Periscope Network

Market Opportunity Report

Smart Inspection and Maintenance; Drones on Ships

Interreg North Sea Region PERISCOPE European Regional Development Fund

EUROPEAN UNION

PERISCOPE reaping the potential of the oceans

Dear Reader,

This report provides a current assessment on the prospects for aerial drone applications onboard ships. Three use cases are each forecasted to their time to implementation and evaluated as an opportunity for the maritime and offshore industries. The report's findings are based on respondents' answers to surveys about the three use cases.

The data for this report is based on desk research and an analysis of survey responses. This report is produced by the PERISCOPE network.

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PERISCOPE

PERISCOPE is an initiative of the Interreg VB North Sea Region Programme working to catalyse entrepreneurial discovery and promote trans-regional partnerships to unlock Blue Growth. We are supporting the combined maritime and marine innovation ecosystem in the North Sea region to accelerate innovation for sustainable business development in emerging blue markets.

The PERISCOPE network has identified more than 60 future business opportunities for the blue economy, developed these into venture concepts, and built an engagement tool for each of these. These studies include crowd-based forecasts about when these are expected to be realized. This information supports planning activities with the intention to orchestrate action towards the realization of said opportunities, and, indirectly, to a transition to a more innovative and sustainable character of the blue economy.

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Contents

1. EXECUTIVE SUMMARY

The transition of the maritime and offshore industries toward a sustainable “Blue Growth” future is driven by incentives to unlock new growth areas, develop and apply new technologies, and increase productivity. As aerial drones are increasingly evolving in their capabilities, precision, and automation, new use cases are emerging. This report documents the results a series of future use cases for aerial drones onboard ships including a forecast to their expected time to implementation and what is needed to make them happen.

The purpose of the studies is to support decision-making in enterprises and research policy. To this end, a survey instrument developed around the use cases that was put to the crowd for validation and assessment. This report presents the outcome and analysis of 3 surveys taken by a total of 83 respondents. Results show that:

- Multipurpose drones for supporting vessel navigation will become an accepted practice 5 years from now (2025), and respondents rated the business potential at 4,04/5. Technological factors are mentioned by most responses (39%), followed by social (36%), political (14%), economic (11%), and environmental factors (0%).

- Document delivery drones will become an accepted practice 5 years from now (2025), and respondents rated the business potential at 3,38/5. Technological factors are mentioned by most responses (61%), followed by political (21%), social (10%), economic (8%), and environmental factors (0%).

- Man overboard rescue drones will become an accepted practice 5 years from now (2025), and respondents rated the business potential at 3,9/5. Technological factors are mentioned by most responses (43%), followed by economic (34%), political (14%), social (9%), and environmental factors (0%).

2. INTRODUCTION

The North Sea Region is a crucial area for Europe's Blue Economy with technologically advanced industries, major port areas, and vibrant offshore activities. The North Sea is one of the busiest areas in the world for maritime traffic. However, the maritime, marine and offshore economies are exposed to profound challenges: While some industries are undergoing a significant growth and change, others are facing stagnation and decline. To ensure the region's stability and long-term prosperity, new ways are needed to increase productivity, and the advancement of aerial drone applications onboard ships have been proposed. Questions of what's next, how, and when further developments in their usage is on the agenda.

To answer these questions, PERISCOPE identified potential next practices for the usage of aerial drones on ships and put them to the crowd for assessment and validation. Survey instruments were developed to this end that describe a series of tasks and missions, each requiring different sensor technology, flight speeds, operation heights, and endurance. These were posted online and distributed to respondents identified as having a qualified opinion. The first question that was asked concerned the question of time to implementation: "On the sliding scale below, please estimate when it will become accepted practice that [technology X] will be used to complete [task Y], i.e. [becomes] commercially available" with the scale spanning a maximum of 30 "years from now." In this question, respondents were also offered an option to answer "it will never happen" or if the use case in question is "already here." The second question: "What is needed to make this happen?" offered respondents an open text box in which they could write their answers. The third question asked respondents to rate the business potential on a Likert scale out of 5. Finally, respondents were offered another open text box to write any additional comments.

In what follows, each study will restate the prompt that was used in the survey, followed by an analysis of the responses. The crowd-based forecast provides the median estimate of the "time to accepted practice." A Political, Economic, Social, Technological, Environmental (PESTE) analysis organizes the responses into categories, the average rating on the business potential is presented, and an analysis is made based on these. After all of the studies are presented, an overall discussion on the business opportunity for aerial drones on ships is undertaken, and the report is concluded.

3. STUDY A: MULTIPURPOSE DRONE ON SHIPS

Fifty-four percent of all ship accidents in 2018 were due to navigational issues such as collisions with other ships, icebergs, infrastructure, or grounding on the seabed floor.[1] Large vessels are challenged to turn in tight spaces, and, depending on the weather conditions, under limited visibility. Captains approaching ports are restricted in their perspective from the bridge and so they rely on radar, cameras, and human spotters.

Drones, mounted on ship platforms, could be equipped with sensors to detect and determine the distance between the ship and obstacles and provide accurate and real time data to the bridge.

The commercial drone market is expected to grow tenfold from $4bn in 2018 to $40bn by 2023.[2,3] This is due to the increasing capabilities that see drones combined with other systems and being used for new purposes. Multipurpose drones on ships could, for example, take photos in case of damage to the ship and could taxi goods from one ship to another while passing.

3.1 RESULTS

3.1.1 FORECAST TO IMPLEMENTATION

The survey data received for Study A was analysed to find the median estimation for the implementations of multipurpose drones used to support navigation. Median, rather than the mean (average), is used for this analysis to prevent skewness resulting from outliers. The estimation is presented in Figure 1 below, which shows that the median, i.e. the value separating the lower and upper half of the data sample, is 5 years from now (2025).

When asked for the time to accepted practice, the respondents had to option to choose "will never happen", to ensure they were able to answer the closed question in agreement to their actual beliefs. This option was used by 4,35%, reflecting a high conviction of a future implementation, making it more a question of *when* it will happen rather than a question of *if* it will happen.

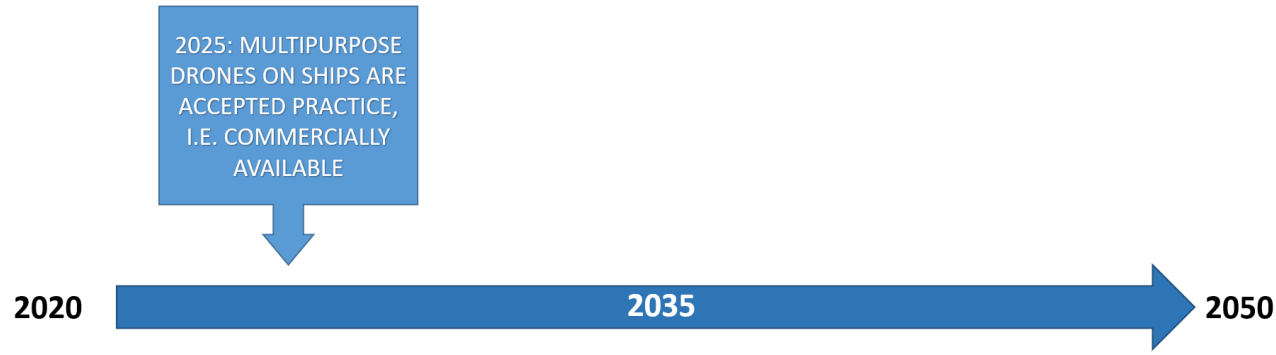

Figure 1: Median estimate for multipurpose drones on ships

3.1.2 WHAT IS NEED TO MAKE THIS OPPORTUNITY HAPPEN?

Respondents, in connection to their estimates, were asked to write what is needed to make this opportunity happen. This question was open-ended.

The comments from the respondents are presented below and have been divided into 5 categories, representing a Political, Economic, Social, Technological, and Environmental (PESTE) analysis. The text in the table are the responses. In some cases, spelling, grammatical corrections, and changes to improve comment clarity have been made. Furthermore, some comments were split to categorize them accordingly to their parts. These appear in no particular order.

POLITICAL

• Legislation of air space for drones. • Rules regarding where and how these drones are allowed to fly. • There are strict restrictions on how high and far they can travel because of privacy laws. There would need to be firm laws put in place that oversaw the operation of this. • This will probably be led by defence forces, and later on adapted in commercial ships. In 10 years, a few ships will be using this, whilst it will be standard on modern navy ships.
ECONOMIC
• More investment from the shipping companies. • Small investments could make this a reality and to integrate it with current infra-structure. • Investments are needed. • An assessment into the practicability of using drones.
SOCIAL
• It sounds like this is already possible, so there needs to be more focus on the benefits of this opportunity to convince the organizations in charge that it's a worthy invest-ment. • Educated drone pilots on each ship. No need to fly out of sight. • Health and safety practices need to be reviewed. • Willingness. • Involvement of insurance companies. • It's a rather conservative market. • Knowhow. • More innovative ideas on how to use the drones and increased production. • If it relies on the skill of ship owners then it may take a longer period or not happen at all. • It is necessary to look carefully at how the use of drone within other domains is al-ready taking place and then extrapolate this to the ship - sea situation.
TECHNOLOGY
• Reliable, sustainable, and safety-conscious ship-ready drones that have all the neces-sary criteria. • Affordable technologies for the implementation of the drones on a significant num-ber of vessels. • If it can be done through a digital interface autonomously then it may happen quicker. • Drones need to be autonomous and be able to recognize the situations it is used for. • Cyberthreats could be an issue. So, technology securing the drones to the maximum is needed.

• Technology. • They would need to develop the sensors and monitoring equipment that the drone needs to be equipped with and be able to deal with the weather elements. • AI platforms and cloud platform to upload and retrieve data. • Developed technology for drones to be used on ships. • Research.
ENVIRONMENTAL
• N/A

The distribution of comments among the 5 categories in the PESTE analysis of the answers to Study A is depicted in Figure 2 below. This figure shows that political factors amount to 14% of all comments while economic factors take up 11%. None of the comments were attributed to environmental factors while social took up 36% and technological factors took up 39%, making the latter the biggest category.

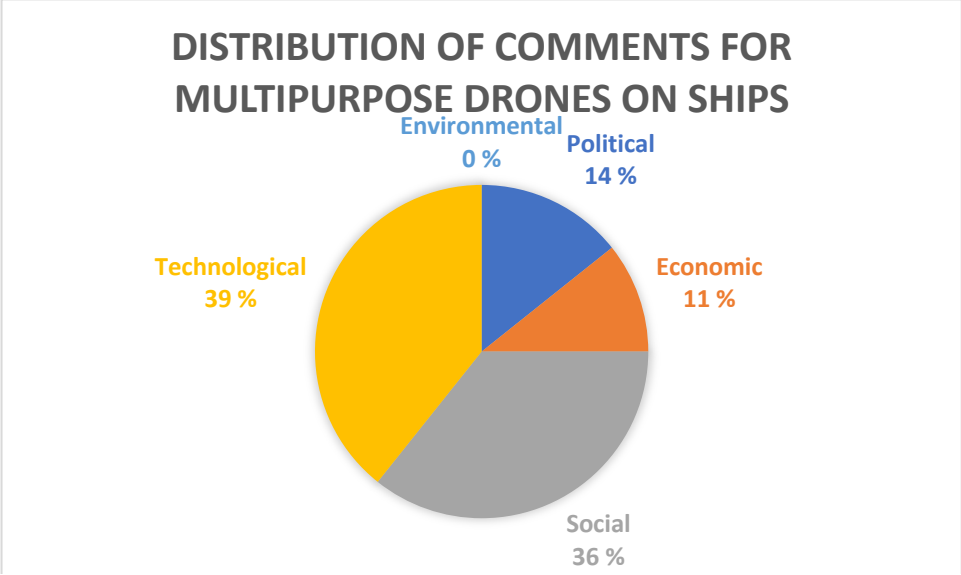

Figure 2: *Respondents' comments to multipurpose drones on ships, categorized*

3.1.3 BUSINESS POTENTIAL

On the question of business potential of multipurpose drones on ships, respondents, on average, rated it 4,04/5.

3.1.4 ANALYSIS

This section reviews and provides commentary based on the open-ended responses.

An important point of contention in the responses demonstrates the uncertainty about the question if multipurpose drones will leave the ship. Current limitations to battery capacity are overcome by attaching an electric cable to the drone, essentially tethering it to the ship. Such a tether would act as a barrier to the distance the drone can fly, for example limiting its use to a small radius around the ship. As a bonus, this tether can also be used to recover the drone if control is lost.

If the drone is to complete missions that require it to fly further than a fixed radius around the ship, then, as many respondents point out, questions regarding air space regulation and potential privacy issues come to the fore as the ships approach ports. Drone operation in many EU countries already require "educated drone pilots," and questions remain regarding such requirements for drones launched and/or operated from ships, as well as cybersecurity concerns that increase with the distances travelled. Yet piloting and navigation require skill sets not readily available in the labour market, and so if control can be made more simple, as one respondent states, if "it can be done through a digital interface autonomously then it may happen quicker."

The respondents point out that it may not solely be a matter of what is possible, but if it is something the industry *wants* to do. Drone capabilities and experimentation is developing rapidly, and as one respondent points out, the defence industry is not only a core developer of advanced capabilities, but future developments "will probably be led by defence forces, and later on adapted in commercial ships." The defence industry thus takes upon itself the costs of research and development and the risks involved with demonstrations to mature such technologies. This works well as a preliminary step for the maritime industry, which respondents note to be "conservative" and lack the "willingness" to take on such development projects, although the relative price tag may be "small."

As depicted by Figure 2, technological factors are the core concern of respondents, but these are not limited to the drone hardware itself. Complementary technological development, the respondents point out, are needed for advanced capabilities, including sensors, autonomous navigation enhanced possibly with AI and the processing power of "cloud platforms to upload and retrieve data" in order to execute tasks reliably.

3.2 REFERENCES TO STUDY A

[1] http://www.emsa.europa.eu/publications/technical-reports-studies-and-plans/item/3734-annual-overview-of-marine-casualties-and-incidents-2019.html
[2] https://www.businessinsider.com/drone-technology-uses-applications?r=US&IR=T
[3] https://www.ft.com/content/cbd0d81a-0d40-11ea-bb52-34c8d9dc6d84

More information:
https://unctad.org/en/PublicationsLibrary/rmt2018_en.pdf
https://www.boatus.com/magazine/2011/april/diy.as

4. STUDY B: DOCUMENT DELIVERY DRONES

A particular pain point in shipping is that vessels need specific documents delivered to ports before they arrive. Unmanned drones can be sent to ships ahead of arrival to retrieve documents and return to the port. This work is currently done by launch boats that average $1,500 per hire. Drones could offer savings to the industry in the magnitude of $675mn per year.[1]

Last year 200,000 commercial drones were sold, and by 2022 the total market value is estimated to be $11.2bn.[2] Standard commercial drones can carry up to 18kg and fly as far as 8km.[3,4] It is already possible to program drones to fly and land accurately from one point to another using signal beacons or GPS coordinates.

Ongoing challenges for drones include communication interruptions and intermittent weather. Other open questions include drone registration and zoning restrictions, as well as security against hackers.

4.1 RESULTS

4.1.1 FORECAST TO IMPLEMENTATION

According to the median answer by respondents, document delivery drones will become an accepted practice in 5 years' time (2025) (see Figure 3). When asked for the time to accepted practice, the respondents had to option to choose "will never happen", 10% selected this option.

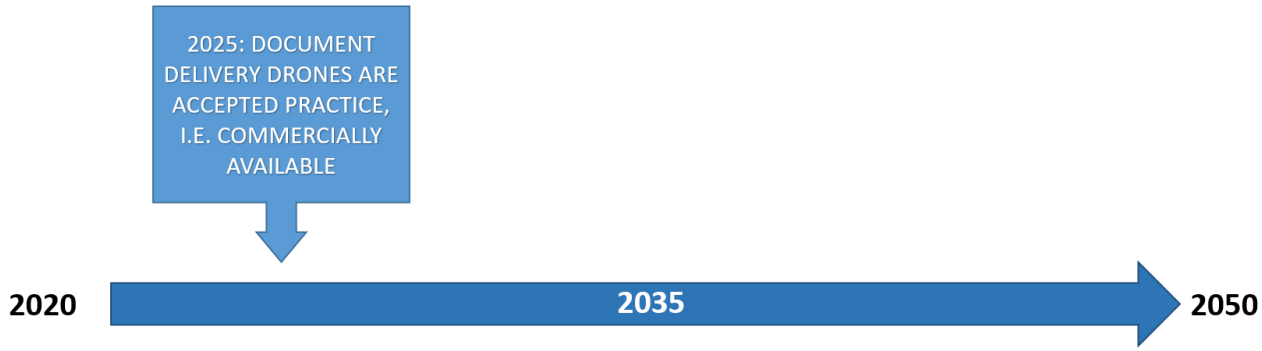

Figure 3: Median estimate for document delivery drones

4.1.2 WHAT IS NEEDED TO MAKE THIS OPPORTUNITY HAPPEN?

The comments from the respondents per this question are presented in the table below, organized across 5 categories, representing a Political, Economic, Social, Technological, and Environmental (PESTE) analysis. The text in the table are the responses. In some cases, spelling, grammatical corrections, and changes to improve comment clarity have been made. Furthermore, some comments were split to categorize them accordingly to their parts. These appear in no particular order.

POLITICAL
• Open questions include drone registration and zoning restrictions. • Legislation would likely need to be passed to make certain areas no fly zones for pedestrian drone use as well, in order to make sure that monitored drones are safe in their travel from A to B. • Legislation to control where and when drones can fly. • Certified training to global standards for drone controllers. • Security and air traffic regulations need to be implemented.

• The challenge relates to flying in safety restricted areas like ports and there are still regulatory boundaries to overcome. • Flying out of sight legislation. • Drone identifier system.
ECONOMIC
• Funding is needed. • Investment. • I am not sure about the business case for a stand-alone solution though. • Why hardcopies of documentation should be required when scanning documents electronically and transmitting them to the relevant authorities would be cheaper and easier to implement?
SOCIAL
• The documents themselves could be private, so they need to be going into the right hands. • Start using drones to deliver mail to remote areas. • Acceptance of change. • More field experience to assess the operational and financial opportunity for all stakeholders
TECHNOLOGY
• Weatherproof drones. • Sturdy, well maintained and durable drones with capacity to travel distance. • Ongoing challenges for drones include communication interruptions and intermittent weather. • Address security concerns. • Security against hackers. These will need to be secure and reliable enough to do ahead with the project. • Protection of drones safely. • Investment in drone battery life, weather proofing, GPS accuracy and speed. • It exists already, the only issues here are weather and unfortunate scenarios. • Security upgrades. • Technology. • Facilities to house and run the drones and sorting of documents. • Weatherproofing. • Resistance to hacking. • Overcoming obstacles such as poor weather and communication issues. • More durable drones that can deal with inclement weather, with a good range of flight and weight-bearing capabilities. • Excellent security measures to thwart hackers. • Security will be the biggest drawback of these drones.

• Development of drones. • Greater data security. • Auto-landing systems. • Knowledge about magnetic interference from large metal structures - magnetic interference is a known source of drone killings. • Just a matter of technical development that has already started. • Compass is strongly influenced by metal of ships. A drone doesn't know exactly where it is. GALILEO satellite system should improve that.
ENVIRONMENTAL
• N/A

The distribution of comments among the 5 categories in the PESTE analysis is depicted in Figure 4 below. This shows that the majority (61%) can be considered technical by nature, while only 8%, 10%, and 21% were Economic, Social or Political respectively. None of the comments could be assigned to environmental factors.

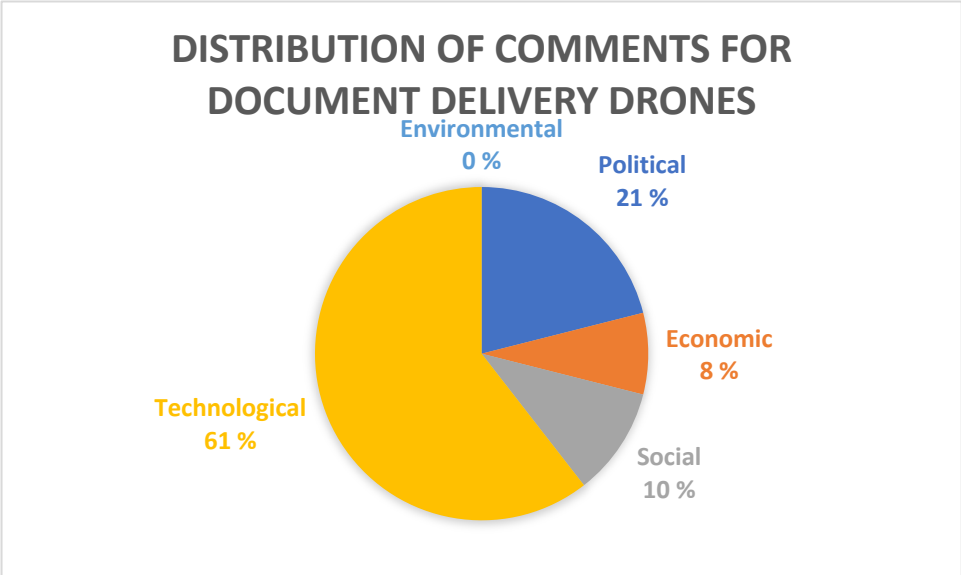

Figure 4: Respondents' comments to document delivery drones, categorized

4.1.3 BUSINESS POTENTIAL

On the question of the business potential of document delivery drones, respondents, on average, rated it 3,38/5.

4.1.4 ANALYSIS

The respondents to this survey attributed the greatest challenges for this opportunity to become a reality as being technological. Respondents point to “weatherproofing” as “range of flight” and “weight-bearing capabilities,” “communication interruptions,” “GPS accuracy, “speed,” “battery life,” and “auto-landing systems,” “magnetic interference” as current shortcomings. Many respondents indicated the need for cybersecurity measures in order to keep sensitive document deliveries safe.

In order to make document delivery possible, one respondent notes that it will require more than the drone itself: “[f]acilities to house and run the drones and sorting of documents,” require investments in infrastructure and ongoing attention from workers. One respondent questions the service altogether: “Why hardcopies of documentation should be required when scanning documents electronically and transmitting them to the relevant authorities would be cheaper and easier to implement?”

Respondents’ concerns for political were wide ranging, and captures the uncertainty over future legislation. These include “where and when drone can fly” as not to conflict with “air traffic regulations,” the need for “zoning,” and operating drones that, in many countries, need to not go “out-of-sight.” Finally, one respondent raises the question of a “drone identifier system” that allows air-traffic controllers to monitor activity and to be able to know who is responsible for the drone.

4.2 REFERENCES TO STUDY B

[1] https://www.wilhelmsen.com/ships-agency/are-drones-a-game-changer-for-last-mile-deliveries/
[2] https://www.prnewswire.com/news-releases/29-06-billion-drone-logistics-and-transportation-market---global-forecast-to-2027--300667775.html
[3] https://3dinsider.com/drone-payload/
[4] https://3dinsider.com/long-range-drones/

5. STUDY C: MAN OVERBOARD RESCUE DRONES

Between 2011 and 2018, 92 out of 298 people who fell overboard in EU waters died.[1] Survival chances depend on detection, response method, water temperature, and luck.[2] In the case of cruise ships, detection relies on eyewitness accounts and surveillance cameras, and given their large turning radius, rescue rates are estimated to be down between 14 and 25%.[1,3]

Thermal cameras can detect a person in the water up to 50 meters away.[4] Equipping these to drones that are prepared for fast deployment and programmed with search pattern optimization for a given vessel, can make a significant improvement of the rescue rates.

Drones can be specialized to locate people, signal their location using light, sound, and GPS, and for dropping flotation devices.[4] Drones can even pull people out of the water and bring them back aboard.

5.1 RESULTS

5.1.1 FORECAST TO IMPLEMENTATION

The survey data are analysed to find the median estimation for the opportunity (see Figure 5). According to the respondents, man overboard drone will become an accepted practice in 5 years (2025).

When asked for the time to accepted practice, the respondents had the option to choose "will never happen". None (0%) of the respondents selected this option, indicating that it is not so much a question of *if* it will ever happen, but rather *when* it will happen.

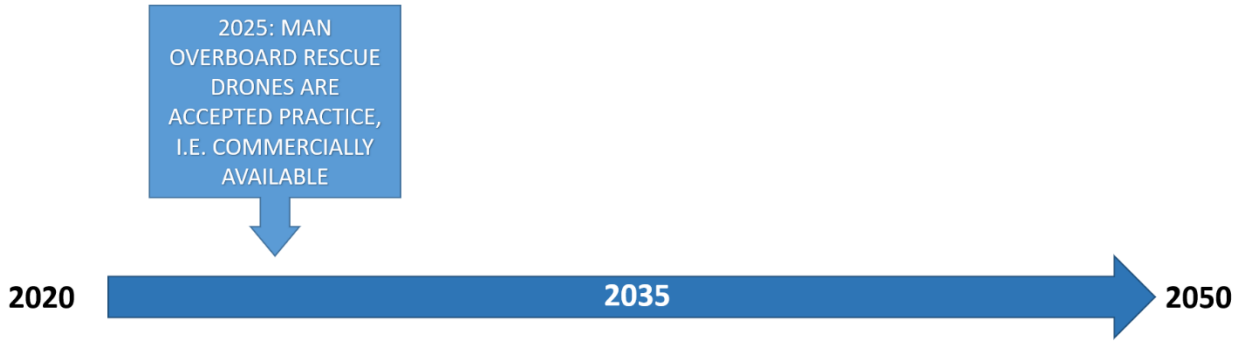

Figure 5: Median estimate for man overboard rescue drones

5.1.2 WHAT IS NEED TO MAKE THIS OPPORTUNITY HAPPEN?

POLITICAL
• Recommendations from [International Maritime Organization] IMO and flag states to encourage vessels to participate. • Regulation which needs to be amended. • Cooperation between companies and countries. • Flying out of sight, so the need is to change legislation. • Legislative issues.
ECONOMIC
• Investment in drones on board ships. • Money. • Investment into the technologies. • Investment. • Cost incentive. • Money.

• The cost to put current technology aboard every ship /cruise ship and the training to use it. • Money. • More investment in drone technology on each ship. • There is no business case for this service as a stand-alone. • A Camcopter has a pricetag on the wrong side of €5m each - and then there are the maintenance costs. • Availability.
SOCIAL
• The only thing we experience with companies is that they need to see that there is a business case in the operation. • Information. • Training.
TECHNOLOGY
• The right research and testing. • Waterproof drone technology • It's a case of combing technologies, we already have drones that would be suitable, and we have the camera technology available. • To equip ships with thermal cameras in order to detect people fallen overboard. • Technology. • Drone technology needs beefing up to enable flying in rough weather and increased payload/pulling power capacity. • The technology exists, it is simply a matter of getting drones strong enough with enough batteries that they can fly out and lift people out of the water. • Thermal imaging as well as combining machinery which is water resistant and providing breathing mechanisms. • Lots of technological improvements to the current version of the drones. • Surveillance systems may also need to be improved to detect a person falling overboard to maximise chance of recovering people. • If it's surveillance / rescue support, then I don't think the opportunity is far into the future. The authorities already use SAR drones. If it's 'pick-man-from-ocean' - that I can't see anytime soon. A Schiebel Camcopter S100 - one of the biggest drones out there, which we fly with our partners on maritime surveillance missions - weighs 150 kg and has a max payload capacity of 50 kg, and then you don't get much endurance. Picking up a sailor requires +100 kg lift, and then he's a lightweight. Passenger transport requires a major improvement in energy efficiency before we get there. • Waterproof and weather-resistant equipment. • Awareness that somebody has actually fallen overboard. • Drones can land on ships/vessels in the near proximity - or have longer range. • Ability to fly in all weather conditions and all times of day/night.

ENVIRONMENTAL
• N/A

The distribution of comments among the 5 categories in the PESTE analysis is depicted in Figure 6 below. This shows that 43% of the comments can be considered technical by nature. 34% of the comments point to economic factors as driving factors, while 14% point to political factors, and 9% point to social factors. None of the comments could be assigned to environmental factors.

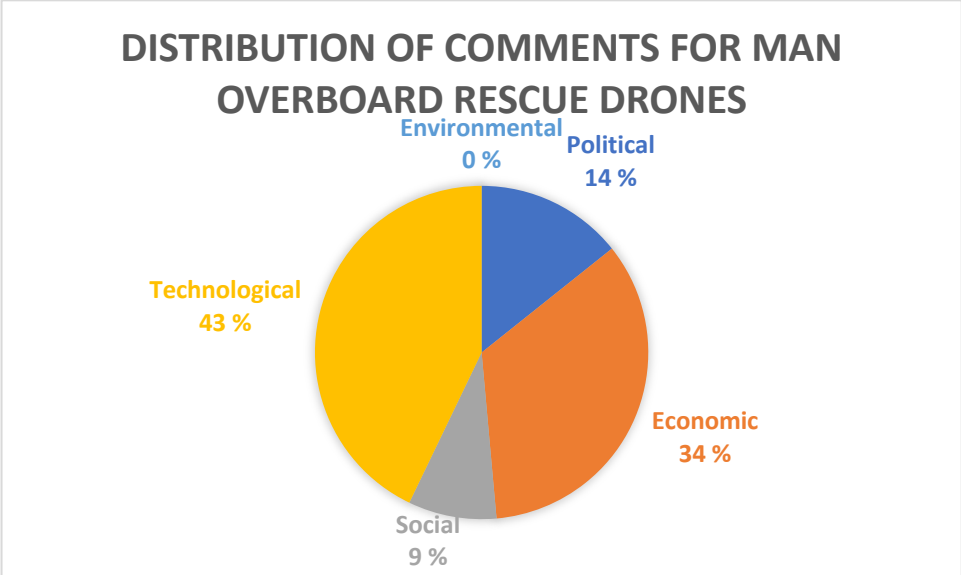

Figure 6: Respondents' comments to man overboard rescue drones, categorized

5.1.3 BUSINESS POTENTIAL

On the question of the business potential of man overboard rescue drones, respondents, on average, rated it 3,9/5.

5.1.4 ANALYSIS

Driving uncertainty in this opportunity is the mechanism for the description of the rescue. "If it's pick-man-from ocean" one respondent states, "I can't see anytime soon" they explain, citing the limitations of heavy-lifting drones, their flight duration time, and the cost of the hardware. Questions regarding "combing technologies," "thermal cameras," and "breathing mechanisms" indicate that the technology, according to the responses, has not stabilized. Additionally, it can be assumed that other considerations were not expressed in the responses, so this should not be considered

an exhaustive list, as transmitting signals to the ship on the position of the man overboard, or to carry and drop a lifesaving device, did not come up..

Additionally, onboard systems that monitor for passenger safety, such as those that use lasers, that when "broken" sent a signal or enact an operation (such as they do for elevator doors), may need to be integrated in order to "detect a person falling overboard" and to "maximise chance of recovering people" from the water. While the business case for this opportunity is seemingly strong, as none of the respondents think that it "will never happen" and many of the responses in the analysis involve the single word: "money," one respondents states that "there is no business case for this service as a stand-alone" and another that "in combination with other services, it does have a potential" making it a question of systems integration and functionality.

Safety at sea is a major concern of many maritime actors. Such a solution as "man overboard rescue drones, according to respondents, could require "cooperation between companies and countries," and the "[International Maritime Organization] IMO and flag states to encourage vessels to participate" in order for systems to receive certification and scale.

5.2 REFERENCES TO STUDY C

[1] http://www.emsa.europa.eu/emsa-documents/latest/item/3734-annual-overview-of-marine-casualties-and-incidents-2019.html
[2] https://www.cntraveler.com/story/what-happens-when-someone-falls-off-a-cruise-ship#
[3] https://www.ship-technology.com/features/setting-international-standards-man-overboard-systems/
[4] https://satir.com/product/uav-drone-640p

More information:
https://qz.com/1443797/why-do-people-keep-falling-off-cruise-ships-because-people-keep-stepping-onto-them/
https://www.formulaboats.com/blog/rescuing-man-overboard/
https://oisair.net/technology/view/159/smart-boat-rescue-system-for-detecting-crew-in-water
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https://satir.com/application/thermal-imaging-search-rescue-sar-application

5 BUSINESS OPPORTUNITY

As global trade and general activities undertaken at sea increase, so does the need for tasks performed on ships and the related challenges. The implementation of drones, capable of undertaking these onboard activities, therefore yields great potential as they would be able to ease some of the costly and difficult activities.

The EU is currently developing rules for drones. However, these negotiations are difficult because many of the member states have already adopted regulations for aerial drones. This is more the case over cities, where drones pose a threat to human safety and privacy. How these regulations develop will shape the speed and use of drone applications in maritime. Questions at stake include the ability to fly a drone “out of sight” the licensing and permit requirements for operation, and the degree to which they can be sent on autonomous missions without oversight. They will furthermore be a need to train a large number of crew members to be able to fly the drones a capability that is currently not present

Another crucial factor is the development of precision navigation, this might be solved by the European Galileo satellite navigation system there is about to go online. This system claims to be able to narrow down the precision of GPS location to 10 cm2. Furthermore, it claims to have the ability to also monitor altitude. This system can unlock precision navigation capabilities, where drones can be sent to land on a moving beacon, e.g. a signal sent out by a 5g mobile phone. Questions remain as to its reliability for such precision and will require demonstration and testing.

Such precision navigation will overcome many of the current challenges to drone applications for industry given that the large metal structures, i.e. ships, interfere with the internal compass of the drones, and many drones have been lost because of the confusion. While GPS does not share this problem, advancements in optic-based navigation provide another solution – that as landscapes are increasingly codified as data, drones will be able to navigate based on the landscape, when it reaches land, but the GPS may still be needed to get to the coast.

This rapid growth in technological capabilities is happening – but unevenly across industries. However, hardware improvements are making drones faster, stronger, more accurate, easier to control, and able to fly longer. At the same time Software is developing such as pattern recognition, optics, advanced and lightweight sensors, and cybersecurity is improving. The market develops specialized drones where it sees the largest potential, and it is unlikely the drones for ships will initially be considered the most attractive market, given other areas are seen to have larger potential, which is energy followed by transport and warehousing [4]. However, the marine sector is likely to benefit from this development, as e.g. Amazon and Walmart start to use drones that can lift larger loads [5].

According to estimates from PWC, the estimated global market potential will exceed USD 125 Billion [1] with the main application being in infrastructure, transport sector, insurance, media, telecommunication and agriculture. This indicates that the technology will be driven by the general use of drones and that the applications in this report will benefit from the general development and advances of drone technology. PWC mentions safety as one of the main blockers for the technology,

which is not a significant issue for the applications discussed here as they are off-shore and thereby only cause an economic loss in case of a malfunction. The significance of the development can furthermore be seen from major consulting firms are opening center focusing on the drones and data analysis [2]. Furthermore, the investment in the drone industry has increased from USD 30 million in 2008 to 1.205 billion in 2019 [3], indicating that there is a general belief that this is a market with a large potential.

There might be a potential for the EU to accelerate this development by supporting research and development in this area.

MULTIPURPOSE DRONE ON SHIPS

As mentioned above, in 2018 more than half the accidents were due to navigational issues such as collisions with other ships, icebergs, infrastructure, or grounding on the seabed floor [6]. The conditions across the world differ significantly, as representatives from one major shipping company mention in a recent workshop that It can be very foggy some places in China when the ships are berthing, and he indicated a high conviction of potential for the use of drones to help in such situations.

This type of drones, and in particular the software, might not be first priority for drone developers, however, if there was support from the EU level, the national level as well as the maritime sector, will it likely be possible to fund the necessary development. Particular if this is seen as a safety measure for the industry combined with an environmental precaution. It is obvious that fewer accidents will improve the safety, both for humans and ships, e.g. the Costa Concordia disaster [7]. From an environmental point of view there might also be great benefits, e.g. being able to avoid oil spills as there will be fewer accidents. For the last decade 58% of oil spills have occurred in collisions and groundings [8] while the oil spill has fallen over time, they still cause major environmental disaster when they happen.

The question is then when these become available would they then be adopted by the ship owners, as that will have a significant influence on the size of the market, i.e. will all ships over a certain size need to adopt them? While this is difficult to answer, one might imagine another way of getting them adopted. One option could be insurance companies that would require this to ensure the ship or increase the insurance if they were not adopted. Alternatively, the EU or national state could require this for allowing a ship to dock. Something similar was done by the USA when they required that oil tankers needed to have double hull to be able to access US ports. Regulation would make this an attractive market.

DOCUMENT DELIVERY DRONE

All ships need to deliver documents to the harbour in advance of their arrival. Currently that is done by boat, i.e. a boat is sent out to the ship to pick-up the documents and then bring them back to the port. As mentioned earlier, an estimated cost of this is USD 1.500 as the ship has to pay for this service. The estimated of using drones for this service is in the area of $675mn per year for the industry [9]. This is a substantial saving for the ship owners.

While there are still issues before this might become common practice, there are also encouraging signs that this might be the first option of the 3 discussed in this report. The weight is not more than drones today can handle; the distance should also be feasible even with today's technology (which it should be noted is improving rapidly). There are however, still some issues in regards to reliability, e.g. weather resilience, and improved navigation system so that the ships iron structure does not interfere with the drone navigation. As previously discussed, there need to be training of drone pilots and possibly some norms, guidelines, or regulations for how to deal with drones landing on a ship as well as drones landing in the port.

However, the general development of drone technology, resilience and regulation should solve these issues. This technology might be especially attractive for ports around the North Sea as they are technological relative advanced and it might not be a big step for them to adopt this technology. The shipowners will also be relatively interested given the potential savings.

What might be needed for this technology to take off is that ports start to experiment with it, maybe together with some of the major shipping companies, and indeed, some already have [10]. Compared to the potential for on ship drones, which is more a safety precaution, this opportunity has direct savings and should be attractive for all parties involved. Clearly, there might a period where ports operate a dual system, but that should only be a transition.

MAN OVERBOARD RESCUE DRONE

There are a significant number of people who fall overboard, as mentioned earlier between 2011 and 2018, 92 out of 298 people who fell overboard in EU waters died.[10], corresponding to that almost 1 in 3 die.

There are two ways in which drones can be used in this context, one is as surveillance / rescue support the second is to "pick-up" somebody from the ocean. In the first case the technology is already there, as drones could be used to look and locate people who have fallen overboard, something which it often difficult. Secondly, one could imagine that drones could drop some kind of survival kit to a person there was identified, creating time enough for conventional rescue mission to be launched. The most attractive market for this is likely to be the cruise industry, where there often are many people onboard, with little experience of ships and the dangers that are present.

The maybe more attractive proposition, drones for picking somebody up from the sea are still facing major challenges. Currently, one of the biggest drones, A Schiebel Camcopter S100 [11] can only lift 50 Kg and cost USD 400.000 + controls, training etc. For being able to be used as a "pick-up" drone it will need more than twice that payload. Which in the moment nobody can say if and when will happens and what the price will be.

The current business opportunities here are relative limited at the current time. However, as everybody is interested in an increased payload, the general drone development might eventually provide a solution. The question is then if the solution will be too expensive for adopted on ships.

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6 CONCLUSION

The transition of the maritime and offshore industries toward a sustainable “Blue Growth” future is driven by incentives to unlock new growth areas, develop and apply new technologies, and increase productivity. The development and utilization of aerial drones on ships provides an opportunity to support the accomplishment of these goals.

This report reviews some of the potential drone use cases that can help stimulate sustainable economic growth and export opportunities. Based on responses to surveys, all three of the median forecasts to the time to accepted practice, i.e. commercial availability, is 5 years (2025).

7 RESPONDENTS

Respondents identifying themselves as actors on these opportunities include:

Aarhus University
Central Denmark EU Office

Dronaar
Energy Cluster Denmark
Explicit ApS
INTERNEST
Terma
Upteko

Periscope Network

periscope-network.eu