Interference, Increased loss of signal, Drone type, redundancy and equipment need careful consideration depending upon role.

Inspection considerations

Cyberhawk carried out an under-deck inspection for Total's Elgin field in the North Sea in May 2014. When the same work scope was carried out using rope access five years before, it took 119 days with six personnel. Typical equivalent inspection now carried out in three days with two personnel – a pilot and a surveyor.



Semi-Sub Inspection

Jack-Up Inspection

Offshore Wind

- UAVs are well established in the UK's wind sector for operational and maintenance inspections.
- They deliver significant benefits in safety and cost reducing the need to:
  - Send skilled technicians to offshore turbines and the associated hazardous transfer from a boat to the transition piece
  - Work at height to survey the tower, nacelle or blades
  - Traditional survey would involve the use of a man with binoculars or manual access via rope access or man riding techniques

Data and legal considerations

- Data availability in the event of claim
- Potential for predictive failure to be better understood – legal and financial
- Storage, transmittal and custody of Data, ensuring continuous chain of custody and appropriate security policy and back up procedures
- Cyber considerations over access to data
- Contracting strategy over ownership, storage interpretation of results etc.

Remote AUV Survey

- Advantages of Remote Survey
  - Reducing safety risks and environmental impact
  - Flexibility due to efficient scheduling performance
  - Involvement of wider audience (client + experts)
- Customer Benefits
  - Reduction of guidance / safety briefing of external staff by operator
  - Faster mobilisation and delivery of survey
  - Increased flexibility of inspection planning,
  - Direct access to global pool of experts
  - Increased frequency of inspection / verification possible due to reduced cost and schedule constrains

AI

- AI is the new driver of drone technology in all kinds of ways. But when it comes to data, AI algorithms are sophisticated and mature enough to be reliably able to analyse footage and classify it in industries like inspections.
- The challenge is the volume of Data. High-definition video or stills, thermal imagery and 360-degree visual allow the development of 3D models and along with improvements in tooling and NDT the data creation is huge.
  - Combine this with:
    - laser measurement,
    - fingerprinting and data filtering,
    - corrosion measurement
    - drone-based ultrasonic non-destructive testing
    - Autonomous take off and landing to moving platforms
    - Video Goggles (Currently not allowed due to sensory deprivation)

  “Intrinsically safe” drones are also being developed.

Finally

- Tag and drop or traditional review will become impossible as the volume of data increases.
- Time is too valuable and demands too intensive to waste going through thousands of images visually. There are numerous tools which use AI and machine learning to inspect and classify images significantly cutting the time spent on routine review.
- It is reasonably easy to foresee a future where drones perform daily inspections underwater, flying around structures and crawling through tanks. Ultimately an environment where the human inspection interface is only utilised for the severest of interventions.

Enter the

Game of DRONES

Captain Stephen Norman
stephen.r.norman@dnvgl.com
07801078019

www.dnvgl.com

SAFER, SMARTER, GREENER

Ungraded