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Unmanned Traffic Management – Empowering Drones in Ports

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1. Executive Summary

Our airspaces have witnessed a substantial increase in drones[1]– flown recreationally and commercially. This surge is due to new regulations and emerging technologies becoming readily available on the market. As such, industry experts have begun to identify new areas where drones can benefit both business and community. And the port is one such area of interest.

Drones are increasingly utilised for specific tasks involving monitoring, inspection, and emergency response. However, their full potential is not yet realised.

Drone deployment in a port environment can support and improve these priorities:

- Optimise round-the-clock safety and security capabilities through dynamic drone surveillance

- Establish real-time situational awareness on the ground and in the air, also for relevant authorities and business partners

- Minimise workplace accidents and inaccuracies in high-risk operations

- Enhance logistics capability like ship-to-shore deliveries

- Reduce carbon footprint by operating as an energy-efficient and environmentally friendly site

As an integral part of a broader trend in Smart Ports, drones meet port objectives of digitisation and operations efficiency. As such, they present an opportunity to increase the value proposition and attractiveness of the port to its tenants and partners.

To facilitate safe drone operations in the port and leverage these benefits, Port Authorities have the responsibility to manage drone access to the port, coordinate drone traffic while protecting the port against unauthorised drones, and support the provision of drone services by connecting different stakeholders involved. Unmanned Traffic Management (UTM) technology enables Port Authorities to fulfil this complex mission.

An Unmanned Traffic Management (UTM) system consists of a software platform supplying a suite of services to drone operators and authorities. The services are highly automated and designed to ensure the following: facilitate safe access to the airspace, enable seamless information exchange between all involved, and coordinate drone traffic, all while maintaining the highest level of airspace safety. UTM technology facilitates management of the third dimention in the Port's ecosystem – on the ground and in the air.

Not only is it crucial to a seamless and scalable integration of drones into the port ecosystem, UTM technology is designed to:

- keep use of airspace safe for both manned and unmanned aircraft

- enhance port operations without creating manpower friction

- create new market and value network for both port and its business partners
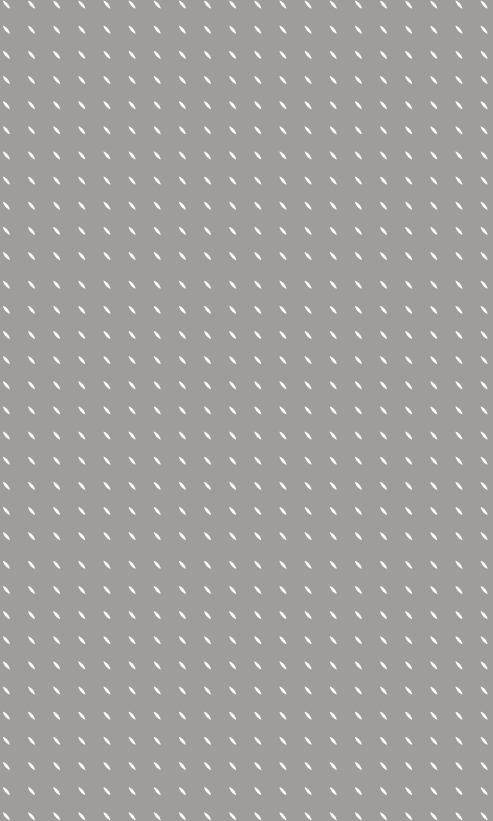
Currently, Unifly's large-scale, robust, and sophisticated UTM system is used by national airspace authorities worldwide. It streamlines data exchange and workflow interaction so the relevant authority and any participating operator can use this system to monitor their airspace as well as plan and manage drone operations. The intuitive map-based view provides complete situational awareness about planned and ongoing drone activity in the port.

An industry first, Unifly's platform offers the scalability and capability needed to simultaneously accommodate multiple workflows and multi-layered authorisation processes needed to offer real-time surveillance and detection capabilities in the vast area of responsibility within any busy port.

The case study of Port of Antwerp illustrates what ports can do to embed drones into their operations. In 2019, Unifly collaborated with Port of Antwerp in SAFIR, a European research initiative, to further explore how drones can benefit the port and its wider network. Since then, Unifly has also been involved in a large-scale and phased commercial rollout of drones in the port area. This led to a precedent being set with Port of Antwerp managing its own airspace and also, kickstarted this paper on how port communities can level up by embracing drones and their benefits.
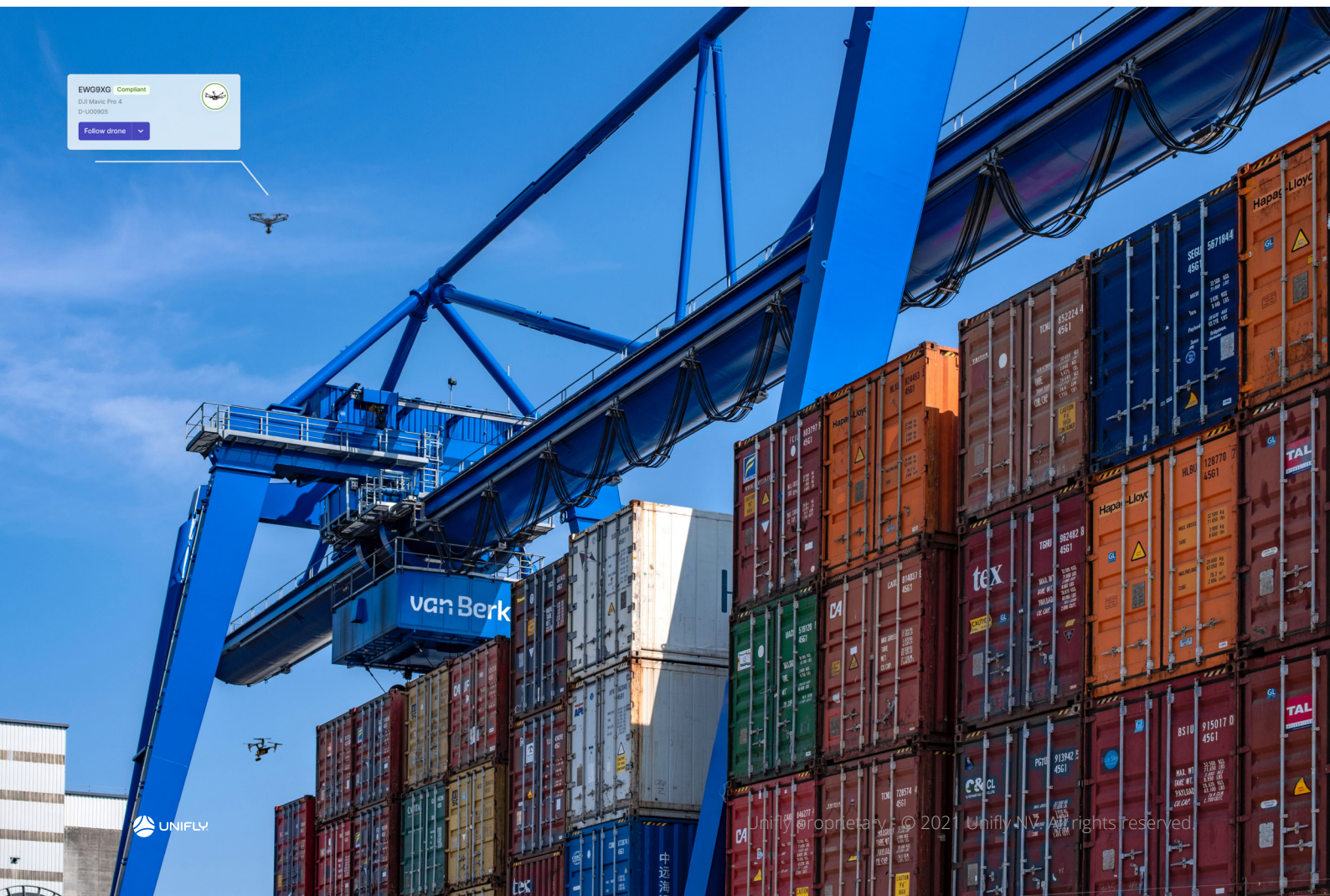
"The adoption of concepts like Internet of Things, Big Data, Artificial Intelligence, Cloud Computing, Robotics and Automation, is transforming the industry and society and...adopted in strategic sectors such as automotive, heavy industries, energy, health, etc. However, the port industry is not taking advantage of the benefits and impacts derived from the digital transformation..."
–Fundación Valenciaport[2]

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2. Introduction: The Age of Drones

- New technology bolsters development of drones

- Drones are here to stay as they are increasingly adopted across many industries

- Drones already benefit critical infrastructure like ports, but full potential yet to be tapped

Thanks to rapid technology advances and affordable prices, Unmanned Aircraft Systems (UAS) or drones have been widely adopted over the last decade. Drones are not only flown for recreational purpose but have also been embraced by many industries for commercial purpose, to optimise safety as well as performance and productivity gains[3].

As a result, there are currently far more drones registered in the world than manned aircraft[4]. This exponential growth will only continue as new regulatory frameworks and technological advancements allow for increasingly complex drone operations.

For port authorities and communities, drones offer tremendous opportunities to streamline core activities with possible gains in costs[5] and productivity, while increasing overall health and safety standards.

- Port of Antwerp concluded through the EU Horizon 2020 SAFIR project[6] that drones' ability to perform Beyond Visual Line of Sight (BVLOS) flights offer "…an immense addition to safety as they were able to manage, inspect and control a large area in a swift and safe manner[7]."

- In 2020, Hamburg Port Authority rolled out a drone program for infrastructure inspection and facilities monitoring[8].

- In the United States, the Police Department for Port of Los Angeles included drones in their security, emergency response, and search-and-rescue operations[9].

- In Chile, APM Terminals began using drones for operational efficiency, as well as monitor traffic flows and container stack efficiency[10].

- Port of Rotterdam began studying the use of autonomous trucks in the port and has been planning a large-scale deployment of the technology at the tail end of 2021[11].

- Around the same time, the Maritime and Port Authority in Singapore deployed drones for surveillance, detection, incident response and management, and has been exploring shore-to-ship delivery applications[12].

Undoubtedly, drones will play an increasingly important role in port operations, provided they are flown safely and securely. The next sections expand on the benefits of drones with respects to ports, roles that Port Authorities can assume to properly utilise drone solutions in day-to-day operations, as well as how Unmanned Traffic Management (UTM) – a software platform supplying a suite of services to connect drone operators and authorities – enables safe and secure use of drones while keeping the ecosystem of stakeholders and systems seamlessly integrated.

At the Crossroads of New Technology

The case for connectivity and drones extends beyond Internet of Things; it involves the timely convergence of emerging technologies like 5G, artificial intelligence like deep learning, computer vision, blockchain[13], cloud computing[14]; all of which bolster drone use.

Port operators already recognise technology, especially with respects to digitisation and automation, as a must-have to stay competitive. In a McKinsey survey[15] on container terminal automation involving 40 key executives of ports worldwide, the general consensus is that automated ports are safer than conventional ones. Technology facilitates reduction of human-related interruptions, human error and therefore, minimising workplace accidents. Technology is not only designed to keep people and port safe, it is also intended to keep data secure as well.

Taking it to the next level – Port 4.0

Approximately 2,000 shipping ports[16] around the world are witnessing increased growth and traffic in recent times, and the allure of automation is undeniable. Steps by operators to achieve Port 4.0 status have already begun in varying degrees with ports supporting container ships being ahead of the pack[17].

In a statement released by the 2019 iTerminals4.0 project by Fundación Valenciaport and funded by the European Commission CEF (Connecting Europe Facility) programme, such emerging technology can dramatically create "… a wide range of transversal benefits – such as an increase in operational efficiency and enhanced levels of cyber security… through the digital evolution of ports[18]." The drone industry can benefit from this and indicates that drones can play a bigger role in ports.
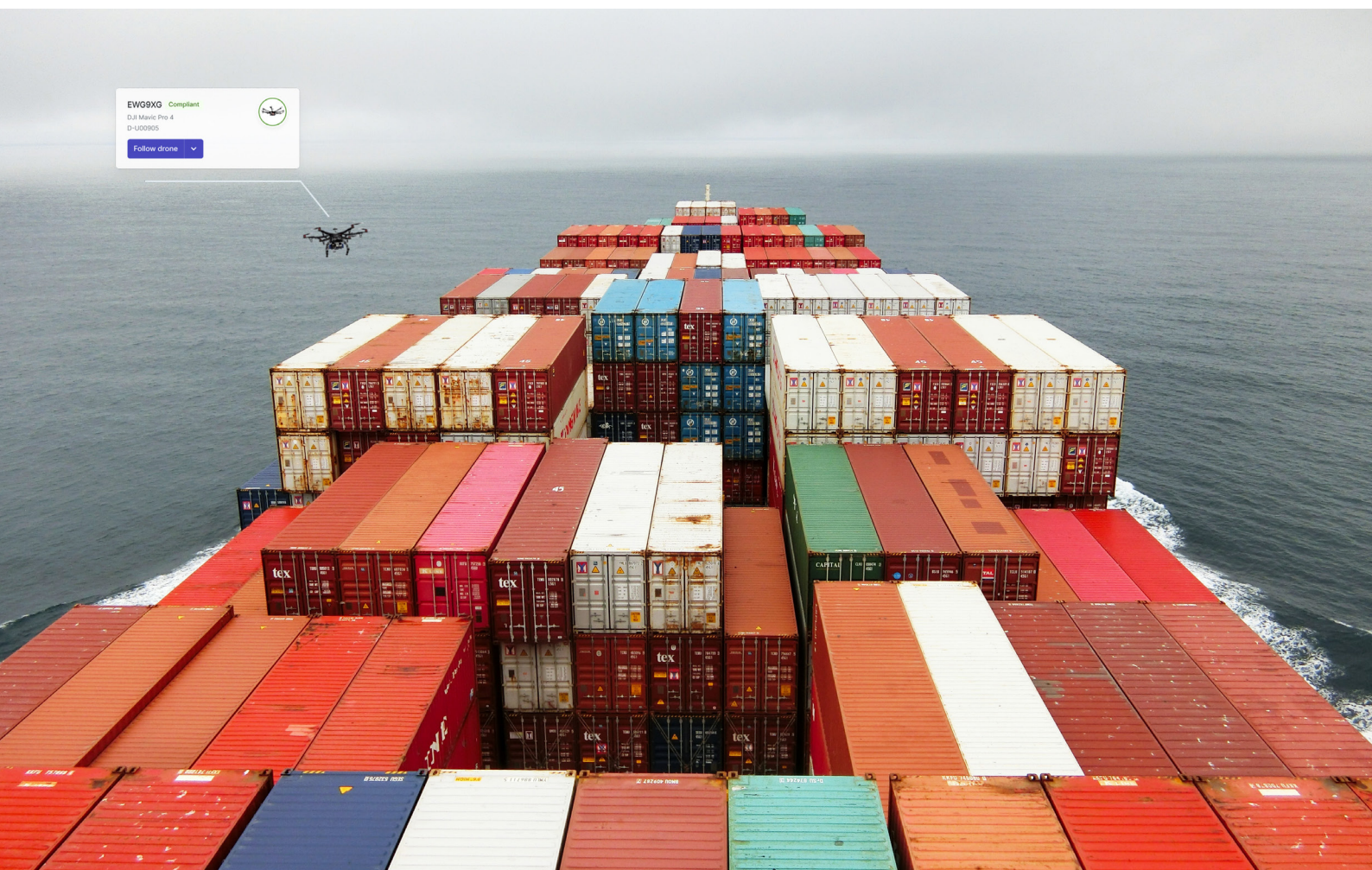
"We presently spend a huge sum cleaning these up, but with drones' ability to spot spillages early, we hope to halve this expenditure."
– Port of Antwerp[19]

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3. Benefits of Drones in the Port Area

- Complementary role of reducing disruption while optimising operations

- Eye in the sky: securing full situational awareness

- Autonomous-based support for work that we can't and won't do

Drones are already utilised in ports for visual surveys and maintenance work; especially tasks that involve high risk or danger to personnel. Put simply, it is cost-efficient and safer when workers can supervise and make necessary decisions while they leave it to the drones to fly up tall structures or out to sea in bad weather. The ability to fly Beyond Visual Line of Sight (BVLOS) is an important capability that is being explored in the ports of Antwerp and Singapore, while ports of Denmark, Hong Kong, the Netherlands and Norway have already been testing BVLOS operations that travel as far as 16 km out to sea for security measures like spotting offenders and criminal activity[20]. Today, industry players acknowledge that drones can be applied beyond current uses.

Presently, drones assist ports in areas of environment, safety, security and infrastructure.

Environment

- Coastline monitoring

- Spillage and leakage of oil and hazardous materials

- Contamination detection

- Debris monitoring and management

- Compliance monitoring of emissions from ships

- Exhaust and hazardous detection, particulate matter detection

Safety

- Rapid emergency response

- Search and rescue including lifesaving devices

- Delivery of medical supplies and inventory such as testing kits

- Incident response and emergency management[21]

Security

- Perimeter security and trespass response: drones act as a digital fence around the port to control access relating to International Ship and Port Security (ISPS)

- Port area surveillance against unlawful activities such as theft, smuggling, drug and human trafficking

Infrastructure

- Ship docking management[22]

- Infrastructure and asset management, routine and preventive maintenance

- Transportation route supervision

- Inventory volume calculation for outdoor bulk storage

- Cargo and container inspection

- Analysis of building and roof condition, technical structures and terminal infrastructure[23]

Diagram 1: Use Cases of Drones in a Port
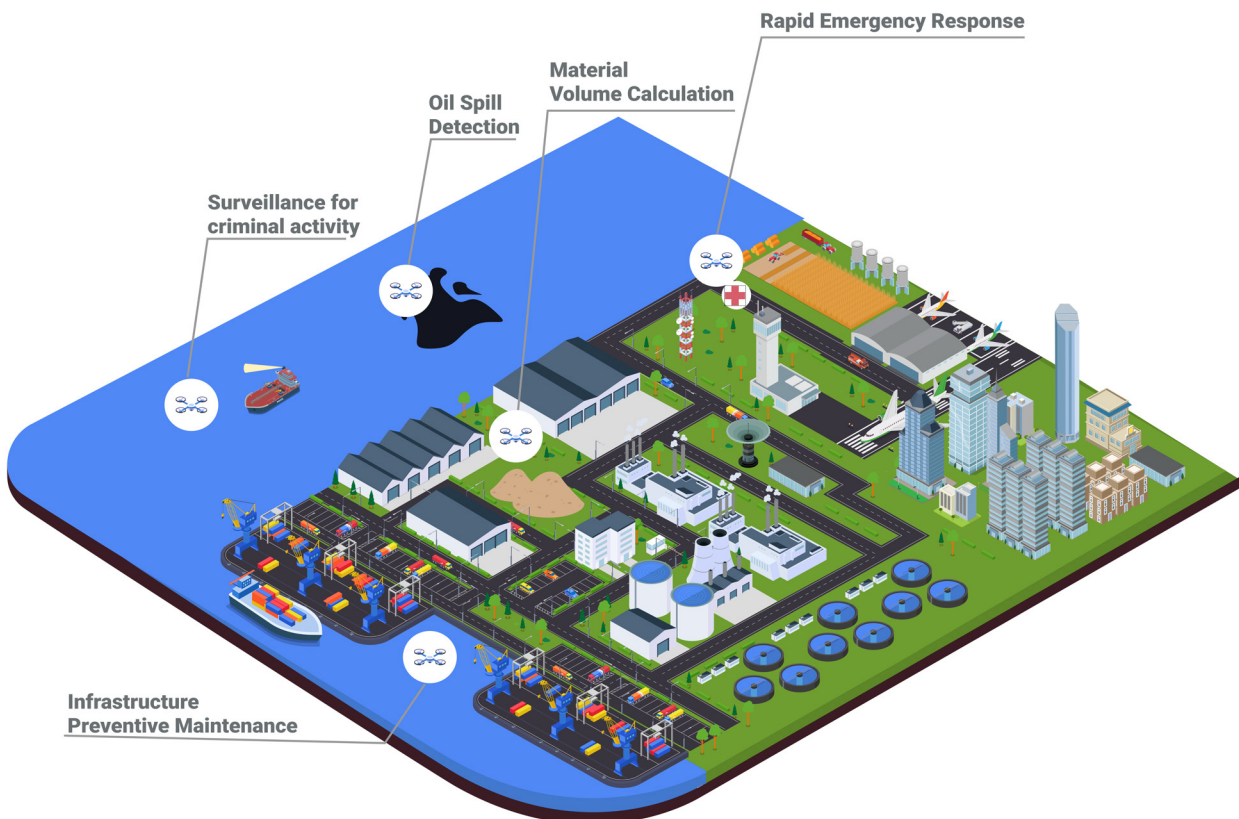
Sustainability is a priority for ports

In 2015, the United Nations laid out 17 Sustainable Development Goals (SDG) for all member states to achieve. The 2030 Agenda for Sustainable Development[24] is a shared blueprint for peace and prosperity for both nations and nature. Substantive support and capacity-building are provided to these SDGs.
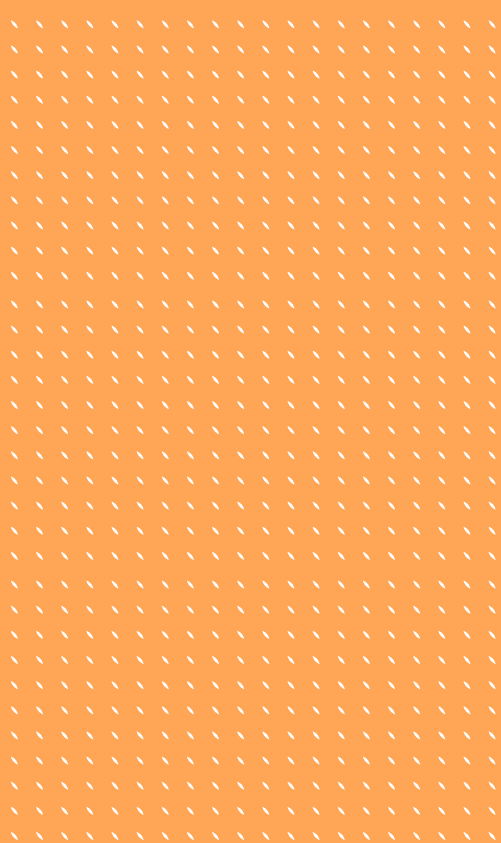
"Ports and their stakeholders should define which of the 17 UN SDG's are in scope for them. Affordable and clean energy (7), sustainable cities and communities (11), life below water (14) are amongst those that are considered most relevant[25]."

According to the International Energy Agency report in 2017, the total world energy consumption will rise 28% by 2040. Ports as the main gateways between countries, contribute notably to the high demand of energy. Ports not only want to meet the international and local directives but also address environmental concerns.

Ultimately, the deployment of drones in a port environment can support next-stage priorities to increase performance and improve market position:

- Optimise security and safety capabilities through dynamic drone surveillance

- Establish real-time situational awareness on the ground and in the air, also for relevant authorities and business partners

- Minimise workplace accidents and inaccuracies in high-risk operations

- Enhance logistics capability like ship to shore deliveries

- Reduce carbon footprint by operating as an energy-efficient and environmentally-friendly site[26]

"We regard drones and unmanned air mobility as the fifth area of transport modality at the port"
–Port of Rotterdam[27]

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4. UTM Enables Safe & Efficient Drone Operations in Ports

- Five roles the Port undertakes to faciliate drone operations

- A well-designed UTM technology is needed to assist these roles

To guarantee port safety and security, Port Authorities need to coordinate all activities within the port area and ensure they adhere to strict policies. Five key roles have been identified that Port Authorities can take to fulfil this mission while unlocking the benefits of drones for the port and its community.

A state-of-the-art Unmanned Traffic Management (UTM) system is a unifying solution that enables the Port Authority to assume these roles and connect all stakeholders and systems within the port ecosystem.

EWG9XG Compliant
DJI Mavic Pro 4
D-U00905

Follow drone
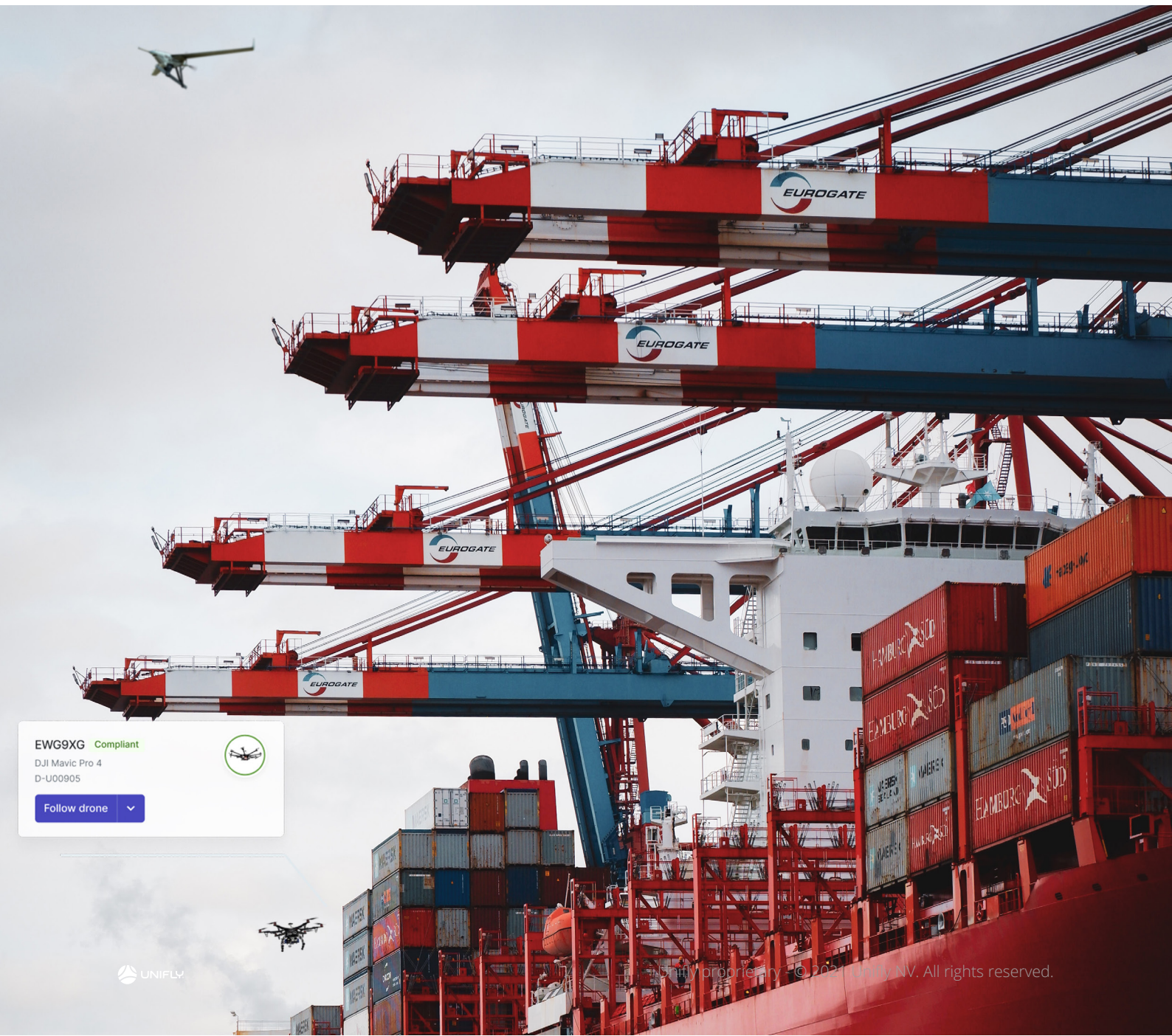
1. Manage Drone Access to and within the Port

This role is fundamental to keep drone operations safe in the port area, irrespective of who is flying: the Port Authority, port tenants, contractors, and even recreational users.

Two key activities fall under this role either as the sole responsibility of the Port Authority, or shared with other departments such as the Port Security or the Port Police:

- **Define conditions to fly in the port:**

    Compliance is maximised when relevant rules and conditions are clearly defined and communicated to the community. Conditions to access port airspace include providing the detailed flight plan, proof of pilot certificate and drone registration, being equipped with a tracking device and so on. In exceptional situations, the Port Authority might also want to temporarily keep drones out of certain areas.

    Examples include emergency response cases, construction work involving cranes, or securing port area for a VIP or official visit.

- **Adopt an efficient permission process:**

    Drone pilots have to submit a flight request with information about route, duration, drone details to the authorities before a flight. Hence, reviewing, approving or rejecting permission requests must be designed with timely efficiency in mind for everyone involved. Legacy formats like emails, simple web or paper forms, and spreadsheets are time-consuming with multiple steps; they do not even offer the scalability and traceability required, especially when there is a change of plans or in an emergency.

    Therefore, it is strongly recommended that a highly ***automated, traceable,*** and ***transparent*** process be applied.
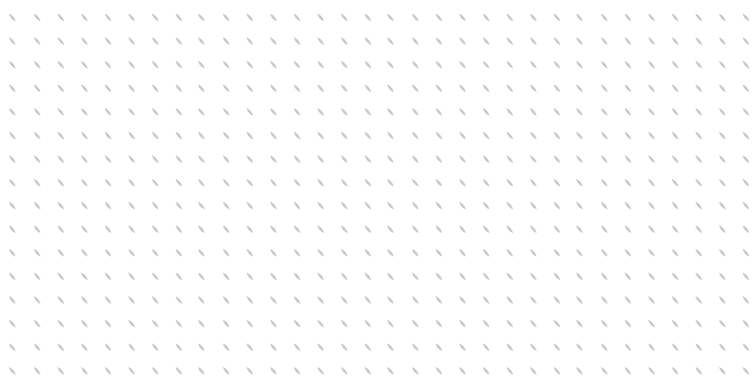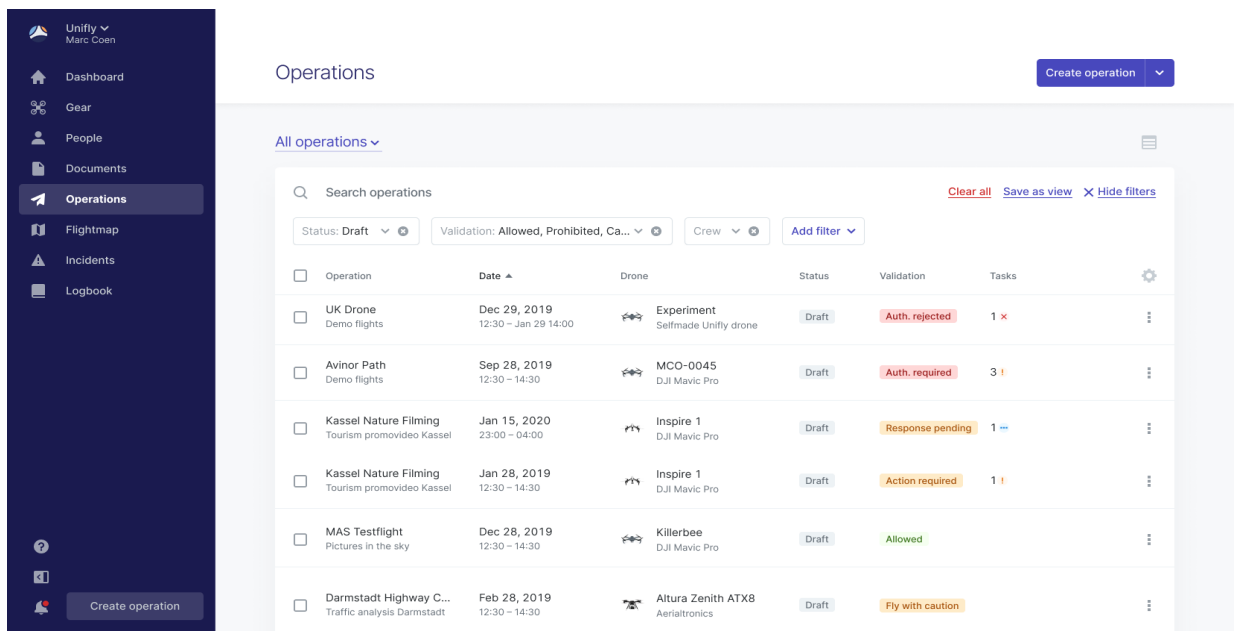
How Unifly UTM enables the Port Authority to fulfil this role

The Unifly UTM system fully digitises and streamlines the process – not only for drone operators to request for access but also for Port Authorities to review and approve requests.

Drone pilots and operators can register directly in the UTM system, visualise where flights are allowed or prohibited in the port, and submit their flight plans. The UTM system then automatically validates the flight plan against all applicable rules and conditions defined by the Port Authority and government and notifies the relevant departments when their approval is required.

When needed, the Port Authority can also quickly and easily create and publish temporary no-drone zones. These new flight restrictions are immediately visible to drone operators and automatically taken into account when the system validates a flight plan.

The UTM system provides both traceability and transparency: the Port Authority can easily track and manage all pending permission requests, while drone operators can check, at any time, the status of their permission requests. All information is recorded in the UTM system and can be immediately retrieved whenever needed.

2. Monitor Drone Activity in Real-time

Once a drone operator is allowed to fly within the port, it is critical to monitor that the actual flight goes according to approved flight plan. In this way, the Port Authority (or the Port Security or the Port Police) should have access to the proper systems that provide full awareness about drone flights taking place and send alerts in case of an emergency situation.

Once again, automation is important. Monitoring drone activity should not require a supervisor to sit for hours behind the system. Instead, the system should immediately notify the Port Authority's personnel who can access the system, assess the situation, and react accordingly.

How Unifly UTM enables the Port Authority to fulfil this role

Through an intuitive map-based view, the Unifly UTM system provides the Port Authority complete situational awareness about planned and ongoing drone activity in the port. The Unifly BLIP (for Broadcast Location and Identification Platform) is a lightweight device that can be mounted on drones and combines electronic remote identification and real-time tracking. The Unifly BLIP device communicates directly with the UTM system. If the UTM system detects an emergency situation or a threat to safety, it automatically notifies relevant departments.

The functionalities offered by the UTM system include *real-time monitoring and tracking, conformance monitoring* (a drone is about to leave its approved area of operation), and *separation monitoring* (two drones or a drone and another aircraft are flying too close to each other). By selecting any operation or drone tracked in the system, the Port Authority can access all the relevant information.
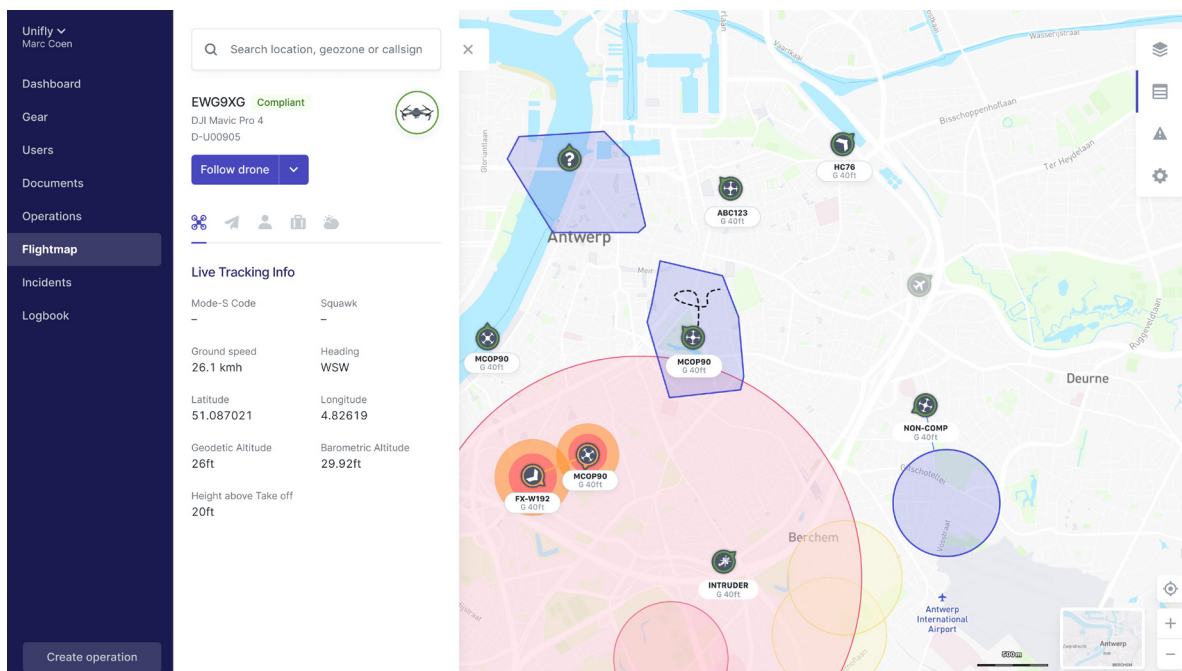
Diagram 2: Scaling Up UTM on a Need-Basis

Superior UTM technology is modular and agile enough to grow with customer needs. Depending on where each port stands in terms of budget, automation and digitisation needs, a UTM system like Unifly is scalable and modular to adopt. It is able to manage complex approval workflows that involve various tiers – from authorities right down to tenants and companies in the port vicinity.

- Streamlined Flight Authorization Process
- Multi-party Approval Workflows
- No-Drone Zone Management

Manage Airspace Access

Perform Operator Services

- Unmanned Operations Management
- Crew & Fleet Management
- Document Management
- Flight Planning and Validation
- Visualize Airspace Restrictions
- Flight Logs

Protect the Airspace

Monitor Airspace

- Remote/Network Identification
- Integration with
  Drone Detection Systems
- Friend-or-Foe Distinction
- Intrusion Alerts

- Integration with :
  -Real-time Tracking
  -Remote/Network Identification
- Conformance Monitoring
- Separation Monitoring
- Emergency Alerts

UTM Services on a step-based approach

3. Protect the Port Against Unauthorised Drones

While the above two roles enable and monitor authorised drone activity, this role focuses on detecting unauthorised drones to maintain the highest level of security in and above the port area. Unauthorised drones can be divided in two categories:

- **Clueless and careless:** drone pilots falling under this category either are simply unaware of existing restrictions and requirements to fly in the port (clueless) or are aware of them but decide to bypass the permission process and fly anyway (careless). Their drone is considered an 'intruder'.

- **Criminal:** drone pilots falling under this category are those who fly with the intent to disrupt port operations, or cause real damage to port infrastructure and harm to personnel on the ground. This drone is considered 'rogue'.

Whether ill-intentioned or otherwise, these drones pose a real safety threat to other airspace users, the port infrastructure, as well as personnel on the ground.

Sensors and radar systems can detect and locate small drones within a certain range. These systems can be deployed to cover either the entire port or within sensitive areas. In case of a drone incursion, processes should be in place to alert the Port Security and/or Port Police immediately.

How Unifly UTM enables the Port Authority to fulfil this role

The UTM system integrates with sensors and radar systems deployed in the port area to offer complete airspace awareness against the clueless, the careless, and criminal drone pilots.

Data received from these sensors is displayed on the map-based view in real-time, and automatically processed by other UTM features such as conformance and separation monitoring. The UTM system is able to distinguish authorised and complying drones from intruders and rogue drones, and immediately alerts responsible departments of the security threat.

4. Provide and Support Drone Services

Port tenants and contractors are not the only ones operating drones here. As seen from the broad range of use cases and benefits presented in Chapter 3, many Port Authorities have or are building their own drone program.

Establishing a drone program entails knowledge building, obtaining drone pilot certificates, and acquiring a fleet of drones equipped with the necessary payloads.

Whether its intended for a Port Authority, tenants or external contractors – drone operators should be able to plan, monitor, and log their own flights. By offering these services to organisations operating drones in the port, the Port increases its value proposition to all stakeholders.

Port Authorities can provide and support drone services in two ways:

- **Provide Drone as a Service (DaaS):** Port Authorities with their own drone program can leverage their resources to conduct operations for their tenants and contractors. In doing so, the port amortises the cost of its drone program while partners benefit from a readily available service

- **Maintain a pool of authorised drone operators:** even without its own drone program, the port can greatly facilitate access to drone technology by maintaining a pool of pre-approved drone operators who are authorised to fly in the port, which port tenants can contract when needed

How Unifly UTM enables the Port Authority to fulfil this role

On top of the planning and monitoring capabilities presented above, a well-designed UTM system equips the Port Authority and any participating operator with capabilities to manage their fleet, crew, and operations.

For Port Authorities, the UTM system offers the ability to review and manage a pool of registered operators. In addition, logbooks and detailed flight information provide valuable insights to i) assess where and how drones are used in port operations, ii) identify untapped potential for drone solutions, and iii) inform decision-making and planning.

5. Connect the Port Ecosystem

The information available in the UTM system can benefit other port departments and stakeholders.

Therefore, it should not operate in isolation. Beyond providing access to the system and automatic alerts in emergencies, a UTM system must be interoperable and offer the ability to integrate with the other systems used by the port.
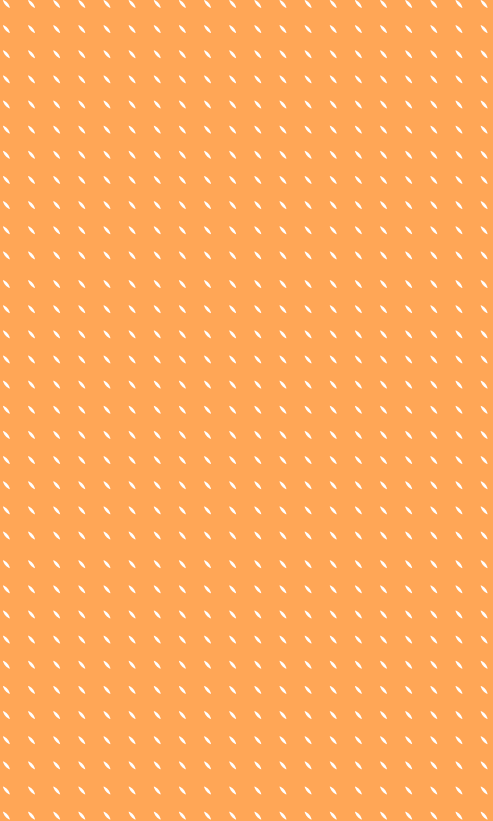
UTM can also act as a connecting factor or system bridge between port authorities and external authorities – with increased responsiveness and verified phone numbers in order to quickly contact drone pilots under urgent or unforeseeable circumstances. For example, relevant incident information can be exchanged with the port's security dispatch system, or with local law enforcement and the Civil Aviation Authority in case of non-compliance with regulations. Likewise, the UTM system can receive additional data from deployed sensors or from the port's Geographic Information System (GIS).

How UTM enables the Port Authority to fulfil this role

A user-friendly UTM system much like Unifly's, promotes interoperability with an Application Programming Interface (API) for seamless interface and data exchange with other platforms.

Diagram 3: Unmanned Traffic Management in a Port

The UTM System combines all inputs to provide full situational awareness and real-time responsiveness
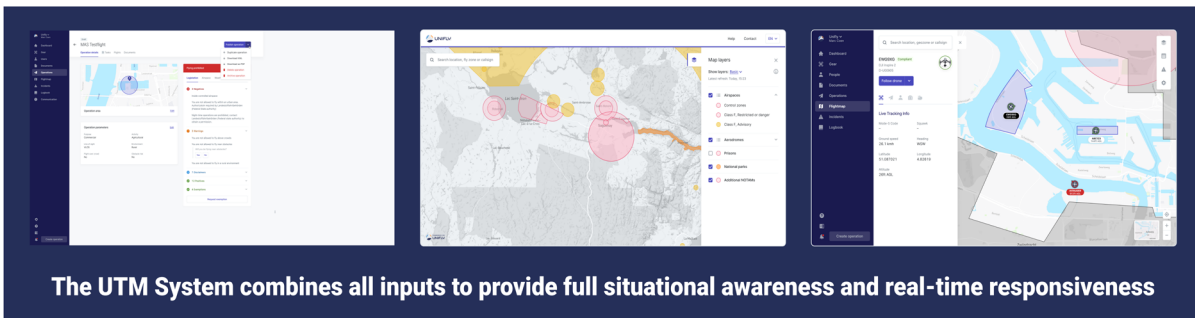
"We all see the drone's potential and that the technology is quite feasible... Drones could be a real boon for ports." – Port of Antwerp[28]

5. Case Study: Port of Antwerp

- Charting the UTM implementation journey by Port of Antwerp

- Crucial to safe air traffic in the port: communication and situational awareness

- Becoming a smart port: key takeaways

SAFIR ignites port interest in drones

In 2018-2019, Unifly steered a research project about U-space[29] – the SAFIR initiative. SAFIR[30] was supported by SESAR Joint Undertaking, the entity responsible for coordinating all research on Air Traffic Management in Europe.

This initiative was unique as it deployed and integrated multiple UTM systems to manage busy drone traffic and a broad range of drones in the Port of Antwerp – a major seaport next to the busy city centre of Antwerp and within the controlled traffic region of Antwerp International Airport.

These drone operations included inspection flights such as container and terminal inspection, oil spill detection, as well as other use cases such as parcel delivery, inter-hospital transport of medical supplies, high-voltage line mapping and pylon inspection.

The project simulated several real-life scenarios such as chemical accidents to explore realistic implications of drone traffic in a complex port ecosystem. This triggered the creation of no-drone zones with cascading effects of flights needing to be rerouted or land. Also, analysis of exhaust plumes from non-compliant vessels by drones were received within 20 seconds, and notifications sent to alert relevant authorities.

All these systems are integrated into the UTM platform, ensuring full situational awareness for all systems through combined use of trackers, such as uAvionix's ADS-B Transponder and Unifly's BLIP, and a radar system capable of detecting intruding drones.

Insights gathered from SAFIR proved these benefits of U-space services and capabilities:

- Improved cost efficiency of flight preparation by reducing associated time and effort

- Improved flight efficiency, for instance, the integration of aeronautical data and flight preparation in one system reduces potential margins or deviation from the optimal trajectory of flight

- Increased capacity in drone airspace through enabling more simultaneous flights using measures such as strategic deconfliction before and during flight time, visualisation of flights in real-time and obstacle avoidance

First port to pioneer a large-scale UTM commercial rollout

Port of Antwerp has emerged in its industry as the first to initiate a large-scale commercial rollout of unmanned air traffic management in a busy and complex port environment.

The port coordinates the mitigation and management of risk for all above-the-ground activity, with respects to operational and working drones, overall safety and seamless integration of processes; all of which are intended to ramp up productivity and efficiency of port operations.

Up till today, other ports have only deployed UTM on a smaller scale or project-basis, with much red tape delaying one-off flight operations. In contrast, Port of Antwerp has implemented a UTM system where all drone operations within the port's area of responsibility can be efficiently[31] and safely managed.

Recently, European regulation has confirmed a change from rule- to risk-based, hence shifting the responsibility from the Air Navigation Service Provider (ANSP) and Civil Aviation Authority (CAA) to local authorities as they are keenly aware about the challenges faced. This shift in regulation empowers Port of Antwerp to adopt a wider mandate – managing air risks over ground and water.

Unifly's platform can simultaneously accommodate multiple workflows, multi-layered authorisation processes and offer robust real-time surveillance and detection capabilities. Given the vast area of responsibility within this busy port, it is the first time that a UTM system is designed to offer scalability and capability.

The multi-layered authorisation flow is a first in the industry. After national aviation authority CAA gives the green light, this feature empowers timely and seamless processing of flight permissions starting from port authority, the masters of each terminal, right down to drone operators of companies and other port users.

Prioritising green initiatives

Greening the port is a priority. The port aims to play a pioneering role in terms of sustainability, with Antwerp becoming the most sustainable port in the Hamburg-Le Havre zone. The 17 Sustainable Development Goals (SDGs) of the United Nations are used as a benchmark for sustainable entrepreneurship, benefitting planet, people, prosperity, partnership and peace[32].

The port aims to tackle these challenges proactively, and harness environmental care as a competitive advantage. Specific goals involving drone solutions are those geared towards good health and wellbeing, decent work and economic growth, sustainable cities and communities, climate action and industry, innovation and infrastructure.

Anatomy of a connected port

Ports have a unique air and water ecosystem, bustling with various traffic. Much like a city, the Port of Antwerp is a sprawling metropolis with unique and intricate infrastructure bustling with activities and amenities. Besides the sheer scale of the port, added complexities include International Ship and Port Security Code (ISPS) and Seveso-related companies, nuclear plants, logistics, transportation, high voltage lines, industrial processes, onshore windmills and large railway yards, all of which pose challenges. A management system such as UTM is part of the solution.

Diagram 4: UTM to Coordinate Multi-Party Processes

The approval process in any workflow is multi-layered, involves different stakeholders and authorities, and requires a robust UTM to coordinate safely and efficiently for a high level of integration between parties, devices and activities.
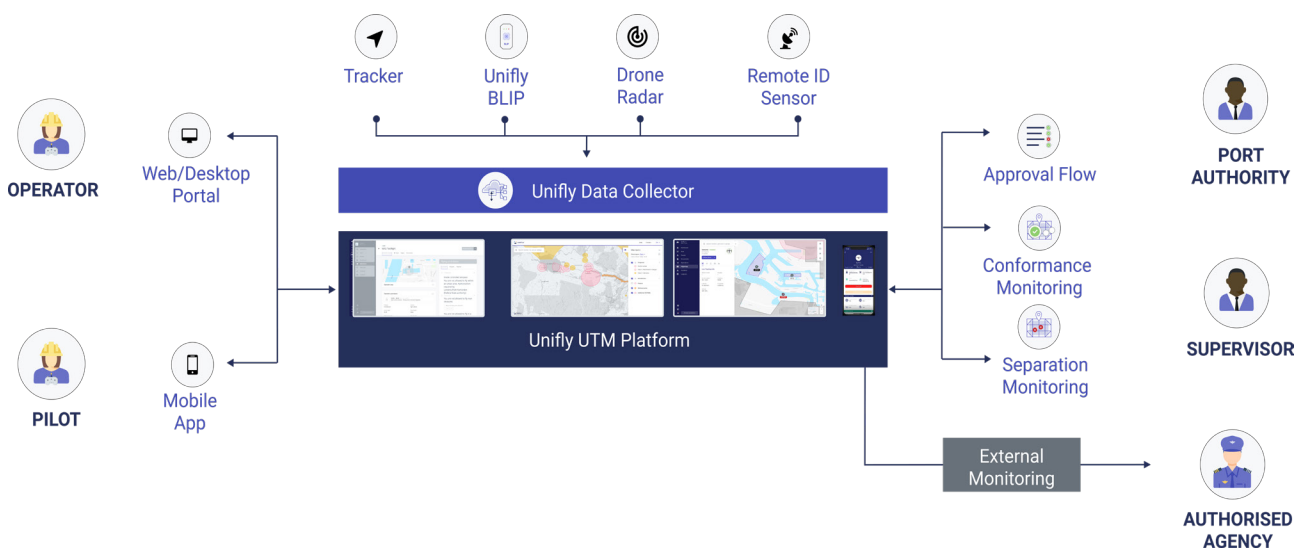
Unifly's UTM platform gathers data from all sources to support all stakeholders

The future for Port of Antwerp

Any port playing the long game will want to fly and manage drones, and thus must invest in creating a robust framework around safety and security. In doing so, Port of Antwerp will have total operational and situational view of its skies, hence creating positive impact for traffic within and around its expansive zone.

Data aggregated from drones adds value to systems and automation processes belonging to the Port of Antwerp – a higher standard of operation, quick response times and increased adaptability, and even resilience to emergencies. As the future heralds a closely interconnected global economy, this agility to change ensures the port is always poised to capture return on investments, and business confidence when opportunity presents.

Erwin Verstraelen, Chief Digital & Innovation Officer at Port of Antwerp: "The ultimate goal we have in mind for our drone-platform is a network of remote piloted and automated drones flying BVLOS, available round-the-clock. Onboard functionalities such as real time data capturing and computer vision will enhance our situational awareness on what is taking place in the vast port area, thereby providing support for our 'regulator' and 'operator' responsibilities."

A new standard of operation powered by management solutions, optimisation through advanced analytics and real-time scheduling

In the process of becoming a smart port, Port of Antwerp progresses into choreographing work and information flows to boost system efficiency and productivity. As the McKinsey report elaborates, "Forward-looking ports will push toward this next horizon, beyond automation, in the coming Port 4.0 era. Every player—terminal operators, trucking companies, railroads, shippers, logistics companies, and freight forwarders—will be connected to optimise not just the port itself but also its entire ecosystem[33]."

Port of Antwerp is an expansive area with public roads traversing its space. In the future, there may be a port traffic management system that safely and efficiently steers autonomous ships, trains, trucks and other vehicles throughout the port, while proximity to the city ensures a close connection, with some terminals located almost entirely within the city limits.

Image ©Port of Antwerp
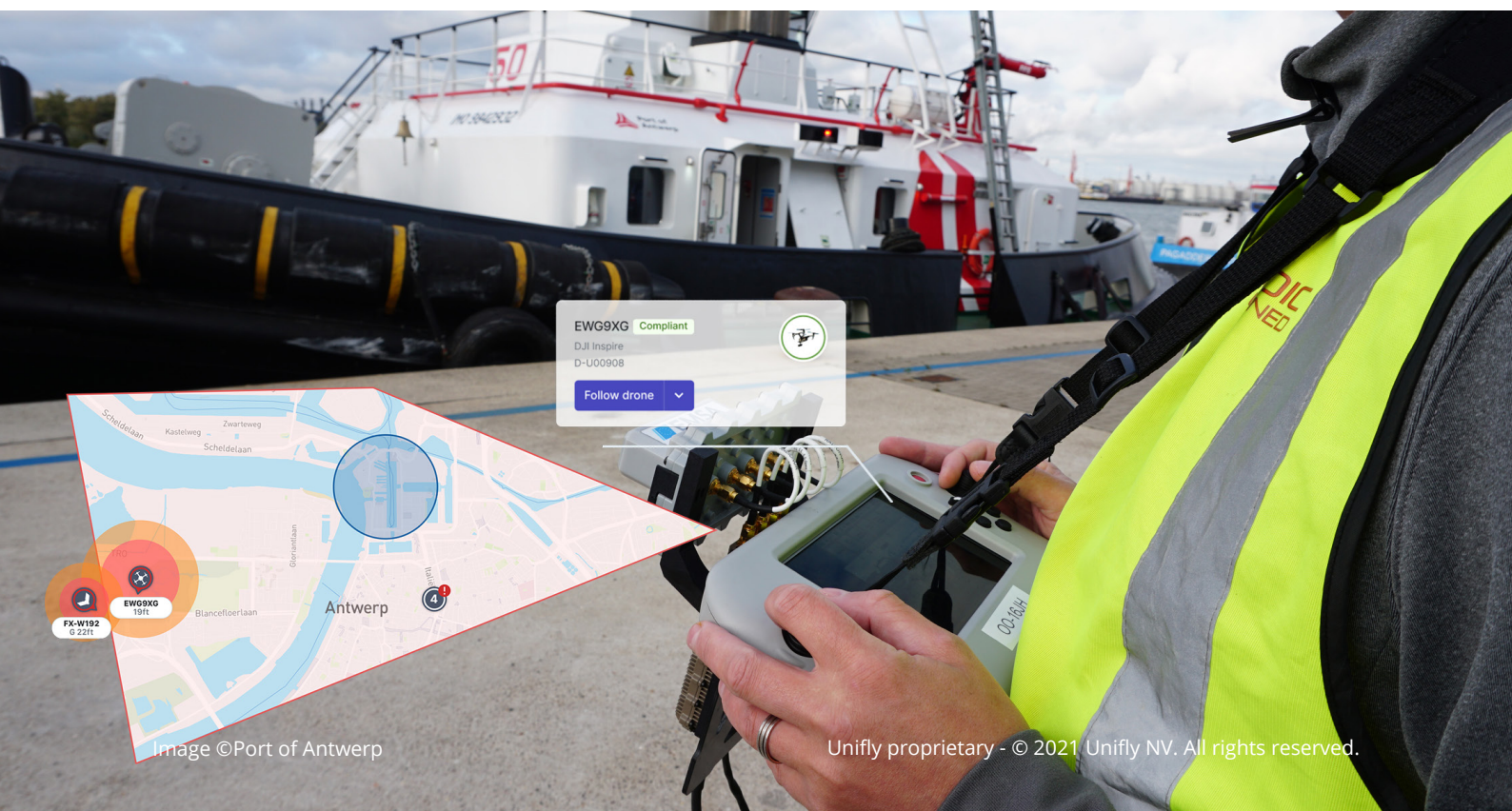
"Human error accounts for 75% of marine liability losses."
– Maritime Journal[34]

6. **Conclusion**

This whitepaper emphasises a real need to start the drone deployment journey by implementing technology and specifically, a UTM system to integrate drones safely and efficiently into the port environment.

There are several benefits in the areas of environment, safety, protection and infrastructure that support broadening the scope of operational drones in the port.

Managing a port ecosystem in a holistic and safety-centric manner certainly includes its airspace. UTM technology should integrate easily with existing systems and support a safe and frictionless integration of drones into port airspace.

A port's willingness to deploy UTM is its first and big step in demonstrating a commitment to being future-ready as well as prepared for increased trade volumes, enhanced facilities support and new business avenues.

In a nutshell, UTM creates new port offerings and attracts new segments of users.

The UTM technology by Unifly is designed to be interoperable, robust and scalable to enable the Port Authority in assuming all roles necessary to support or offer drone solutions.

In addition, there are bigger benefits at play. Ports are ideal as as proof of concept for testing and progressing implementation relating to autonomous technology in cities. Data compiled from ports adopting UTM technology can be used as in-roads into:

- **smart ports**: where technology such as UTM enables seamless and integrated connectivity, while automation amps up productivity without sacrificing safety and accuracy

- **smart cities**: a port models after a busy city, complete with amenities and administration such as marine police, but minus the risk of involving human inhabitants

- **smart logistics**: insights gleaned from ports can lend to advancements in transportation, traffic flow, fleet management and schedulings with fewer disruptions and delays

- **new means of delivery**: ports are in a ripe position to test better ways of moving people and parcels, as well as bulk and raw aggregates. With cities and roads getting more congested now, solutions from last mile delivery to end-to-end transportation will be very welcomed

With the help of UTM technology, managing the entire port ecosystem efficiently and safely, including the deployment of drones in its environment, shows a port's intention to advance overall performance and bolster market position.

7. Meet Unifly

Unifly is the global leader in Unmanned Traffic Management, or UTM. The drone services market is rapidly growing as new commercial use cases are discovered and established. This will change how many industries, including ports, operate and evolve.

As drone traffic increases, so do concerns regarding safety, privacy, and security. To mitigate these risk factors and allow the drone industry to flourish, the ability to monitor and manage all drone traffic is of the highest priority. Inadequate regulation or procedures may cause even the smallest drone to have a major impact on a large group of people, including bystanders and those in manned aviation.

Communication and responsive data exchange are crucial. Unifly's UTM technology connects national and local authorities, such as ports, to drone operators and pilots. This way we provide a seamless and secure way of facilitating drones and other aircraft to co-exist in the airspace. Our solutions are created through tried-and-tested means with clients, and real-life experience and learnings via large-scale rollouts in multiple continents.

As we have designed our UTM platform to be modular, scalable and future-proof, we've been able to cater to a wide variety of clients and their requirements. As UTM continues to evolve with advancements in the drone industry, Unifly remains at the forefront of technological development with our deployments worldwide.

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