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UK drone regulations and net risk

Balancing risk to unlock growth and save lives in the UK

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Balancing risk to unlock growth and save lives

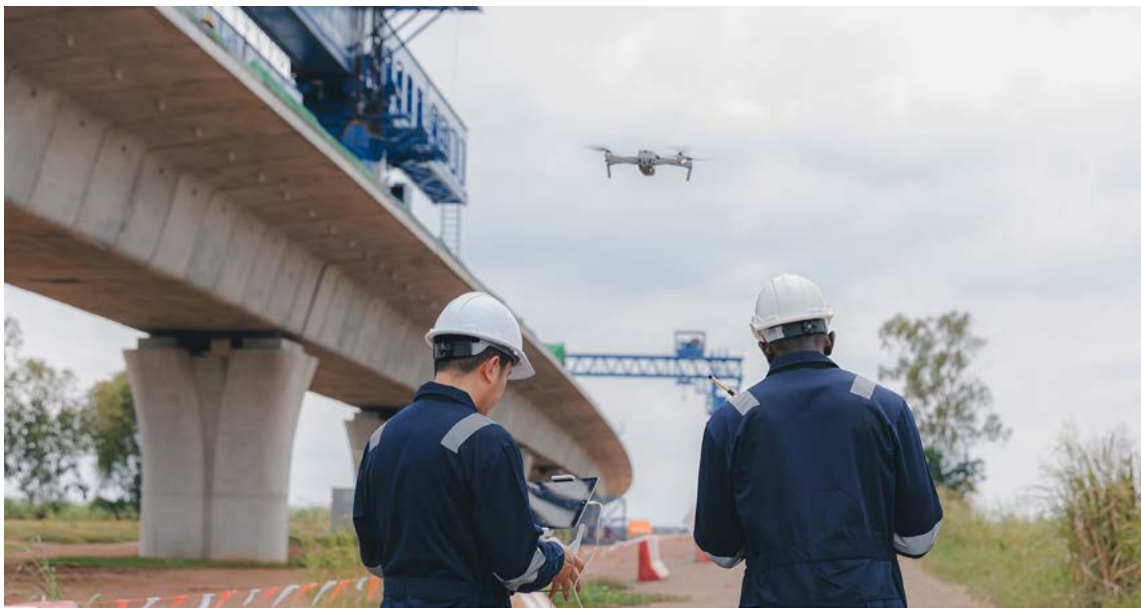
Our 2024 paper, Skies Without Limits v3.0[1] (SWL3), offered an insight into the progress (or otherwise) of the UK drone industry from 2021 to 2024. One of the themes that emerged was that the UK regulator is significantly more risk-averse and less prescriptive than Comparable Countries[2] such as the USA. Several pioneering drone entities in SWL3 noted that this risk-averse mindset and "tell us what you want to do and we'll tell you whether it's ok" approach to non-standard permissions such as Beyond Visual Line of Sight (BVLOS) was stifling growth. Some mentioned that this was diverting investment from the UK to elsewhere.[3]

This suggested that a different view of drone risk and more permissive (allowing more BVLOS operations), prescriptive (providing clear, repeatable pathways to approval) regulation could unlock productivity and growth, save lives and deliver environmental benefits that are not realised with the existing mindset. By weighing drone risk against the wider socioeconomic risks of traditional activities that drones can replace, it becomes clear that the traditional methods carry more risk overall and that drones remove risk. We refer to this alternative as a "net risk" approach. It challenges the idea that a "zero risk"[4] approach to aviation safety must be pursued in isolation of wider societal impacts.

This paper considers the risk perspective of specialist drone insurers in Comparable Countries who offer real-world insight because they have skin in the game. It analyses commercial drone incident reports from 2022-2024 in the UK and Comparable Countries. It concludes that drone risk is intrinsically low and that there is no evidence the UK's complex and cautious regulatory stance has delivered safer skies than found in Comparable Countries. There is, however, clear evidence that it has delayed progress. The case for change is strong.

Another theme across SWL3 and **Building Trust in Commercial Drones**[5] (BTiCD) was the need for the UK regulator to pick winners – compelling use cases where its limited capacity should be focussed, rather than trying to serve every operator equally. One respondent to BTiCD described the UK's current strategy as "a rising tide lifts all boats" and this paper argues instead for targeted, prioritised change. It picks winning use cases based on benefit, aviation risk, regulatory complexity and end-client demand. These winners should get clear, prescriptive regulatory treatment (e.g. digital Pre-Defined Risk Assessments – PDRAs) that make requirements crystal clear and the application process cost-effective, simple and efficient to enable scaling and maximise growth in the UK.

1. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf
2. Comparable Countries – USA, Europe (we are aware that this is not a country and are referring to European Union Aviation Safety Agency (EASA) covered countries), Singapore, Canada
3. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=45
4. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=47
5. https://www.pwc.co.uk/intelligent-digital/drones/building-trust-commercial-drones.pdf



The suggestions in this paper align with the UK Government's 10-year Modern Industrial Strategy, specifically its priority to strengthen the UK's global leadership in technology and innovation. By adopting a net risk approach and focusing regulatory effort on high-benefit drone use cases, the UK could directly support Industrial Strategy goals of raising productivity, accelerating technology adoption and driving export growth. This approach is also consistent with recent activity from the Regulatory Innovation Office, which has highlighted drones as a target area for red tape reduction.[6] The RIO's 2025 plan calls for smarter regulation to unlock scale and accelerate adoption across high-impact technologies, including uncrewed flight.

This paper comprises three parts and two appendices:

Part 1 sets the foundation. It uses evidence from insurers in the UK and Comparable Countries to show that drone operations carry extremely low absolute risk. It then contrasts this with the higher and better-understood risks of the tasks drones are replacing. The implication is clear – drones do not introduce risk, they remove it.

Part 2 introduces the concept of "picking winners." Unlike the UK's current approach, which tries to serve all use cases equally, we propose focusing regulatory effort where the benefit is highest and the change can realistically be delivered.

BVLOS use cases are assessed based on:

01	02	03	04
Tangible benefits including Net Risk	Relatively low aviation risk	Minimal regulatory complexity to implement	Clear end client "pull"

6. https://www.gov.uk/government/news/game-changing-tech-to-reach-the-public-faster-as-dedicated-new-unit-launched-to-curb-red-tape

Five use cases "winners" are identified:

- Emergency response
- Powerline inspection
- Maritime and coastal search and rescue
- Rail inspection
- Crop spraying and seeding

Part 3 sets out how to make this happen. It recommends a shift away from bespoke, case by case assessments towards clear, prescriptive regulatory tools – such as digital PDRAs – that make the process faster, more transparent and repeatable. The goal is simple: unlock the value and growth potential of drones by increasing clarity, removing friction and focusing effort.

Appendix 1 contrasts the differing regulatory approach in the USA, Europe, Canada and Singapore. **Appendix 2** analyses commercial drone safety incidents across the UK, USA, Europe, Canada and Singapore from 2022 to 2024.

The paper concludes that a prescriptive approach which is grounded in evidence, focused on high-impact use cases and supported by streamlined regulation will maximise the benefits of drones for the UK. This means moving beyond "zero risk" thinking, backing winners and giving industry a predictable, scalable route to BVLOS operations. The prize is significant: lives saved, safer jobs, reduced emissions, a more competitive drone sector and economic growth. The question is no longer if drones can deliver net benefit; it is whether the UK will unlock it fast enough.

Drone risk evidence from insurers and “current” task risks

Introduction

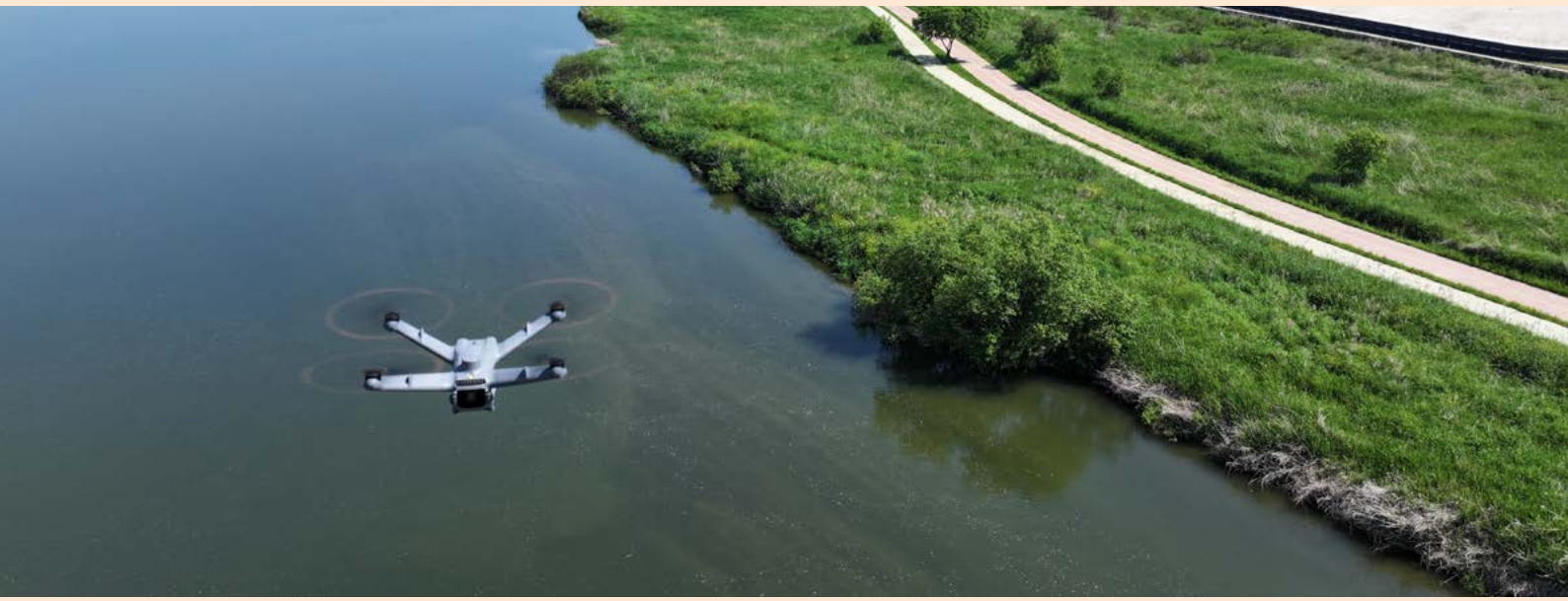
This section uses evidence from insurers to emphasise the low absolute risk of commercial drones, allowing us to contrast this with the (relatively) higher risk associated with the tasks drones can replace. It explores whether different regulatory regimes, in countries other than the UK, result in materially different drone risk profiles.

Our rationale for seeking insurers' views of drone risk was threefold. First, insurers have to put their money where their mouth is – their view of drone risk is based on real-world exposure in a competitive market, not theory. Second, many insurers operate across multiple countries. Finally, drone incident reporting varies considerably between countries, as you can see in Appendix 2. Overall, the deep dive comparison of incident reporting in this appendix supports the assertion that drones have low absolute risk across Comparable Countries,[7] but the data is inconsistent. The insurer view somewhat compensates for these inconsistencies.

The insurer perspective, then, gives us a way to understand how risk varies internationally and to assess whether the UK's "zero risk,"[8] less-prescriptive approach has in fact delivered safer skies than in Comparable Countries.

With the overall risk profile of international drone operations established, we explore whether the predominantly Visual Line of Sight (VLOS) risk profile is also likely to apply to Beyond Visual Line of Sight (BVLOS) operations.

We examine risk proxies for activities that drones could replace. A handful of examples are provided to highlight the scale of risk reduction that drones offer. These are grouped into non-emergency and emergency services.



7. USA, Europe (we are aware that this is not a country and are referring to EASA-covered countries), Singapore, Canada
8. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=47

Insurers' views on commercial drone risk

We consulted drone insurers because they have skin in the game. Their perspective on risk is grounded in real-world claims data and underwriting experience across diverse operations. They often operate globally, offering insights into drone risk across various international regulatory regimes.

The consensus is clear: drones have an extremely low risk profile based on claims data. Early apprehensions about drones causing significant damage or injuries have not materialised.

Trehane Oliver of McLarens Aviation:

> The concern from insurers at the beginning was around the liability exposure: UAVs coming down on houses or people or busy road intersections. But in our experience, there are very few claims that result in significant liability." Another adjuster added, "We haven't had any claims where a person was injured in a drone incident."[9]

Simon Ritterband, Founder and Managing Director of Moonrock Drone Insurance, a Managing General Agent (MGA)[10] commenting for this paper:

> In the 10 years that Moonrock have been writing drone insurance policies, it's clear from the data, that the anticipated frequency of 'major' drone claims has not been observed in practice."

In fact, the insurers consider that drone risk has markedly reduced over the past decade. Improvements in technology and pilot training have been a major factor in risk reduction. Fewer "Fred in a shed" operators is also a factor; risk has been lowered by the consolidation of the drone service provider industry and/ or end-clients in large corporates building, rather than buying, drone solutions.

9. https://www.insurancebusinessmag.com/ca/news/life-insurance/risks-to-be-wary-of-as-the-global-drone-market-takes-off-415617.aspx (2022)
10. Moonrock are one of the UK's largest and fastest growing underwriting specialists focused exclusively on drone/eVTOL insurance

Moonrock:

> The lower loss ratio seen in the past few years isn't because of regulation, it's down to new technology and enhanced training."
>
> We're not insuring so many individuals anymore. Instead, clients tend to be bigger businesses such as an entire surveying company. These companies are not bringing in a one-man band for the day – they have their own drone fleets and pilots."

Moonrock noted that the sector has seen **"very few notable third-party liability claims"** since commercial drone insurance launched. They attributed this to the factors above, rather than regulatory approach.

Coverdrone is another UK-based specialist drone MGA. Their multi-year claims data reinforces the same story. Across three years of portfolio-wide data there is no record of a bodily-injury or fatal-accident payout, underscoring the very low absolute risk of commercial drone operations.[11] [12] [13] Most claims relate to pilot error and are small and swiftly settled. Coverdrone notes its fastest payout at two hours from notification to cash transferred and a typical turnaround inside 24 hours.[14] Such speed is possible only when losses are minor property or equipment damage, not serious third-party harm. From their user survey, the majority of Coverdrone's clients are the UK (54%) but there is also a significant proportion in Europe (40%).[15]

We also contacted Global Aerospace, one of the world's largest aviation underwriters for this paper. They echoed many of the sentiments above:

> Drone operations have become safer over time, largely because of increased awareness of loss potential and training."[16]

If we look to the future of drone operations, we arrive at an important question: is it likely that the low-risk profile seen in VLOS operations will also hold for BVLOS? When we asked the insurers whether they thought VLOS risk could realistically read across to BVLOS risk, both Moonrock and Global Aerospace indicated that well-managed BVLOS operations do not appear materially riskier than VLOS. Moonrock noted that **"the risk from BVLOS doesn't appear to be significantly higher in practice"** where appropriate risk mitigations are in place. Global Aerospace framed BVLOS as **"an operational detail, not a game-changer from a risk perspective,"** emphasising that factors such as location and safety management were far more predictive of risk than visual contact with the drone.

11. https://www.coverdrone.com/an-insight-into-coverdrones-2024-claims
12. https://www.coverdrone.com/an-insight-into-coverdrones-2023-claims
13. https://www.coverdrone.com/an-insight-into-coverdrones-2022-claims
14. https://www.coverdrone.com/an-in-depth-look-at-the-coverdrone-claims-department
15. https://www.coverdrone.com/drone-user-study-2024-overview/
16. Global Aerospace noted that "human factors like complacency, fatigue, and excessive dependence on technology – known to impact manned aircraft safety – also play a significant role in unmanned aircraft system (UAS) accidents."

Moonrock:

> The main operational risks are from lapses in concentration rather than anything else. These claims tend to happen "closer to home," i.e. when the pilot is in the final stretch of the operation, such as landing the drone. Therefore, conversely, operators are likely to be more attentive during BVLOS operations, with the main risks still coming from the part of the operation "closer to home."

Data from other sources corroborates this insurer view. For example

- DJI claimed there were over 10 million drone flight hours in the U.S. without a single fatality.[17]
- ARPAS-UK summarised a DCRO (Dutch Association of Certified RPAS Operators) study encompassing 1.4 million professional flight hours where only one fly-away event was recorded, suggesting that European regulators may have overestimated such risks by about 100x (two orders of magnitude).[18]
- Wing, Google's drone delivery company, completed over 300,000 deliveries across Australia, including tens of thousands of BVLOS flights over urban areas such as Canberra and Logan. While Wing faced significant community resistance in Canberra over noise and privacy during early trials[19] (as we reported in SWL3[20]), its broader safety record remained strong, with no injuries or serious incidents recorded by regulators. This reinforces the view that well-managed drone operations, even in populated environments, carry low intrinsic risks
- Regulator investigations into commercial drone safety incidents in the UK and Comparable Countries paints a similar picture, refer to the "Drones Remove Much More Risk than They Introduce" section below and to Appendix 1 & 2.

In conclusion, drones have an exceptionally low incident rate and, although this is largely based on VLOS flights, in the view of some insurers it likely holds for BVLOS too.

You're more likely to be killed by lightning than a commercial drone!

These figures highlight how rare drone-related fatalities are. With roughly 22 million commercial drone flights in the US last year, there were zero recorded fatalities. In contrast, lightning kills 20-30 people in the US each year (1 in 10 million per person-year).[21]

17. https://viewpoints.dji.com/blog/you-already-knew-drones-are-safe.-heres-more-proof-by-the-numbers (2020)
18. https://www.arpas.uk/dcro-white-paper-on-the-probability-of-a-uas-flyaway (2025)
19. https://royalsocietypublishing.org/doi/10.1098/rsta.2024.0107 (2024)
20. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=22
21. Different denominators: lightning is a per person-year risk and the drone figure is per flight (see Appendix 1 for our conservative calculation of 22 million commercial drone flights per year in the USA). Accordingly, we are not comparing rates directly – the comparison is to put drone-related fatalities in context against something widely regarded as unlikely (lightning strikes).

Has the UK's "zero risk" approach delivered safer skies (or just lower growth?)

The UK has a low drone incident rate. But so does the rest of the world. What does this tell us about the UK's regulatory approach?

The UK's approach to drone regulations has been described as "zero risk," refer to SWL3.[22] It emphasises strict rules aimed at eliminating aviation risk entirely and combines this with a non-prescriptive framework. Rather than providing clear steps for operators to follow for recurring non-standard permissions, the CAA typically asks operators: "tell us what you want to do and we'll tell you whether it's ok." This creates uncertainty for BVLOS operations. This was certainly the case when Operating Safety Cases (OSCs) were required for non-standard scenarios. In March 2025, the UK introduced a Specific Operations Risk Assessment (SORA) methodology. This makes risk quantification more prescriptive (albeit complex) but mitigations and Acceptable Means of Compliance (AMC) remain qualitative and subject to case-by-case review without clear published requirements. In addition, SORA approvals for non-standard scenarios are usually restricted spatially and temporally. SORA applications are also very expensive, refer to Part 3.

This conservative approach was designed to reassure the public and prevent worst-case scenarios. And it delivered: in late 2024 and early 2025 the AAIB reviewed numerous drone incidents but initiated no full investigations into serious accidents or collisions,[23] and we found the same pattern in our detailed analysis of 2022-2024 incidents in Appendix 2. However, this raises an important point: has the UK's cautious, zero-risk stance delivered safer skies compared to more enabling regimes abroad? The evidence suggests not. In the round, Comparable Countries with more prescriptive and permissive drone regulations and higher numbers of BVLOS flights have achieved similarly strong safety records. The insurers we consulted were unanimous that drone risk remains consistently low and similar between the UK and Comparable Countries despite varying regulatory approaches.

Moonrock underwrites complex drone operations in the UK and internationally using the same criteria, and stated:

> "From our experience across global markets, the risk profile of drones remains low regardless of the regulatory environment."

This suggests that, in practice, cautious and non-prescriptive frameworks do not deliver materially better outcomes.

The primary factors in assessing risk are operational context and exposure, not national regulatory approach, at least for Comparable Countries.

22. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=47 (2024)
23. https://www.gov.uk/aaib-reports/aaib-annual-safety-review-2024

Moonrock again:

> Insurance criteria are the same regardless of territory, with a few exceptions. As an example, we rate liability risk in the USA differently, due to the highly litigious culture of liability claims in the USA. Generally speaking though, our underwriting guidelines are similar across the board regardless of country."

Global Aerospace:

> Regulations may help to lower crash rates, but the most critical factors remain the methods of operation and the competency of the operators themselves."

Clearly, the UK's cautious regulatory environment is not uniquely safer than the, arguably, more permissive and prescriptive approaches seen internationally. In attempting to minimise aviation risk, has the UK stifled its drone growth? Consider this 2024 quote from Cyberhawk in SWL3:

> The ability to scale in the US with BVLOS and automation and difficulties in obtaining permissions in the UK that support growth has led to the majority of our investment being driven outside of the UK. The CAA has been far too slow to look at what they can do to influence market growth now and sadly they are inhibiting the industry and investment."[24]

This difference in regulatory mindset helps explain why the more prescriptive, permissive frameworks used elsewhere may enable progress without undermining safety.

Drones, then, have proven to be a very low-risk technology, regardless of regulatory approach. There is no evidence the UK's "zero risk" model delivers safer skies than alternatives. Safety levels are consistently high in countries with more prescriptive and permissive drone regulation.

That alone makes the case for change. But there's more. Drones don't just carry less risk, they remove it from the system. They take people out of dangerous environments and cut the exposure hours that drive accidents. If the low intrinsic risk of drones doesn't justify a more enabling mindset, the net risk case does. The next section shows how drone adoption transforms risk profiles in real-world operations.

24. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=45 (2024)

Drones remove much more risk than they Introduce

Commercial drones reduce overall risk. They protect workers by taking over tasks traditionally done at height, in confined spaces or from low-flying helicopters. These activities have historically caused high numbers of injuries and fatalities, for example, in 2023-24 falls from height[25] were the leading cause of work-related deaths in the UK, killing 50 people a year, and accounting for over a third of all workplace fatalities. Above and in Appendix 2, we establish that commercial drones themselves have very low risk profiles in Comparable Countries. As you can see in Appendix 2, from 2022 to 2024, there are only a handful of incidents that could be considered serious in Comparable Countries and there are zero fatalities. By directly replacing dangerous tasks, drones actively lower the risk that workers face every day.

Safety experts and insurers confirm drones reduce risk rather than increase it. The reasoning is simple: drones remove the need for humans to be physically present in hazardous scenarios. Dramatically cutting exposure time. Exposure duration is a core metric in safety management: the fewer hours people spend in hazardous environments, the lower their risk.

Over the next two sections, we first look at the overall risk reduction associated with VLOS use cases for commercial and then emergency services applications. We then discuss how BVLOS operations can deliver similar or even greater risk reductions. This lays the foundation for a net risk approach that supports more permissive and prescriptive regulation in the UK to reduce overall risk for the UK workforce and save lives.

25. https://worknest.com/blog/workplace-fatalities-6-key-takeaways-from-the-hses-2023-24-statistics (2024)

VLOS use cases: Traditional vs drone methods

1. Commercial drones

Drones save time

Drones often complete tasks faster than traditional methods. Reduced task time means reduced exposure to risk. A wide range of industry case studies show the scale of the improvement:

Land survey

10-20
minutes to measure a stockpile using drones, compared to at least
1/2
a day using alternative methods. Overall reduction of
800
"working at risk days" per year[26]

Building and roof inspections

Drone use at St Luke's Church cut inspection time by
88
days completing the job in just
3.5
days a
96%
reduction[27]

Oil and gas internal inspection

Inspecting a condenser using traditional methods took
8
days of confined entry. Using drones, this took just
8
hours a
92%
reduction[28]

26. https://www.heliguy.com/blogs/posts/bbv-using-mavic-3-enterprise-on-hs2
27. https://www.arpas.uk/drones-in-action-inspection-work-at-st-lukes-church-reduced-by-over-88-days/
28. https://www.flyability.com/casestudies/condenser-inspection

Lee Johnson, Senior Survey Manager at Balfour Beatty VINCI, referencing this HS2 project:

> Drones allow us to cover large areas very efficiently and we can survey far more safely from a remote position, removing people from potentially dangerous areas."

The time savings – and associated risk reduction – can often be multiplied by the reduction in crew size associated with drones replacing traditional approaches. Inspection teams often include four or five people. Drone jobs typically use one pilot and, sometimes, one observer. For example, if an inspection takes 1 drone pilot 1 day but, using a traditional approach, would have taken a 4-person crew 5 days, the exposure reduction is 95%[29] (vs 80% if drone and traditional crew sizes were the same).

Using drones often means fewer trips to site. This represents a significant risk reduction as driving to site is usually one of the riskier activities on a drone RAMS (Risk Assessment and Method Statement).

These examples show how drones cut task duration, exposure time, team size and trips to site. This means fewer people at risk for less time in more controlled conditions.

29. 4-person crew × 5 days = 20 person-days vs 1 pilot × 1 day = 1 person-day; exposure reduction = (20 − 1) ÷ 20 = 95%

2. Emergency services: VLOS drones saving lives and reducing risks

Drones cut emergency response times and reduce risk to frontline teams. Used under VLOS, they give fast aerial views, locate casualties quickly and may reduce the entries into dangerous buildings or areas. Across the UK, emergency services report fewer high-risk hours and safer operations when drones are on the case. In certain scenarios, drones can also achieve a positive outcome where traditional methods have fallen short. Examples:

Search and Rescue (SAR)

In Nottinghamshire, police drones found

19

missing vulnerable people, found criminal suspects at

55

incidents and located

6

missing vehicles in 2024. This eliminated the need for hundreds of hours of risky foot searches.[30]

Search and Rescue (SAR)

Glencoe Mountain Rescue team's remarkable use of drones and AI to find a target in less than

1day

after 10 unsuccessful days of full-scale search using traditional approaches.[31]

Multiple use cases

Lincolnshire Police stated that their drones had been successfully deployed more than

1,300

times in 2025, examples included.[32]

- **294** searches for missing people
- **314** searches for suspects
- **138** live downlinks provided for operational commanders
- **81** firearms deployments supported
- **67** cannabis farms disrupted
- **46** events and operations
- **24** serious or fatal collision scenes
- **22** internal searches of buildings before officers entered

30. https://www.nottinghamshire.police.uk/news/nottinghamshire/news/news/2025/january/police-drones-save-lives-and-snare-criminals-during-demanding-2024/
31. https://www.mountain.rescue.org.uk/news/new-lake-district-drone-technology-assists-with-a-difficult-find-in-the-scottish-highlands/
32. https://www.hellolincoln.co.uk/index.php/categories/sport/drones-vital-role-in-policing

Chief Drone Pilot (Nottinghamshire Police), Sergeant Vince Saunders:

> Drones are now an indispensable part of policing operations around the world and are an excellent addition to traditional aerial policing options delivered by helicopter and fixed wing aircraft.
>
> They provide a readily available and cost-effective option for officers who need an additional eye in the sky to help them protect and serve the public.
>
> Whether that's locating missing or otherwise vulnerable people, tracking offenders or simply providing an aerial view of an evolving situation, their usefulness is increasing all the time which is why we had more calls for service in 2024 than ever before."

Richard Warren of the Lake District Search and Mountain Rescue Association

> [after] a herculean effort, involving multiple MRTs [Mountain Rescue Teams], Coastguard helicopters, RAF MRTs, search dogs, drones and police cell-data analysis. In spite of the exhaustive efforts from all involved, and some encouraging signs, such as the finding of the missing person's rucksack, Glencoe MRT made the difficult decision to scale back their operations after 10 days of effort… The area of the find in question [by the drone] had been searched by ground teams, at least twice, all passing within 50m of the body. It had also been overflown with helicopters and dogs had searched nearby. The complexity of the ground meant that despite these efforts, the body remained hidden."

Risk reduction: Time as a proxy and other metrics

Exposure hours are commonly used as a primary metric for assessing risk in industries that use Commercial Drones. Fatal accident rate (FAR) and other safety measures are typically calculated per million hours worked. A 90% reduction in task duration, as drones commonly achieve, represents at least a 90% reduction in the likelihood of accidents.

Further, drones don't just reduce exposure time; they shift exposure from physically hazardous work (such as climbing, confined entry or traffic exposure) to safer tasks like drone operation from stable ground locations. Commercial metrics might include:

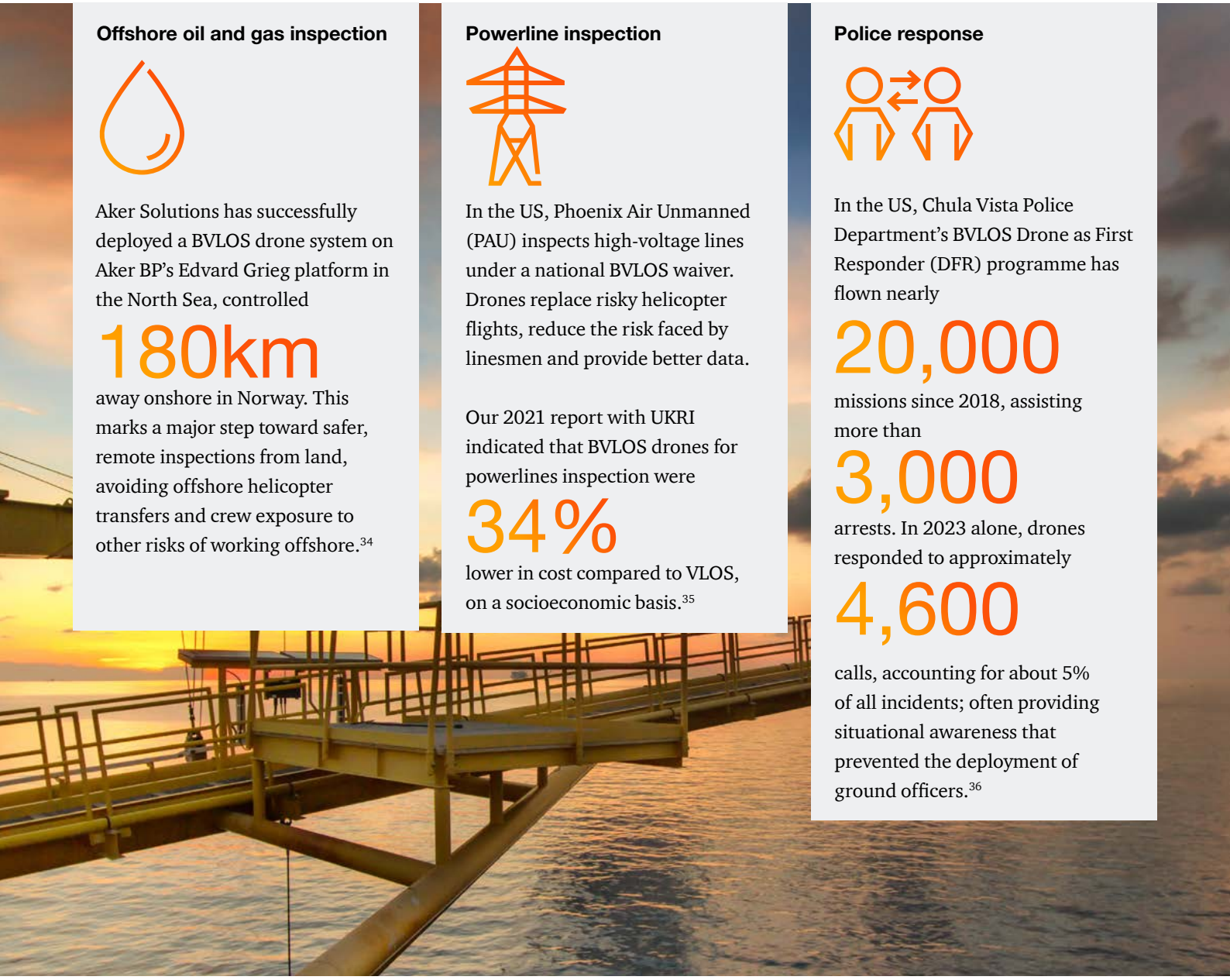
- Hours of working at height avoided
- Confined-space entries eliminated
- High-risk permits no longer required

It's a similar picture for the Emergency Services. Drones shift risk away from frontline responders and create safer conditions for emergency responders. The aerial intelligence from drones may also reduce or eliminate trips to site. Drones may increase success rates. Emergency Services metrics might include

- High-risk entries avoided
- Faster response times
- Fewer emergency vehicle miles and road incidents
- Higher success rate in SAR missions

BVLOS use cases: Further risk reduction for commercial and emergency services

BVLOS operations unlock further risk reduction. Indications are that insurers don't perceive a meaningful increase in drone risk when shifting from VLOS to BVLOS, making the "net risk" case even stronger. BVLOS enables new use cases and improves existing use cases by further cutting trips to site, reducing time on task and removing people from hazardous locations.[33] Examples:



Offshore oil and gas inspection

Aker Solutions has successfully deployed a BVLOS drone system on Aker BP's Edvard Grieg platform in the North Sea, controlled

180km

away onshore in Norway. This marks a major step toward safer, remote inspections from land, avoiding offshore helicopter transfers and crew exposure to other risks of working offshore.[34]

Powerline inspection

In the US, Phoenix Air Unmanned (PAU) inspects high-voltage lines under a national BVLOS waiver. Drones replace risky helicopter flights, reduce the risk faced by linesmen and provide better data.

Our 2021 report with UKRI indicated that BVLOS drones for powerlines inspection were

34%

lower in cost compared to VLOS, on a socioeconomic basis.[35]

Police response

In the US, Chula Vista Police Department's BVLOS Drone as First Responder (DFR) programme has flown nearly

20,000

missions since 2018, assisting more than

3,000

arrests. In 2023 alone, drones responded to approximately

4,600

calls, accounting for about 5% of all incidents; often providing situational awareness that prevented the deployment of ground officers.[36]

33. This is not to downplay the technical or regulatory complexity of BVLOS flight. These statements assume that operators follow appropriate procedures and implement reasonable mitigations to ensure acceptable levels of aviation risk (as in Comparable Countries and a limited number of UK examples)
34. https://www.offshore-energy.biz/drone-ops-edging-north-sea-oil-platform-closer-to-autonomous-offshore-inspections
35. https://www.ukri.org/wp-content/uploads/2022/01/UKRI-140122-ISCFFutureFlightChallenge-Socio-economicStudyFull.pdf
36. https://www.govtech.com/biz/data/drone-cops-the-future-of-policing-american-cities

Joachim Hovland, Head of Drones and Robotics, AkerBP:

> We estimate that autonomous drones can reduce inspection costs by up to 70% and deliver detailed insights within hours — a process that traditionally takes days with manual drone operations”

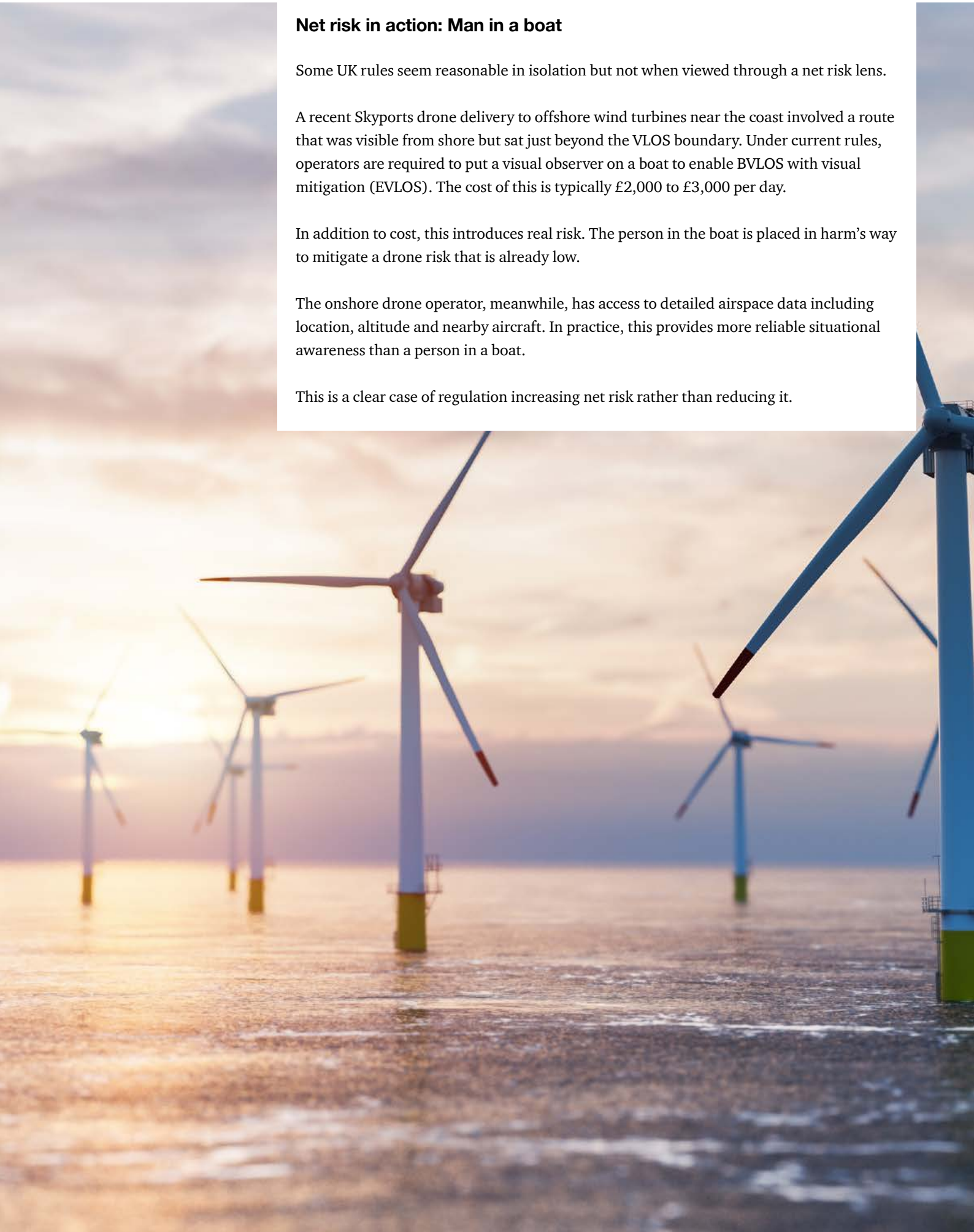
William Lovett, Managing Director, PAU

> PAU is thrilled to now offer scalable BVLOS UAS inspection services to utilities nationwide. Our past performance and commitment to aviation safety has led to this complex authorization. We have flown over 13,000 miles of inspections for Xcel Energy under FAA BVLOS”

Chula Vista Sgt. Anthony Molina

> When we first started, officers were sceptical. They used to kind of joke around…Now, if drone-as-first-responder (DFR) is ever not operating at a specific time, you hear the grumbles of the officers not having it available, because there’s so much more information that we didn’t have in the past. It puts officers at ease.”

These examples show that BVLOS operations don’t just match the safety gains of VLOS. They extend them by removing even more risk across harder to reach and higher stakes environments.



Net risk in action: Man in a boat

Some UK rules seem reasonable in isolation but not when viewed through a net risk lens.

A recent Skyports drone delivery to offshore wind turbines near the coast involved a route that was visible from shore but sat just beyond the VLOS boundary. Under current rules, operators are required to put a visual observer on a boat to enable BVLOS with visual mitigation (EVLOS). The cost of this is typically £2,000 to £3,000 per day.

In addition to cost, this introduces real risk. The person in the boat is placed in harm's way to mitigate a drone risk that is already low.

The onshore drone operator, meanwhile, has access to detailed airspace data including location, altitude and nearby aircraft. In practice, this provides more reliable situational awareness than a person in a boat.

This is a clear case of regulation increasing net risk rather than reducing it.

Socioeconomic benefits and net risk implications

The evidence is consistent. Drones reduce risk across multiple sectors. They replace hazardous work with safer methods and take people out of high-risk environments.

Drones improve workplace safety by, for example

- Removing the need for work at height and confined-space entry
- Reducing the number of people involved in hazardous tasks
- Shortening exposure times dramatically, including reducing crew size
- Minimising trips to site

They may also deliver other socioeconomic benefits such as reducing maintenance costs (through better inspection data) or saving lives by increasing the odds of a successful SAR outcome. On the drone-risk side of the equation, evidence from insurers indicates that drones have a low intrinsic risk and that the VLOS risk profile is also likely to apply to BVLOS operations.

Replacing traditional methods with drone operations then, will reduce overall harm; drones remove more risk than they introduce. There is a strong socioeconomic case for regulatory reform that enables safe adoption at scale and delivers better outcomes for people, the environment and the economy. We explore some options on how to achieve this in Part 2.

Five high-benefit, low-risk BVLOS use cases

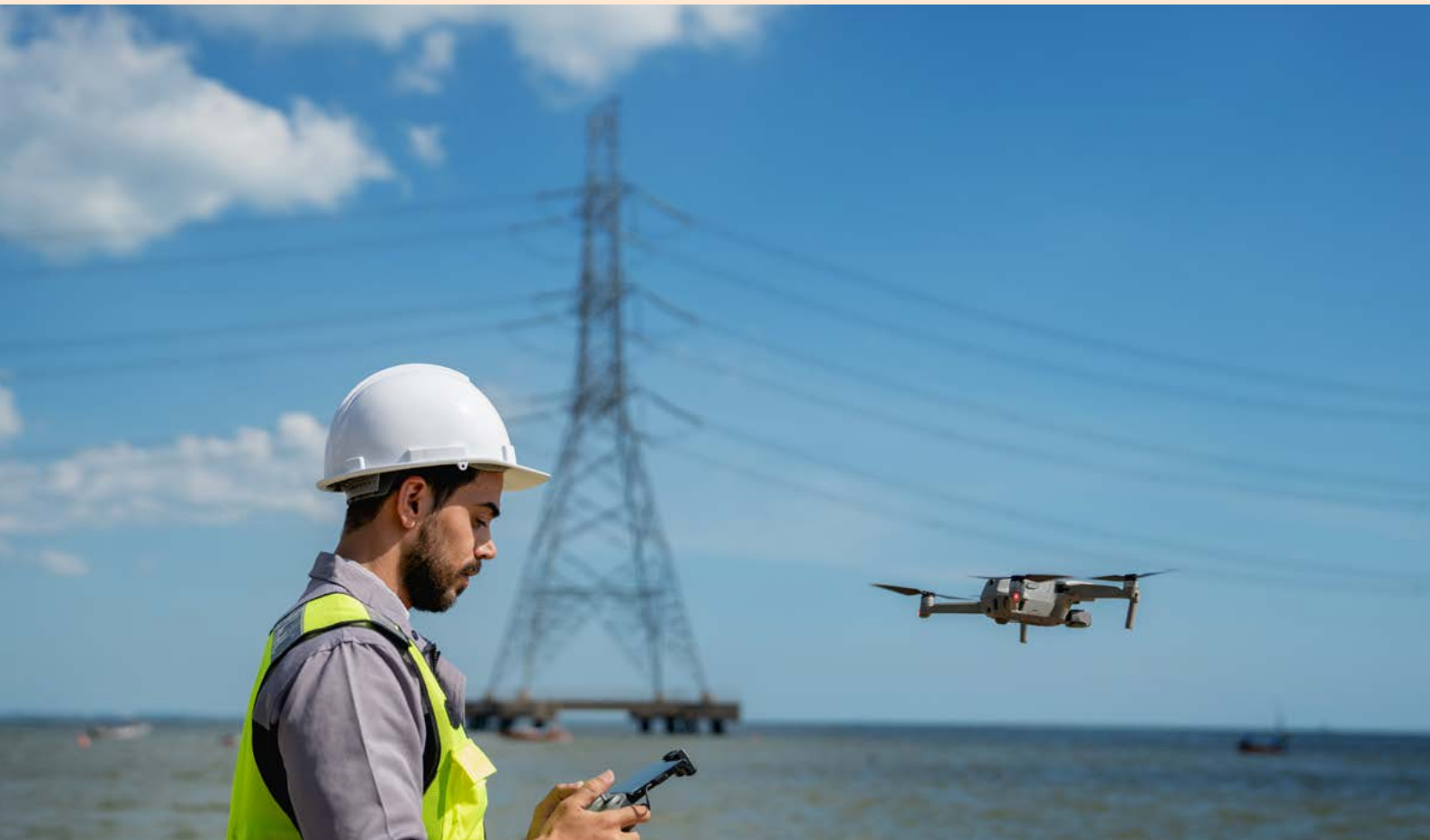
Introduction

We've established that drones carry low intrinsic risk and that, in most cases, they are safer than the traditional methods they replace. That opens the door for regulators to take a more holistic view. We're not suggesting that drone risk should not be managed. Rather, that the window of acceptable drone risk should be seen in the context of overall societal risk.

If regulation is to reflect this net risk logic, then we need to be clear about where to start. Not everything needs to be solved at once – instead of trying to build a system that works for every drone and every use case, we should focus on picking winners. That means identifying a small number of high-benefit, low-risk operations that are ready to scale now. These are the use cases where regulatory attention can deliver the fastest and most meaningful results. We suggest that such uses cases should meet four criteria:

- **Tangible benefits:** clear gains in safety (net risk), productivity, emissions, cost or service delivery (vs traditional methods)
- **Low aviation risk:** minimal exposure to people or crewed aircraft preferred, i.e. relatively low ground and air risk
- **Minimal regulatory complexity:** feasible to unlock using existing tools like PDRAs (leveraging experience of approving multiple OSCs) rather than requiring more substantive change
- **Clear end-customer pull:** strong demand from industry, public sector or communities for solutions that solve real problems

The next section sets out five use cases that meet these tests. They show where the UK can move fast and deliver results.



Picking winners that can deliver for the UK

We have identified five priority BVLOS drone use cases that meet the four criteria; tangible benefits, low aviation risk, minimal regulatory complexity and clear end-customer pull. They are:

- Emergency response
- Powerline inspection
- Maritime and coastal search and rescue
- Rail inspection
- Crop spraying and seeding

We discuss each use case in turn below. Note that references to PDRAs are illustrative only. While PDRAs may offer a path forward (see Part 3), they represent the broader need for prescriptive regulatory tools that define exactly what is required for safe and repeatable BVLOS flight. Such tools should provide operators with straightforward, repeatable pathways to approval, minimising friction, cost and enabling scalable operations. Note also that this is an indicative rather than definitive list; our aim is to illustrate the logical conclusion of a **net risk** and **picking winners** approach as "food for thought" for the regulator.

1. Emergency response

Tangible benefits

Emergency services include Fire Services, Police and Search and Rescue (SAR) teams. These are frontline responders who deal with life-threatening events. These could include house fires, road collisions and missing persons.

These jobs carry risk. Responders could face unsafe buildings, dangerous individuals and difficult terrain. As set out in Part 1, drones reduce that risk. They provide a rapid aerial view to enable faster, more informed decisions that keep crews out of danger.

Drones can also improve productivity. For example, Lincolnshire Police, who consider themselves to be one of the worst financed in the country, have saved hundreds of hours of police time per year, in addition to removing officers from the most dangerous situations.[37]

Sergeant Kevin Taylor:

> "There are people alive today who wouldn't be today without drones – and also people in prison who wouldn't be otherwise… Lincolnshire Police doesn't have enough staff, and drones provide the best bang for buck of anything we have. We're ahead of the game compared to many forces because it lets us be so cost-effective, and it also suits how rural Lincolnshire is."

BVLOS could take this further. Drones can be launched from a central control room or mobile command station to cover more ground faster. They offer early situational awareness before ground teams arrive. They are safer, cheaper and more flexible than helicopters, allowing for more frequent deployment. They may also limit high-speed driving and avoid unnecessary helicopter callouts, reducing road risk and minimising environmental impact. In SAR scenarios, there also are many examples of drones increasing the chance of a successful outcome (refer to Part 1), potentially saving lives.

Low aviation risk

Ground and air risk varies tremendously between emergency response scenarios. For example, there is a clear case for BVLOS SAR in rural locations, where population density and ground risk is low and air risk may also be. However, as the Chula Vista Police example in Part 1 illustrates, BVLOS Drones as First Responders can also operate safely in more congested urban areas. That said, we suggest that initial regulatory effort is directed towards more rural and/ or directly controlled settings. Regulations for more challenging airspace can follow.

37. https://www.lincsonline.co.uk/spalding/news/there-are-people-alive-today-who-wouldn-t-be-without-drones-9391432/

Minimal regulatory complexity

Emergency services used to operate under a standing exemption (ORS4 No. 1233 / General Exemption E4506), which allowed short-range BVLOS flights under emergency circumstances. That exemption has now lapsed, leaving teams reliant on full BVLOS approvals, which are slow, inconsistent and – on average – do not enable emergency response.

A dedicated BVLOS PDRA would solve this. It would define standard conditions for low-altitude, short-range flights over managed incident zones or in sparsely populated areas. We view this starting point as somewhat analogous to reinstating the previous standing exemption (E4506). PDRA S02 in the EU offers a reference, covering BVLOS in low-density areas with standard mitigations.

Clear end-customer pull

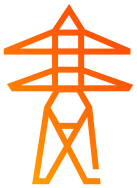
Emergency services are not asking for drone innovation trials. They want routine permissions to deploy drones where and when they need them. Emergency Service vehicles may operate under “blue light” rules, accepting higher risk because lives are on the line. Air ambulances (Helicopter Emergency Medical Services (HEMS)) follow a similar model. Emergency drones don’t yet have that option.[38]

There are many examples of end-customer pull in this area, including multiple trials. However, we think the most compelling is the British Transport Police (BTP) example. They found the process of obtaining routine BVLOS approval using the standard CAA route challenging and elected to fly routine BVLOS under State Aircraft rules instead. [39] [40]

Chief Constable Lucy D'Orsi

> “Our new 'drone in a box' capability is going to be transformational to our ability to reduce disruption across the rail network.”
>
> This is groundbreaking technology which will allow us to respond to trespass incidents quickly, saving the industry money, improving safety, and keeping the railway moving for passengers.
>
> It is a fantastic example of the advances we are making at BTP to shape the future of policing, and I’m excited to work with rail industry partners to expand this across the railway as we work together to keep the public safe and reduce disruption.”

38. https://www.thunderbirdproject.org.uk/lifesaving-beyond-sight
39. https://www.btp.police.uk/news/btp/news/england/btp-become-first-police-force-to-launch-remote-drone-in-a-box-capability
40. We have seen evidence of the state aircraft approach being taken in other countries such as Belgium e.g. https://press.skeyes.be/skeyes-and-skeydrone-support-the-deployment-of-drones-by-the-brussels-police-force . Our understanding is that the BTP used a SORA based model to understand and mitigate risk. Expanding the use of the State Aircraft approach is an alternative to an Emergency Services PDRA.



2. Powerline inspection

Tangible benefits

Helicopters are still the standard method for inspecting overhead powerlines. It's expensive, risky and carbon-heavy. Drones remove those risks. They inspect powerlines without putting crew in the air or workers on towers.

VLOS drones address many of these points but logistics, cost and safety performance increase dramatically when BVLOS drones are deployed. As mentioned in Part 1, our 2021 study with UKRI found that BVLOS drones were 34% cheaper than VLOS drones, on a socioeconomic cost basis.

BVLOS drone operations are faster and more flexible. They cover long distances without the need for road access or helicopter. In 2023, National Grid helicopter flights covered 32,000 miles of network, mainly for asset inspection.[41] This use of helicopters, and associated drone opportunity, is broadly consistent across UK electricity utilities. It represents a clear opportunity for drones to reduce cost, cut emissions and improve safety.

Drones collect better data, more often. Routine BVLOS operations by firms like sees.ai[42] are already delivering detailed condition assessments across live infrastructure in unsegregated airspace but only for a small fraction of the network. This may be set to increase with National Grid's recently announced (Sept 2025) "Centralised Autonomous Drone Inspections" initiative[43] and supports earlier fault detection, better maintenance planning and faster response. However, permissions such as those enjoyed by sees.ai are one-offs and not easily replicated by other entities wishing to carry out routine BVLOS inspection of powerlines to address the vast helicopter-substitution opportunity.

Low aviation risk

Inspections take place along transmission corridors, which are often remote; refer to the Atypical Air Environment (AAE) policy concept. Flights follow the line and stay at low level.[44] Risk to people and other airspace users is often low. This may also apply to distribution towers, many of which run through farmland or edge-of-town strips.

Minimal regulatory complexity

This is one of the most tested BVLOS use cases in the UK. The AAE policy supports flights along linear infrastructure but is not yet the simple, repeatable authorisation route that a UK PDRA could offer. For example in Europe, PDRA-G03 covers linear BVLOS flights in low-population areas with defined mitigations. In Canada, their "low risk" BVLOS policy was informed by more than 300 prior BVLOS approvals (refer to Appendix 1), we are suggesting a similar approach here.

41. https://www.nationalgrid.com/national-grids-eyes-sky-how-helicopters-are-helping-keep-britains-electricity-flowing
42. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=42
43. https://www.sees.ai/2025/09/04/national-grid-rolls-out-centralised-autonomous-drone-inspections-across-its-network/
44. https://www.caa.co.uk/publication/download/23432

Clear end-customer pull

The demand for grid expansion and faster inspections is growing. As sees.ai noted in **Skies Without Limits v3.0 (SWL3)**:

> Since we began working on this problem in 2021, the urgency to find a solution has intensified significantly, in line with government announcements of ambitious renewable targets... What started as an incremental improvement has now become a necessity. Simultaneously, interest in the solution has expanded from Condition Monitoring and Maintenance teams to a much broader range of stakeholders including Major Projects."[45]

National Grid and other operators have already embedded BVLOS trials into live operations but our understanding is that these only cover c. 5% of the opportunity. This is a real-world use case with clear benefit and clear end customer pull. A PDRA would turn trial deployments into standard practice.

45. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=42

3. Maritime and coastal search & rescue

Tangible benefits

Maritime SAR is dangerous work. Crews operate in poor weather, low visibility and open water where delays cost lives. BVLOS drones reduce that risk. They extend coverage without putting responders in the air or at sea. Many of the helicopter themes in the powerline section above are repeated here. Large numbers of expensive, polluting and risky helicopter flights could be replaced by drones.

The Maritime and Coastguard Agency (MCA) conducts daily BVLOS coastal surveillance from Lydd using a Temporary Danger Area (TDA). This is a clear sign the MCA sees the benefit of drones. However, as covered in SWL3,[46] their TDA is extremely limited in time and space. They cannot use drones for emergency response unless the emergency happens to align with the TDA's fixed locations and time windows. The other 99% of their patrol area is not covered.

As a result, the safety benefits, cost savings and emissions cuts that drones could deliver are not being realised. It also means the MCA cannot act quickly with drones when it matters most. In some cases, drones may be more effective than helicopters. They are faster to deploy and better suited to certain search protocols. Recent examples include drones locating people cut off by the tide. In these cases, drones are not just cheaper and cleaner – they may save more lives.

Low aviation risk

Many flights take place over open sea or low-density coastline. These are some of the lowest-risk environments for BVLOS in the UK. Routes are often predefined, coordinated with air traffic and flown by trained MCA crews. If a drone fails it is likely to land in water. Exposure to people or other aircraft is often minimal.

Minimal regulatory complexity

The MCA operates BVLOS under a CAA-approved TDA. These flights are structured and repeatable but limited in scope. The area and daily operating hours are fixed. The model does not allow fast response to emergency incidents in the other 99% of the MCA's patrol area. It is operationally useful but not scalable.

A PDRA would solve this. PDRA G01 in Europe covers BVLOS surveillance in low-density areas. With adaptation for maritime use it could support consistent permissions across the UK based on the MCA's proven experience.

Clear end-customer pull

The MCA is clear, from SWL3[47]

> The MCA is advocating for changes in regulations and risk mindset to enable the use of BVLOS for swift emergency responses throughout their patrol area."

46. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=34
47. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=33

4. Rail corridor inspection

Tangible benefits

Trackside work is risky. Many inspections rely on line possessions[48] which can go wrong, sometimes with fatal consequences.[49] Helicopter surveys carry their own hazards and cost, as covered above. BVLOS drones remove both.

Drones can deliver better data – faster than manual teams and at a fraction of the cost. BVLOS also supports rapid response after disruption, helping services to get up running again sooner.

Replacing helicopters cuts emissions and avoids noise in built-up areas. Removing foot patrols reduces vehicle movements, trackside hours and the associated risks. This clearly meets the tangible benefits test.

Low aviation risk

Many rail corridors are in sparsely populated (AAE) areas. Most flights are linear and at low altitudes. Ground and air risk is therefore low for most miles of railway track.

Minimal regulatory complexity

Rail inspections are repeatable. They follow mapped infrastructure with controlled access and trained teams. However, BVLOS approvals remain slow and inconsistent. As mentioned above, to maintain progress Network Rail and British Transport Police have used the State Aircraft exemption for certain surveillance scenarios, which may in time extend to inspection.

The CAA's Atypical Air Environment policy points in the right direction but is not a permissioning tool. The EU's PDRA G03 allows linear BVLOS in low-risk environments using standard mitigations. A UK PDRA could follow that model, leverage learnings from other linear asset approvals, and give operators a clear route to scale.

Clear end-customer pull

Network Rail is ready. It has invested in drone teams and integrated trials into its maintenance strategy. Dominic Mottram, Network Rail National Drone Strategy Manager:

> "The potential for these projects to deliver a more reliable, safer railway for our passengers and colleagues is huge and could even be a game-changer."

Rail operators want faster inspection, better coverage, fewer "boots on ballast" and a lower carbon footprint. The government has backed trials and innovation funding is flowing. What's missing is a routine, repeatable permission.

48. A "line possession" is when a section of a railway line is closed for work e.g. inspection, maintenance, construction
49. https://www.britsafe.org/safety-management/2025/network-rail-fined-3-75-million-after-two-track-workers-killed-by-train

5. Crop spraying and seeding

Tangible benefits

Using drones for crop analytics, spraying and seeding is faster, safer, cheaper and better for the environment than traditional approaches. Drone spraying may be up to five times faster than manual.

Using drones reduces exposure to chemicals, lowers runoff into the environment and minimises soil compaction. It also limits the number of trips to site. In SWL3, we noted a potential reduction of 30% of sprayed chemicals[50], due to more precise targeting (this now looks conservative). Drones also improve food security.

Low aviation risk

Spraying and seeding usually take place over private land. The drones, although heavy at often more than 100kg, fly at low levels, e.g. 50 feet Above Ground Level (AGL). Although requiring BVLOS for maximum efficiency, spraying and seeding drones typically don't fly long distances.

Minimal regulatory complexity

We mentioned the pioneering work carried out by AutoSpray Systems in SWL3. Since this report, they have obtained approval to fly BVLOS in unsegregated airspace, using the AAE methodology. This can be used as a template for an agricultural PDRA, although we note that the Electronic Conspicuity element of their approval may not be scalable.

As stated in SWL3, the other element of regulatory complexity facing this sector is regarding chemicals. Refer to the paper[51] for a discussion on how the Chemical Resources Directorate may take steps to unlock further growth in this area

Clear end-customer pull

There are compelling signs of end-client pull. The Autospray BVLOS approval mentioned above (400ha of rural peatland in Greater Manchester) was for a commercial client. A recent M&S-funded trial also used drones and autonomous vehicles to grow parsnips at a field in Sherburn, Yorkshire. The autonomous field saw a 57% Class 1 yield compared to 40% in a conventional field, along with fewer crop pests and better spray coverage.[52] Other live examples include a water utility with a 300ha site that needs to progressively seed new woodland over the next 3 years – they acknowledge that this timeline not currently possible or accessible without drone intervention. There is also a significant pull from National Trust's policy to tackle climate change which includes woodland creation and restoration of peatlands.[53]

50. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=48
51. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=50
52. Paper not publicly available but reviewed by PwC
53. https://nt.global.ssl.fastly.net/binaries/content/assets/website/national/pdf/national-trust_transitionplan_june_2025_-1.pdf

As Yorkshire grower Andrew Manfield put it after another drone trial:

> This is a real breakthrough. The ability to apply an essential pre-harvest treatment without ever setting foot in the crop is extremely exciting. It's cutting-edge technology that has the potential to make UK farming faster, smarter and more efficient."

There are also significant environmental benefits:

> Drone technology allows us to drastically reduce water volumes. In the trial, we were operating at just 25 l/ha and still achieved excellent coverage."[54]

54. https://www.desangosse.co.uk/news-and-blog/drone-pod-sealant-oilseed-rape-trial/

03

Regulatory approach to reduce net risk and deliver growth

Introduction

Historically, obtaining non-standard drone permissions in the UK (for operations beyond the basic rules) required developing a bespoke Operating Safety Case (OSC). The OSC process was opaque, resource-intensive and slow. Each operator had to produce a detailed risk assessment and mitigation case from scratch, with no guarantee of approval.

This approach, characterised by a "tell us what you want to do and we'll tell you if it's okay" stance, meant that only a small percentage of UK drone businesses secured these enhanced OSC permissions. This one-off, case-by-case method does not scale well, especially for routine BVLOS use cases that many operators want to perform repeatedly.

In 2025, the CAA adopted the Specific Operations Risk Assessment (SORA) 2.5 framework. Introduction of the SORA 2.5 digital platform was a major step forward and provides a more structured methodology for risk assessment. It also puts the UK ahead of the EU on SORA version, with the EU still working on SORA 2.0.

While SORA improves transparency by giving operators a common process to follow, it still places a heavy administrative and cost burden on applicants. In the UK, a SORA application at Specific Assurance and Integrity Level (SAIL; classifies the level of risk associated with a drone operation) II costs £3,495.[55] This is particularly challenging given the spatial and temporal limits often associated with the permission. ARPAS-UK has expressed concern over these high costs and the complexity of the process, calling for simpler, more relevant authorisation frameworks.[56]

There is also evidence that SORA risk calculations may be overly conservative. The Dutch Association of Certified RPAS Operators (DCRO) has challenged the probability assumptions for unmanned aircraft system flyaways in SORA 2.5, arguing that real-world risk is significantly (100x) lower than that assumed by SORA (refer to Part 1, above).

Crucially, while the assessment of ground and air risk, SAIL classification and Operational Safety Objectives (OSO) is quantitative, the mitigations required to meet the OSO are not. Nor are the Acceptable Means of Compliance (AMC) required to show those mitigations are in place. The mitigations and AMC then, are usually subject to qualitative assessment. Unless a published AMC exists for the relevant OSO, we are back to OSC-style case-by-case judgement from the regulator. For well-understood and repeatable scenarios, this level of effort, cost and uncertainty seems disproportionate. Requiring each company to rebuild essentially the same safety case for every time and location, for example, every BVLOS powerline inspection wastes drone operator and regulatory resources without clear safety gain.

So what? If we accept the Net Risk logic from Part 1, complexity, cost and uncertainty in SORA drone approvals may keep higher-risk traditional methods in use. That puts people in harm's way. In the next section, we suggest a change in focus to deliver for the UK.

55. https://www.caa.co.uk/drones/specific-category/uk-sora-based-operational-authorisations/charges-for-a-uk-sora-based-operational-authorisation/
56. https://www.suasnews.com/2025/02/arpas-uk-statement-on-its-engagement-with-the-caa-and-its-advocacy-priorities

Prescriptive regulation to improve safety and growth

In Part 2, we noted the need for prescriptive regulatory tools that define exactly what is required for safe and repeatable BVLOS flight. Such tools should provide operators with straightforward, repeatable pathways to approval, minimising friction, cost and enabling scalable operations.

While there are other options in a SORA framework (see Appendix 1, Canada), our view is that the more efficient path is to implement prescriptive digital PDRAs (Pre-Defined Risk Assessments), initially for the high-priority use cases we identified in Part 2. PDRAs, derived from the SORA framework, use the same risk logic but shift the initial workload to the regulator, who can leverage their knowledge of prior approvals to build a simple, repeatable approval template. Instead of starting from scratch, operators follow a clear rule set built on already-agreed safety assumptions. With PDRAs established, all stakeholders enjoy a more efficient process (including the regulator). This would dramatically reduce costs and make applying for permission in new locations less onerous. In effect, a PDRA acts as a pre-approved template for a class of operations. One PDRA exists in UK guidance (PDRA-01 covers standard VLOS scenarios), and expanding this concept to BVLOS would be relatively straightforward.

Let's consider one of the use cases in Part 2; a digital PDRA for BVLOS powerline inspection in low-density airspace. This would specify altitude limits, rural geography and associated airspace limitations, drone reliability criteria, pilot training, emergency procedures and other clear parameters. For some applications, such as agriculture, Electronic Conspicuity (EC) may be required. In others, Detect and Avoid (DAA) or airframe approval may apply. These criteria should be clearly set out in the PDRA. As touched on above, such PDRAs could build on the large body of existing work associated with previously approved BVLOS OSCs, refer, for example, to the 335 Special Flight Operations Certificates that informed the Canadian low risk BVLOS rules (see Appendix 1). European PDRAs for relevant operations could also be leveraged (refer to Part 2), albeit with a less conservative interpretation. Any operator meeting the conditions in the PDRA would quickly receive authorisation, shifting the process from narrative justification to a cost-effective checklist compliance exercise.

Crucially, moving to prescriptive PDRAs for known low-risk scenarios wouldn’t compromise safety. The requirements would be derived from rigorous risk analysis but would greatly improve efficiency and consistency. It avoids the need for subjective case-by-case SORA analyses where they aren't necessary. Compared to more complex regulatory constructs like a full Light UAS Operator Certificate (LUC) programme, which grants a handful of experienced operators broad privileges but is administratively intensive to implement, PDRAs are a pragmatic intermediate step. They can be rolled out with minor adjustments to current rules, leveraging existing Specific Category processes. In summary, directing regulatory resources to rapidly deploy digital PDRAs for the "winners" identified in Part 2 is a practical and proportionate next step. It would unlock commercial value and scalability by removing needless friction, all while maintaining a high level of safety through clear, predetermined standards.

Conclusion

Part 1 showed that drones carry low intrinsic risk, based on insurers' experience across thousands of flights in the UK and Comparable Countries such as the USA, Canada, Singapore and those covered by EASA[57]. It also showed that when viewed through a net risk lens, the benefit of drones is even clearer. Drones actively reduce harm by replacing tasks that are more dangerous, more time-consuming or more resource-intensive. They take people out of harm's way and reduce hours of exposure to risk. Drones, then, are almost always less risky than the alternatives people are forced to use if drones are not approved. Managing aviation risk is absolutely the right thing for the regulator to strive for if viewed in isolation; but not if this approach actually increases aggregate risk by forcing people to use dangerous legacy techniques and equipment.

Despite this, UK regulation still treats all drone operations as high risk. This has slowed adoption and blocked proven use cases from scaling, despite evidence from global experience indicating this is not necessary. Looking at Comparable Countries, we find that regulations are more permissive and more prescriptive than the UK. This clarity minimises uncertainty and administrative burden. It delivers growth and net risk safety benefits without compromising safety.

Parts 2 and 3 laid out how to fix this. We suggest that the regulator focus its effort on "winners" – use cases with high benefit, low risk, minimal regulatory complexity and clear end-customer demand. These use cases should be enabled using prescriptive tools like digital PDRAs. After an initial push from the regulator, this will maximise efficiency and minimise cost for all stakeholders. It will increase drone use and deliver more benefits to the UK economy.

The case for reform is clear

Net Risk

01

Drones carry low intrinsic risk and can reduce overall harm by replacing more dangerous legacy methods

Picking Winners

02

Ensures focus and efficient use of resources

Digital PDRAs

03

leverage EU PDRAs and the CAA's experience of OSC and SORA approvals, to deliver a permissive and prescriptive framework that maximises the delivery of drone benefits for the UK

The tools are already in place. The benefit is measurable. What's needed now is a focused regulatory response that aligns with the net risk principle and delivers for operators, regulators and the wider public.

57. European Union Aviation Safety Agency

Contact

Thanks to Moonrock and Global Aerospace for their insightful comments and quotations and to DSIT and RIO for their suggestions.

Craig Roberts
Head of Aerial Intelligence & Innovation
PwC UK
E: craig.roberts@pwc.com

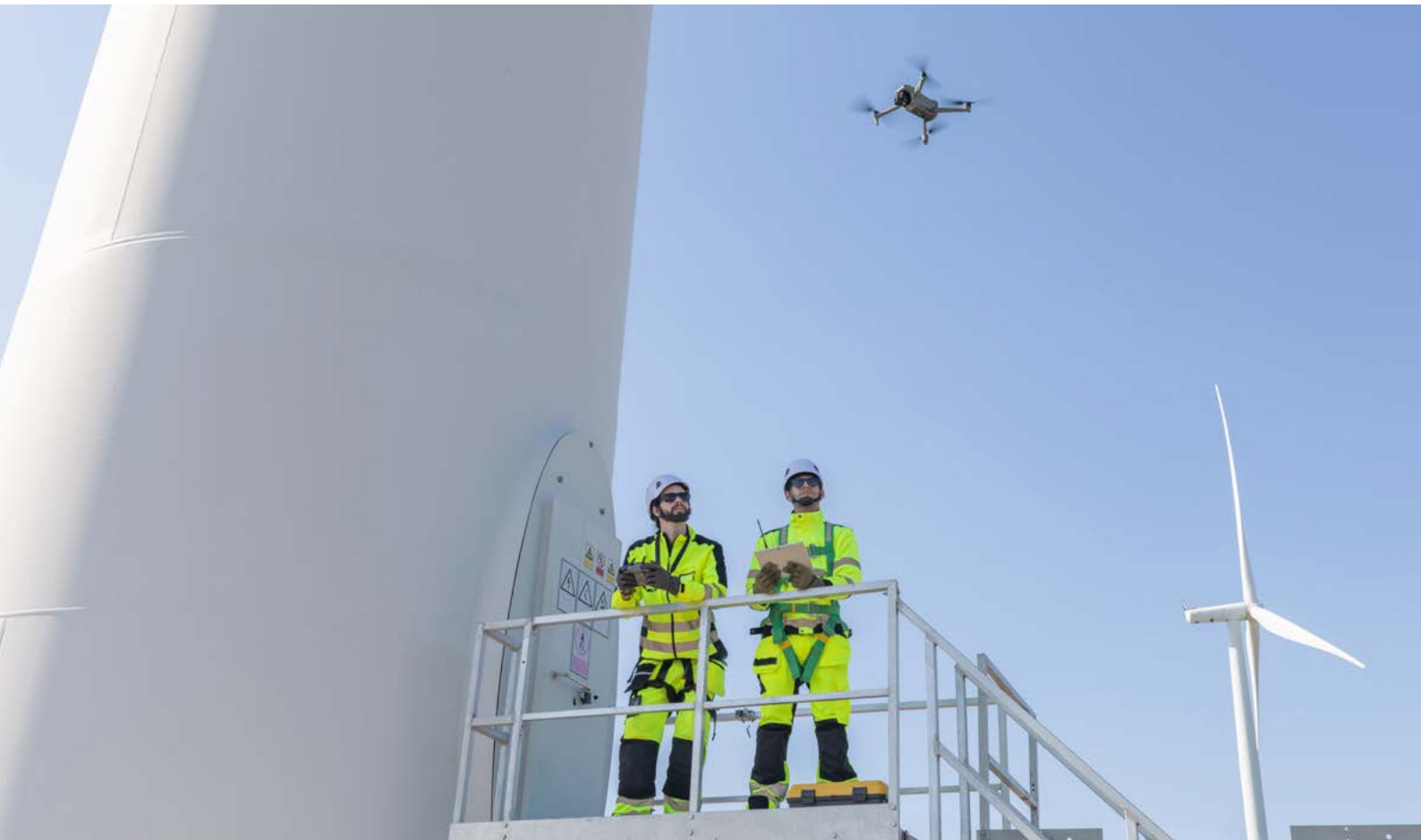
Ben Evans
Manager, Aerial Intelligence & Innovation
PwC UK
E: benjamin.evans@pwc.com

Faye Melly
Lead Client Partner for Department for Science Innovation and Technology (DSIT)
PwC UK
E: faye.melly@pwc.com

Euan Cameron
AI and Emerging Technology Leader
PwC UK
E: euan.cameron@pwc.com

Tomasz Kłosowicz
Senior Manager, Drone Powered Solutions & Geospatial Hub
PwC Poland
E: tomasz.klosowicz@pwc.com

Appendix 1 – Regulatory approach in comparable countries



Introduction

This Appendix supports the case made in Parts 1 to 3 by assessing how the regulatory approach in Comparable Countries (USA, Europe,[58] Singapore, Canada) compares to the UK. Although there are differing approaches, in the round, all Comparable Countries have a more permissive and prescriptive approach than the UK. We could infer that, explicitly or implicitly, regulators in Comparable Countries have acted with net risk in mind; drones remove more risk than they introduce.

There is also evidence that the anticipated benefits of drones have shaped regulatory intent. A standout example is in the US, where President Trump signed two drone Executive Orders on June 6, 2025, one of which, "Unleashing American Drone Dominance,"[59] instructs the FAA to fast-track BVLOS rulemaking.

Comparable Countries then, don't focus on managing drone risk to be as low as possible, they have a more balanced view of the overall net positive impact of drones – flying more BVLOS and reaping more benefits than the UK.

The Comparable Countries profiles below show how countries with comparably strong safety records to the UK have adopted frameworks that are both more permissive (enabling more BVLOS operations) and more prescriptive (providing clear, repeatable pathways to approval). For each country, we cover regulatory approach, BVLOS use cases, industry perspective and safety (we dig further into safety in Appendix 2, where we analyse incident reporting in the UK and Comparable Countries in period 2022-2024). The final part deals with Unmanned Traffic Management (UTM); there are several contrasting views to whether this is foundational to BVLOS operations and drone growth, refer to SWL3[60] for further discussion on this point (we consider UTM to be critical for BVLOS adoption at scale).

Finally, note that this section does not intend to regurgitate the regulations in each country; it is focused on approach rather than being a comprehensive "how to" guide.

58. USA, Europe (we are aware that this is not a country and are referring to EASA-covered countries), Singapore, Canada
59. https://www.whitehouse.gov/presidential-actions/2025/06/unleashing-american-drone-dominance/
60. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=26

USA

Overview

The majority of USA BVLOS approvals have been through Part 107 waiver. The process is not particularly streamlined but requirements are clear (prescriptive) and many more BVLOS flights have taken place in the USA than the UK (permissive). The USA approach is also consistent and has bipartisan backing; politicians are keen to unlock drone benefits. UTM use is increasing and it is considered key for complex scenarios.

Regulatory approach

The US does not use SORA or predefined risk tiers. Instead, the Federal Aviation Administration (FAA) uses a case-by-case waiver system under Part 107 to authorise BVLOS flights. While it lacks a formal risk classification model, the waiver process is prescriptive, repeatable and built on precedent. Operators must show they meet specific safety objectives, including airspace deconfliction, command and control (C2), reliability and pilot competence.

Waivers are granted based on evidence. Our understanding is that, once a particular platform has been approved for a BVLOS use case, others may follow that same template. For example, if a platform manufacturer obtains BVLOS approval for a certain use, others using the same setup can leverage the approval. It is clear what works, and there is growing industry familiarity with the hoops to jump through, refer to Industry Perspective, below.

The FAA is now under legislative instruction to formalise this process. The 2024 FAA Reauthorization Act[61] mandates the creation of routine BVLOS rules under Part 108. These are due in 2025 and are expected to reflect the most common waiver conditions already in use. An Executive Order from the White House has reinforced this timeline.[62]

61. https://www.congress.gov/bill/118th-congress/house-bill/3935/text
62. https://www.whitehouse.gov/presidential-actions/2025/06/unleashing-american-drone-dominance

Operational use cases

- **Powerline inspection:** Cyberhawk and Phoenix Air Unmanned (PAU) fly routine BVLOS missions nationwide,[63] PAU had completed 13,000 miles of powerline flights by 2023[64] (and 16,000 miles of linear infrastructure flights in total[65])
- **Emergency response:** Police forces including Chula Vista use BVLOS drones daily as first responders, Flying Lion stated they had completed more than 35,000 BVLOS operations for Chula Vista and more than 30 other partnered law enforcement agencies[66]
- **Urban delivery:** Zipline operates BVLOS deliveries in suburban and peri-urban environments in Utah[67] and Arkansas[68], Flytrex and Wing sharing airspace in Texas for BVLOS deliveries (see UTM heading below)

Industry perspective

In SWL3,[69] Cyberhawk reported that US BVLOS permissions took 2 months and involved a c.50 page submission. Their UK application, which did not include BVLOS[70], contained 1,600 pages and was still not closed after 5 months. Per above, Cyberhawk has since obtained a national BVLOS waiver in US. The US lets operators build scale, however, it's not perfect. Although there were 1,229 BVLOS flights in 2020, rising to 26,870 in 2023, challenges remain. Market commentators consider that US BVLOS has shown impressive growth but that scalability is limited.[71]

Safety record

As of 2024, we could find no evidence that the FAA has reported any confirmed fatalities from commercial drone operations, nor any verified collisions between commercial drones and crewed aircraft. In Appendix 2, we review commercial drone incidents from 2022 to 2024 and find that, of 14 incidents investigated by the National Transportation Safety Board, 3 were more serious in nature. To put these in context, there were 433,407 commercial drone registrations as at July 2025[72], if we estimate a conservative 50 flights per registration per year, this is 22 million flights per year. Reported incident rates, then, remain low despite the rapid increase in commercial use.

63. https://thecyberhawk.com/news/cyberhawk-granted-faa-nationwide-bvlos-waiver
64. https://dronelife.com/2023/04/06/bvlos-power-line-inspection-no-visual-observers-whats-involved-in-the-pheonix-air-unmanned-waiver
65. https://dronelife.com/2025/01/09/phoenix-air-unmanned-completes-320-mile-pipeline-patrol-in-single-day
66. https://dronedj.com/2025/01/11/flying-lion-hits-55000-drone-as-a-first-responder-missions
67. https://www.zipline.com/newsroom/news/announcements/zipline-achieves-first-u-s-bvlos-flight
68. https://www.revolution.aero/news/2023/09/19/faa-issues-initial-bvlos-approval-for-zipline
69. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=46
70. Apart from Visual BVLOS, formerly known as extended visual line of sight
71. https://dronelife.com/2025/07/08/faa-makes-significant-bvlos-progress-but-critical-gaps-remain-in-achieving-scalable-operations
72. https://www.faa.gov/node/54496 [accessed August 2025]

UTM and airspace integration

UTM adoption is piecemeal but there has been a strong drive from NASA and FAA in this area and indications that UTM is considered foundational (refer to SWL3[73]). Perhaps most significantly, the FAA has begun approving operations that represent genuine industry breakthroughs. In July 2024 the FAA authorised Zipline and Wing to fly BVLOS commercial drones in the same Dallas area airspace using UTM[74]. It was the first FAA approval for shared BVLOS airspace by multiple operators. This achievement, enabled by UTM, demonstrates the potential for scalable operations.

In May 2025 Wing and Flytrex began daily BVLOS operations in overlapping Dallas airspace using UTM coordination.[75] Yariv Bash, CEO and co-founder of Flytrex, said:

> Unmanned Traffic Management is the backbone of a scalable drone delivery ecosystem," said. "It allows multiple operators to fly safely and efficiently, even in densely populated areas, by mitigating drone to drone collision risks. We're proud to work alongside Wing to pioneer a new standard for airspace coordination built for scale."

Flytrex is part of the FAA's UTM Operational Evaluation program.[76]

73. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=26
74. https://www.faa.gov/newsroom/faa-makes-drone-history-dallas-area
75. https://secure.businesswire.com/news/home/20250528259945/en/Flytrex-Wing-Implement-Commercial-Strategic-Flight-Coordination-in-Overlapping-Airspace-in-the-U.S..
76. https://www.faa.gov/uas/advanced_operations/traffic_management

Europe

Overview

Europe has a strong regulatory framework for BVLOS but usage remains patchy. Operators have access to structured tools such as SORA, Standard Scenarios (STS), PDRA and LUC (Light UAS Operator Certificate), but these are not always deployable at scale. Uptake is limited by national variation, low availability of class-marked drones and while UTM is used in many European countries, U-Space deployment is in its infancy.

Regulatory approach

Operators can apply under the SORA model, use STS, PDRAs, or, if certified, operate under a LUC. U-Space came into effect in 2023, with functions including electronic identification, digital flight approvals and strategic deconfliction. However, only a minority of EU countries have fully implemented U-Space.

Although STS are available[77], they are rarely used. This is due to low market availability of class-marked drones, which are required for STS approval. PDRAs, although covering a wider range than the UK and not requiring class-marked drone, are considered too conservative by many.[78] The result is friction for small operators and continued reliance on more bespoke and complex SORA-based applications. The exception is those experienced drone operators who manage to obtain LUC[79], enabling them to self-certify flights (including BVLOS) across Europe. Those with LUC certification report that it's a game changer for permission efficiency.

EASA on LUC:

> "The highest privilege may be the possibility to start operations in the specific category without needing an operational authorisation by the NAA [National Aviation Authority]. The availability of LUC certification represents a quantum change in the efficiency of drone aerial services, while ensuring safe conditions. Many working hours can be saved by speeding the process that otherwise would halt any work waiting for an authorisation to be formalised and approved."

77. https://www.easa.europa.eu/en/domains/drones-air-mobility/operating-drone/specific-category-civil-drones/standard-scenario-sts
78. https://www.arpas.uk/tag/pdra/
79. https://www.easa.europa.eu/en/domains/drones-air-mobility/operating-drone/specific-category-civil-drones/light-uas-operator-certificate-luc

Operational use cases

- **Infrastructure inspection:** Skeye are using BVLOS Drone-in-a-Box solutions to collect data for two Shell facilities in the Netherlands. Their 24/7 remote piloting operation, enabled by Skeye's LUC, underpins Shell's "rounds by exception" initiative; routine drone inspections mean human teams are only dispatched when anomalies are detected.[80]
- **Urban delivery:** Manna Aero has flown over 200,000 low-altitude BVLOS delivery flights in Dublin and Helsinki. Operations are approved by national regulators and conducted within controlled corridors with real-time oversight.[81] We note that 3 incidents have been reported, one of which – a minor injury – was investigated by the Air Investigation Ireland Unit[82] [83]
- **Public safety and monitoring:** Nokia and Citymesh have deployed a nationwide 5G-connected network of Drones-in-a-Box in Belgium. Over 500 BVLOS flights have been flown for first response and incident monitoring, including on active airport infrastructure. These missions use automated authorisations and integrate with national U-Space and SORA approval pathways[84]

Industry perspective

SORA provides a robust pathway to BVLOS but remains complex and documentation-heavy. The LUC model is highly valued by operators that hold it, but remains limited to a small number of organisations. PDRAs are available but often too narrow. STS approvals are rare due to the continued absence of class-marked aircraft.

Safety record

No fatal commercial drone incidents have been reported across EU member states in the last five years.[85] Refer to Appendix 2 for our detailed review of EU incident data from 2022-2024, covering a handful of incidents investigated by National Aviation Authorities (NAAs) including the Manna incident referenced above. Despite early caution, regulators have enabled complex missions without compromising safety.

80. https://www.flytbase.com/case-studies/shell-petroleum-autonomous-drone-inspections-oil-and-gas (note since this article, the operation has moved to 24 hours per day)
81. https://www.theguardian.com/technology/2025/apr/11/amazon-slayer-dublin-startup-manna-aero-taking-giants-autonomous-drone-deliveries
82. https://www.dublininquirer.com/amid-plans-for-food-delivery-drones-to-spread-across-dublin-some-worry-about-safety/
83. https://aaiu.ie/wp-content/uploads/2024/11/Final-Report-2024-011.pdf#page=7
84. https://www.citymesh.com/news/citymesh-first-responder-drone-activated-at-droneport-the-first-diab-installed-on-an-active-airport/
85. EASA's 2024 Annual Safety Review reported one fatality in 2023 involving an 8 kg model aircraft that struck a bystander. This incident was linked to hobby use and did not involve a certified commercial drone or authorised operation, see https://www.easa.europa.eu/en/document-library/general-publications/annual-safety-review-2024

UTM and airspace integration

UTM is considered foundational in Europe but, at time of writing, U-Space is only formally designated and active in one member state. Under Reg. (EU) 2021/664, a designated U-Space airspace must be supported by at least one U-Space Service Provider (USSP) and a Common Information Service Provider (CISP). Early deployments are underway: Italy designated the San Salvo U-Space in late 2024[86] and, by early 2025, d-Flight had been certified as CISP and USSP.[87] In May 2025, EASA issued its first EU-level USSP certificate to ANRA,[88] showing further progress towards U-Space implementation. U-Space, then, is viewed by the European Commission and EASA as a foundational enabler for routine BVLOS operations at scale.

Manna on UTM in SWL3[89]

> The EU regulatory framework, governed by EASA, including the U-Space legal requirement, is ready for drone delivery at scale. This framework provides a solid foundation that supports the safe and efficient operation of drone deliveries. We look forward to local airspace regulators across the EU demonstrating their ability to comply with these regulations at an appropriate pace, ensuring that permits allow safe operators to build out initial scale effectively."

UTM technologies are crucial for UK BVLOS drone operations. The integration of Unmanned Traffic Management (UTM) systems is essential for managing the increased air traffic volume associated with BVLOS operations. These technologies ensure that drones can operate safely and efficiently alongside both unmanned and manned aircraft, preventing collisions and facilitating smooth traffic flow. Additionally, UTM systems support regulatory compliance by providing the necessary infrastructure for monitoring and controlling drone flights, which is vital in the UK's densely populated and complex airspace."

86. https://www.unmannedairspace.info/uncategorized/italy-publishes-first-airspace-area-dedicated-to-u-space-operations
87. https://www.unmannedairspace.info/latest-news-and-information/enac-certifies-d-flight-as-a-ussp
88. https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-certifies-anra-technologies-first-u-space-service-provider
89. https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2024.pdf#page=26

Canada

Overview

Canada's new BVLOS regulations come into force on 4 November 2025, following a phased rollout. The framework categorises operations into very low, low, medium and high complexity and adds a separate lower-risk BVLOS category. This structure allows certain routine, lower-risk BVLOS flights to go ahead without requiring a Special Flight Operations Certificate (SFOC), while other non-standard missions fall into the complexity categorisation and require a SFOC and more detailed oversight.

According to Transport Canada, the reform, particularly the introduction of the lower-risk BVLOS category, is designed to "unlock the potential of medium-sized drones and beyond visual line-of-sight (BVLOS) operations in Canada."[90] The lower-risk BVLOS changes were informed by more than 300 BVLOS SFOC prior approvals. Canada is progressing toward a national UTM system, but unlike Europe or Singapore, it is not yet foundational to its approach.

Regulatory approach

In November 2025, a lower-risk BVLOS category will be introduced and other non-standard operations (i.e. requiring a SFOC) will be classified by complexity:

- **Lower-risk BVLOS:** Flights in uncontrolled airspace, below 122 m (400 ft) and more than 1 km from populated areas. Operators must hold an RPAS Operator Certificate (RPOC) and the pilot must have a Level 1 Complex Operations certificate. A SFOC is not required, unlike under the previous regime. RPAS between 250 g and 25 kg can fly BVLOS over areas with up to 25 people per square kilometre, classified as "sparsely populated" (5–25 people/km²), or more than 1 km from built-up zones. RPAS between 25 kg and 150 kg are limited to "remote" areas with fewer than 5 people per square kilometre. These conditions are Canada's analogue to the "atypical air environment" concept used in the UK. These lower-risk BVLOS rules are comparable to a PDRA: Canadian operators do not have to submit a SORA application. Rather, Transport Canada has predefined the risk and requirements, mirroring a low-SAIL operation captured by a PDRA in Europe.
- **Very low and low complexity:** These are SFOC categories for limited cases. Very low-complexity covers foreign recreational pilots/ operators who need a SFOC. Low-complexity covers advertised events (including microdrones). These categories provide streamlined SFOC pathways with tailored conditions; they do not change the new lower-risk BVLOS standard-rules track.
- **Medium and high complexity:** These cover operations near people, infrastructure or in urban or controlled airspace. They continue to require a full SFOC and are assessed using a Canadianised version of the Specific Operations Risk Assessment (SORA) methodology, as outlined in Advisory Circular 903-001.[91] SAIL ratings are used to determine the level of assurance and mitigation required. The addition of complexity categories helps clarify risk levels for applicants but does not materially change how applications are assessed or approved.

90. https://tc.canada.ca/en/aviation/drone-safety/2025-summary-changes-canada-drone-regulations
91. https://tc.canada.ca/en/aviation/reference-centre/advisory-circulars/advisory-circular-ac-no-903-001

Transport Canada has issued over 300 low-risk BVLOS SFOCs and these informed the new lower-risk BVLOS category. Incident reports remain rare (refer to Appendix 2), and there is no evidence of systemic risk linked to BVLOS. This record gave regulators confidence to simplify lower-risk BVLOS regulations.[92] The approach, then, streamlines the previous catch-all SFOC process by introducing standard rules for lower-risk BVLOS and triaging the remaining non-standard operations into complexity tiers. A phased rollout gives operators time to align with the new categories and requirements.

Our understanding is that Transport Canada's general policy direction is to enable progressively more complex operations (including BVLOS and, ultimately, fully autonomous missions) within standardised frameworks, such as the lower-risk BVLOS rules set to be introduced. This will significantly reduce reliance on SFOCs. This evolution will take time and benefit from robust UTM services, but it is key to unlocking the industry's potential to deliver advanced services across both private and public sectors.

Operational use cases

Prior to these new rules, Canada facilitated BVLOS flights, albeit with a more complex authorisation process. For example

- **Nationwide BVLOS at scale:** In May 2025, Volatus Aerospace was authorised to conduct BVLOS operations across Canada. They can fly day or night, in remote regions and near rail, tower and powerline assets, using a centralised Operations Control Centre[93]
- **Urban environmental monitoring:** In 2023, In-Flight Data received one of Canada's first BVLOS approvals for autonomous flights over urban infrastructure. The mission involved pre-mapped aerial corridors and was approved without visual observers by Transport Canada, marking a shift toward scalable, sensor-driven operations[94]
- **Remote healthcare delivery:** In 2021–22, a partnership between Drone Delivery Canada, Stellat'en First Nation and UBC conducted over 1,200 BVLOS flights transporting medical supplies between Fraser Lake and the Stellat'en community in northern British Columbia. Approved under a legacy SFOC, this was one of the highest-volume BVLOS projects in Canada[95]

92. https://gazette.gc.ca/rp-pr/p2/2025/2025-03-26/html/sor-dors70-eng.html
93. https://www.globenewswire.com/news-release/2025/05/27/3088439/0/en/Volatus-Aerospace-Announces-Broad-National-Expansion-of-Drone-Operating-Authorities-Across-Canada-Unlocking-Scalable-High-Value-Aerial-Operations.html
94. https://www.forbes.com/sites/jenniferhicks/2023/02/17/transport-canada-approves-autonomous-drones-for-beyond-visual-line-of-site-monitoring/
95. https://www.cbc.ca/news/canada/british-columbia/stellaten-first-nation-ubc-fraser-lake-drone-delivery-medicines-1.6210216

Industry perspective

Industry feedback shaped the final rules. One industry commentator stated

> all-in-all, it's what we were expecting and hoping to see: Common-sense amendments to existing regulations."[96]

Lower-risk BVLOS will operate under clear rules, whilst other non-standard missions continue along the SFOC path. Overall, industry feedback is positive regarding the regulatory framework and the efforts of Transport Canada and NAV CANADA to coordinate drone operations and support industry growth. That said, expectations remain high: stakeholders seek reliable UTM services and BVLOS rules that enable more operations without a SFOC, a direction that aligns with Transport Canada's roadmap.

Safety record

As of 2024, we found no evidence of any confirmed fatalities linked to commercial drone operations in Canada, nor verified collisions between crewed aircraft and drones flown under approved frameworks.[97] As you can see in Appendix 2, we found no evidence of incidents that the Transportation Safety Board considered necessary to investigate.

UTM and airspace integration

Transport Canada is developing a national UTM (referred to as RTM or Remotely Piloted Aircraft Systems Traffic Management) in collaboration with NAV CANADA and the iART Alliance.[98] It will align with ICAO principles and include situational data layers to support safe BVLOS, such as population density and aerodrome buffers. At this stage, we would not consider that Canada views UTM as foundational.

96. https://indrorobotics.ca/what-canadas-new-drone-regulations-mean-for-you
97. Wanner, D., Hashim, H. A., Srivastava, S., & Steinhauer, A. (2024). UAV avionics safety, certification, accidents, redundancy, integrity, and reliability: A comprehensive review and future trends. Drone Systems and Applications – section 2.3 https://www.researchgate.net/publication/379689369_UAV_avionics_safety_certification_accidents_redundancy_integrity_and_reliability_a_comprehensive_review_and_future_trends
98. https://dronelife.com/2025/07/24/canada-launches-first-rtm-interoperability-trials-in-edmonton/

Singapore

Overview

Singapore runs one of the more complex and structured drone regulation systems. BVLOS approvals are risk-ranked and centrally managed. Routine urban BVLOS is happening now, under tight controls and unified airspace infrastructure – so permissive, if a little clunky. The focus is not just on safety but national productivity. Policy is performance-based and technology-agnostic but very prescriptive. UTM is clearly foundational.

Regulatory approach

All BVLOS operations are classed as low, medium or high risk. Each level has set requirements for operator qualifications, system reliability and airspace mitigation. Operators need both an Operator Permit and an Activity Permit.[99] These are issued by Civil Aviation Authority of Singapore (CAAS) and flights are authorised through the Centralised Flight Management System (CFMS). Flights may require sign-off from multiple entities in addition to CAAS such as Singapore Police Force, IMDA (Info-communications Media Development Authority) and Singapore Armed Forces. Risk ownership is shared and approval is centralised.

Low-risk operations (like extended VLOS in low-traffic areas) can be approved through standard forms. Higher-risk cases in cities or near ports must show detect-and-avoid capability, command redundancy and site-specific mitigations. Unlike the EU, Singapore does not use standard scenarios or PDRAs.

From December 2025, drones over 250g must carry Broadcast Remote ID.[100] This is part of Singapore's real-time enforcement model and integrates with national airspace tracking.

99. https://www.caas.gov.sg/docs/default-source/default-document-library/ac-anr101-2-2-bvlos-operations-for-ua_301219.pdf
100. https://www.caas.gov.sg/who-we-are/newsroom/Detail/unmanned-aircraft-required-to-be-equipped-with-broadcast-remote-identification-from-1-december-2025

Operational use cases

- **Urban logistics:** Skyports has partnered with CAAS and Singapore Post to conduct BVLOS deliveries of post and small parcels across industrial and coastal zones, including Marina South and Sentosa. These operations demonstrate scalable last-mile drone logistics.[101] [102]
- **Infrastructure inspection:** ST Engineering's DroNet system has flown over 18,000 BVLOS flights for inspection, surveillance and delivery missions in urban airspace. It supports autonomous drone operations with AI-driven route planning and live video analytics. DroNet has been approved for flight over populated areas and meets both Singaporean and European safety benchmarks[103]
- **Maritime operations:** Skyports Drone Services conducts BVLOS deliveries to vessels at anchor in the Port of Singapore, including documents and supplies. These missions are approved by CAAS and managed remotely through the CFMS, with flights launched from the Maritime Drone Estate and controlled from Seletar Aerospace Park[104]

Industry perspective

Operators see Singapore as demanding (if a little clunky) but clear and fair. Approvals need full documentation and strong operational control, but the pathway is predictable. Central oversight means national consistency. CAAS aligns drone policy with wider goals in smart city planning and port automation.

Safety record

There are no reported commercial drone fatalities in Singapore, nor verified crewed aircraft collisions. As you can see in Appendix 2, there were two incidents in 2022-2024 that were investigated by the Transport Safety Investigation Bureau. For example, one incident involved a drone veering off course and crashing into the façade of One-North Residences, causing a minor fire. No injuries or fatalities were reported, and CAAS responded by initiating a sector-wide safety review.[105]

101. https://skyportsdroneservices.com/2023/04/skyports-drone-services-cash-to-master
102. https://en.wikipedia.org/wiki/Skyports
103. https://dronetalks.online/blog/st-engineering-dronet-solution-bvlos
104. https://skyportsdroneservices.com/2023/01/the-power-of-ship-to-shore-drone-delivery-in-maritime-supply-chains
105. https://file.go.gov.sg/tle06-2025.pdf

UTM and airspace integration

Singapore's Centralised Flight Management System (CFMS) is compulsory for all non-recreational drone flights. It handles pre-flight planning, tracking, deconfliction and enforcement. It connects across agencies and underpins all BVLOS operations. In 2025, the government issued a national RFQ to expand CFMS, reinforcing its role as a pillar of UTM and Smart Nation policy and pointing to Singapore's view of UTM as foundational tech.

Summary Table

BVLOS Area	USA	Europe	Canada	Singapore	UK
Safety Record (commercial drone flights, see also Appendix 2)	0 fatalities	0 fatalities	0 fatalities	0 fatalities	0 fatalities
Risk model	Currently waiver-based	SORA (SAIL levels)	Low/ Med/ High complexity, (SORA based)	Low/ Med/ High risk (not SORA)	SORA (SAIL levels)
BVLOS authorisation route	Part 107 waiver, Part 108 (BVLOS) due 2025	SORA or PDRA or LUC	SFOC for all, new BVLOS reg in 2025, no SFOC for low complexity	Operator & Activity Permits	SORA only
Remote ID	Broadcast only	Broadcast only	None yet	Broadcast (from Dec 2025)	Planned, not deployed
UTM status	Patchy, core for some use cases such as delivery	U-Space mandatory, few live systems	In development	Centralised, operational, fundamental	Not operational
Routine BVLOS happening?	Yes	Limited	Some, growing	Yes	Limited
Industry view on scale-up	Predictable	Improving	Positive	Clear, structured, "clunky"	Case-by-case, high friction
Complexity	Low for proven use cases	High unless LUC granted	Low for rural, high for urban	Medium, tiered	High across all scenarios
Government backing for advancing the drone agenda	Strong, bipartisan	Strong at EU level	Clear reform agenda	Centralised innovation role	Many initiatives, little commercial pull-through

Risk model: the approach used to assess and classify the risk of a particular drone operation. **BVLOS Authorisation Route:** the approach, regulation or risk model that an operator would need to abide by to pursue BVLOS operations. **Remote ID:** a system to allow for identification and tracking of drones in flight – this can be broadcast based or network based. **UTM status:** Does the region have an Unmanned Traffic Management System and is it required for drone operations. **Complexity:** How challenging is it for operators to fly BVLOS?

SORA – Specific Operations Risk Assessment, SAIL – Specific Assurance and Integrity Level, PDRA – Pre-Defined Risk Assessment, LUC – Light UAS-operator Certificate, SFOC – Special Flight Operations Certificate.

Appendix 2 – review of commercial drone safety incidents

Introduction

This Appendix provides further details of drone safety incidents involving commercial drones across the UK, USA, Europe (EASA covered countries), Canada and Singapore from 2022 to 2024. For this paper, we carried out a deep "web scrape" of relevant areas such as official accident investigation reports, media coverage and industry commentary.

The analysis confirmed that commercial drones pose an intrinsically low risk, even as operations scale up. Despite substantial increases in commercial drone activity from 2022 to 2024, there are no fatalities and only a handful of serious injuries (accidents[106]). However, commercial drone safety incidents do happen, mostly involving technical failures or operational issues. In the course of this research, we observed a wide range of drone incident / occurrence reporting practices between Comparable Countries. In this section, we use "incident" to describe any safety-related event. Some jurisdictions refer to these as "occurrences"; the terms are interchangeable for the purposes of this paper. At a top level, reporting splits into

- **Investigated incidents:** those which the regulator has deemed serious enough and/ or offer potential safety learnings to investigate fully, e.g. Air Accidents Investigation Branch (AAIB) reports in the UK, National Transportation Safety Board (NTSB) in the USA, Transportation Safety Board (TSB) in Canada, and Transport Safety Investigation Bureau (TSIB) in Singapore
- **Report-only incidents:** self-reported incidents which are not investigated but are logged. E.g. AAIB's record-only investigations in the UK, Aviation Safety Reporting System (ASRS) reports in the USA, Civil Aviation Daily Occurrence Reporting System (CADORS) in Canada

While the UK and USA incident data is public and reasonably easy to search, this is not the case for all Comparable countries. Canada's TSB database of investigated incidents is challenging to search and their CADORS self reporting system does not categorise drone incidents, meaning that a keyword search is required to identify commercial drone report-only incidents. In Europe, the EASA occurrence reporting data in ECCAIRS2[107] is not searchable unless you are a National Aviation Authority (NAA) or otherwise have access. EASA's safety reporting included drones for the first time in 2024, see below. A handful of EASA-covered NAAs have published investigations into major occurrences. In Singapore, there is no searchable database of occurrences but we did see reports on two investigated major occurrences, both on the CAAS website and in media reports.

We present representative examples of commercial drone incidents below the summary table.

106. For the purposes of this paper: an incident is defined as an unplanned event during drone operations that disrupts normal activity or requires intervention, but does not result in injury or significant damage (e.g. temporary loss of control link, GPS interference, or minor equipment failure). This category is limited by the reporting regimes in the countries and not directly comparable.

An accident is defined as an event that results in serious injury, fatality or significant damage to property, infrastructure or aircraft (e.g. mid-air collision, crash into a person, or loss of the drone with serious consequences).

107. https://aviationreporting.eu/en

Summary table of commercial drone incidents by country (2022–2024)

Note the limitations stated above and methodology described below by Comparable Country; this table is indicative only for minor incidents.

Country	Incidents[108]	Accidents[109]	Fatalities
	Report only / minor investigated incidents	Investigated major incidents	Subset of accidents
UK	132 / 10	0	0
USA	167 / 11	3	0
Europe	2	2	0
Canada	20	0	0
Singapore	Not available	2	0

108. See footnote 106 on p54
109. See footnote 106 on p54

United Kingdom

Investigated incidents

The following 10 commercial drone incidents occurred between 2022 and 2024 and were investigated by the AAIB[110] through its correspondence process and published as formal bulletins. No full field investigations were carried out. There were no serious injuries or fatalities (accidents).

- **6 May 2022, Isle of Arran (Scotland):** An Avy Aera 1.5 delivery drone experienced lift propeller bolt failure during a hospital trial flight at Arran War Memorial Hospital. A detached propeller blade struck the ground; the drone crashed in a nearby field. No injuries occurred.[111]
- **29 June 2022, Henley-on-Thames (Oxfordshire):** A Freefly Alta X drone suffered low battery voltage mid-flight and crashed into construction equipment. The incident was during a media imagery project. No injuries resulted.[112]
- **2 July, 2022, English Channel:** A Tekever AR3 drone used for maritime operations experienced fuel starvation due to a failed fuel pump. The engine stopped mid-flight and the drone ditched into the sea.[113]
- **19 July 2022, Morlais Quarry (Mid Glamorgan):** A DJI Inspire 2 was used for vehicle filming and drifted into a quarry area. During descent, the drone's propellers injured an actor on set. The person sustained a non-life-threatening cut.[114]
- **25 July 2022, St Albans (Hertfordshire):** An Evolve Dynamics Sky Mantis lost power mid-flight due to a suspected battery issue. The drone made a forced landing during routine operations.[115]
- **7 August 2022, Bangor (Wales):** A DJI Mavic 2 Enterprise used by police over a public carpark lost power mid-hover. The drone fell and struck the roof of a train station building; no injuries occurred. AAIB attributed it to battery detachment likely due to wear or mis-latching.[116]
- **5 December 2022, Garstang (Lancashire):** A DJI Mavic 2 Enterprise Zoom lost power and control during a commercial survey flight. The drone descended unpredictably, struck a construction worker, and fell into wet concrete. The worker received minor bruising.[117]
- **31 December 2022, Horse Guards Parade (London):** Two UVify IFO drones, operating in a coordinated swarm display, collided mid-air during a New Year's event. Both drones were damaged; no injuries occurred.[118]

110. https://www.gov.uk/aaib-reports?aircraft_category%5B%5D=unmanned-aircraft-systems&date_of_occurrence%5Bfrom%5D=31/12/2021&date_of_occurrence%5Bto%5D=1/1/2025
111. https://www.gov.uk/aaib-reports/aaib-investigation-to-avy-aera-1-dot-5-uas-registration-n-slash-a
112. https://www.gov.uk/aaib-reports/aaib-investigation-to-freefly-systems-inc-alta-x-uas-registration-n-slash-a
113. https://www.gov.uk/aaib-reports/aaib-investigation-to-tekever-ar3-uas-registration-n-slash-a
114. https://www.gov.uk/aaib-reports/aaib-investigation-to-dji-inspire-2-uas-registration-n-slash-a-190722
115. https://www.gov.uk/aaib-reports/aaib-investigation-to-evolve-dynamics-sky-mantis-uas-registration-n-slash-a-250722
116. https://www.gov.uk/aaib-reports/aaib-investigation-to-dji-mavic-2-enterprise-uas-registration-n-slash-a
117. https://www.gov.uk/aaib-reports/aaib-investigation-to-dji-mavic-2-enterprise-zoom-uas-registration-n-slash-a
118. https://www.gov.uk/aaib-reports/aaib-investigation-to-uvify-ifo-1-and-uvify-ifo-2-uas-registrations-n-slash-a

- **17 January 2023, English Channel (Temporary Danger Area EG D098):** A Tekever AR5 Evolution Mk 2 drone temporarily lost its communication link during a maritime surveillance flight. The link was re-established, and the aircraft recovered safely.[119]
- **9 February 2024, Weybridge (Surrey):** A DJI Mavic 2 Enterprise Advanced lost power during a commercial deployment. Investigation found possible battery detach or swell. The drone fell safely outside populated areas. No injuries occurred.[120]

Record-only incidents (not investigated)

This section covers incidents logged by the AAIB but not investigated; they were published as "record-only," without analysis or findings. We manually downloaded the AAIB's record-only data for drones with incident dates from 2022-2024[121] and removed hobby drone use to leave us with commercial incidents. Note that, due to limited details, we classified an incident report as "commercial" based on the value and intended use of the drone model in the reports. If the drone type suggested "hobby" use but the text implied commercial, we classified these as commercial (total of 3 reports in this category). We used these categories for UK report-only occurrences:

- **Airspace Violation or Evasive Action:** drone operations that caused unauthorised airspace entry, or required a crewed aircraft to change course. Includes ATC advisories, near-miss reports and airspace confusion.
- **Loss of Control or Link**: unintended loss of control over the drone, including loss of command link, fly-away events, and failsafe activations. Also includes inability to regain control during recovery. Most commonly triggered return-to-home or uncontrolled descents.
- **Operational Diversion or Cancellation:** drone operations that were delayed, cancelled or diverted due to safety concerns, pilot assessment or automation triggers. Includes precautionary returns and auto-aborts during mission.
- **Technical Failure or Damage:** mechanical or systems failures resulting in flight disruption or drone damage. Includes in-flight malfunctions (e.g. motor faults), structural failures (e.g. propeller separation), or landing gear issues. May lead to precautionary landings or equipment loss.
- **Other / Unclassified:** reports that did not clearly fit the categories above but reflected disruption or abnormal behaviour. Includes: autopilot glitches; firmware issues; loss of GPS lock without clear outcome; reports with unclear summaries or ambiguous results

UK – Record-only investigations for UAS, 2022-2024

Incident Category	2022	2023	2024
Airspace Violation or Evasive Action	1	0	1
Loss of Control or Link	6	10	9
Operational Diversion or Cancellation	0	1	0
Technical Failure or Damage	18	14 (incl 1 BVLOS)	10
Other / Unclassified	24 (incl 1 BVLOS)	20	18 (incl 1 BVLOS)
Total	**49**	**45**	**38**

119. https://www.gov.uk/aaib-reports/aaib-investigation-to-tekever-ar5-evolution-mk-2-g-tekv-170123

120. https://www.gov.uk/aaib-reports/aaib-investigation-to-dji-mavic-2-enterprise-advanced-uas-registration-n-slash-a

121. https://www.gov.uk/search/research-and-statistics?parent=/transport/air-accidents-and-serious-incident keyword search "Record-only UAS"

United States

Investigated incidents

We searched the NTSB database (aircraft category "unmanned," 2022-2024).[122] There are 14 incidents, of which 3 are serious (accidents), in this period (once we remove eVTOLs and non-USA locations). There are no fatalities. Accidents:

- **February 20 2024, Orlando, Florida:** An Apellix B1 washing drone, operating under Part 107 for hospital façade cleaning, experienced a critical loss of directional control shortly after takeoff. The drone became unresponsive to remote commands. In an attempt to disarm it manually, the remote pilot was struck by the rotors and sustained serious lacerations and a partial finger amputation. The NTSB classified the event as an accident under 49 CFR § 830.5.
- **August 7 2024, Francesville, Indiana:** An XAG P100 Pro agricultural drone operating under Part 137 was descending to land when it lost positional accuracy due to GPS signal fluctuations. The drone drifted ~30 feet sideways and struck a ground crew member, causing a broken shoulder. The NTSB determined the probable cause to be the pilot's loss of control due to signal instability
- **December 21 2024, Lake Eola Park, Orlando, Florida:** A Sky Elements drone light show, operating under a commercial waiver, suffered a catastrophic flight path misalignment. Multiple drones collided mid-air, scattering into the audience and causing a serious injury to a seven-year-old child. The NTSB classified the event as an accident under 49 CFR § 830.5. The FAA suspended the operator's waiver pending investigation[123]

Self-reported incidents (not investigated)

We used NASA's Aviation Safety Reporting System (ASRS), which captures voluntary, self-reported aviation safety events. These reports are not formally investigated by the FAA or NTSB and are anonymous by design. We found 167 reported incidents for commercial drones using the ASRS[124] (**Date of Incident** between 2022 and 2024 and **Reporter Organization** Commercial Operator (UAS)). A subset of incidents includes possible beyond visual line of sight (BVLOS) operations. BVLOS status is not formally recorded in ASRS, so these were flagged through keyword analysis of free-text fields (e.g. "beyond visual", "BVLOS"). Figures are indicative from data mining, not definitive. Incident categories are per UK, above.

USA – Self-reported UAS Incidents (ASRS), 2022-2024

Incident Category	2022	2023	2024
Airspace Violation or Evasive Action	28	33	41
Loss of Control or Link	13	5	8
Operational Diversion or Cancellation	2	4	4
Technical Failure or Damage	3	2	2
Other / Unclassified	5	6	11
Total	**51**	**50**	**66**

Figures are indicative only, due to the anonymous and unverified nature of ASRS data.

122. https://www.ntsb.gov/Pages/ResultsV2.aspx?queryId=4ce5ea4a-c9f2-44d2-9115-e638aad112e7 if the table does not render, go to https://www.ntsb.gov/Pages/AviationQueryv2.aspx (CAROL, aviation query) Aircraft Category to "Unmanned" and dates from 2022-2024

123. https://data.ntsb.gov/carol-repgen/api/Aviation/ReportMain/GenerateNewestReport/199458/pdf

124. https://asrs.arc.nasa.gov/search/database.html

Europe

Public reporting of drone incidents in Europe is fragmented. There is no unified, publicly searchable database covering all EASA countries. Most NAAs are only required to report drone incidents if the event resulted in serious or fatal injury and/ or significant damage. Accordingly, incidents involving small drones or those causing no harm are often not reported or published.[125] EASA maintains the ECCAIRS2 database, which aggregates drone incident reports across NAAs from member states, but this is not accessible to the public.

To identify commercial drone incidents, we conducted manual searches across NAA websites, government investigations, industry publications and drone media (e.g. sUAS News, DroneXL, Dronelife and DroneDJ). Only confirmed incidents involving commercial operations or drones operating in the certified or specific category were included. Hobbyist, military and unverified social media reports were excluded. Given the limited transparency and inconsistent publication across member states, publicly-accessible coverage of commercial drone incidents in Europe remains patchy.

EASA began publishing drone-specific data for the first time in its 2024 Annual Safety Review[126], which stated:

- 12 drone occurrences were recorded in 2023
- Only 2 were flown under an operational authorisation in the specific category, i.e. likely to be commercial
- The remainder were in the open (mostly hobby) category and included 1 fatality (model aircraft)

We note that, per recommendations prepared by the UAS Working Group of the Network of Analysts, the ECCAIRS taxonomy (drone incident categorisation) is set to be amended to improve how drone occurrences are categorised and reported.

125. Reporting obligations are set out in Article 3(2) of Regulation (EU) No 376/2014, as amended by Regulation (EU) 2018/1139.

126. https://www.easa.europa.eu/en/document-library/general-publications/annual-safety-review-2024

National investigators across Europe have documented a handful of incidents involving commercial drones since 2022, for example:

- **May 2022, Oslo (Norway):** A DJI Mavic 3 operated by TV 2 Luftfoto collided with a ship's mast while filming from a vessel. No injuries[127]
- **May 2022, Fehmarn (Germany):** A Schiebel Camcopter S-100 (200 kg) performing emissions monitoring for EMSA suffered an engine failure and crashed into the Baltic Sea. No injuries[128]
- **July 2022, Dublin (Ireland):** A Manna delivery drone lost a propeller mid-flight; the detached blade struck a man on the ground (minor cut to head). The drone's emergency parachute deployed and it landed safely[129]
- **August 2022, Bergen (Norway):** A DJI Mavic 3 operated by TV 2 Luftfoto lost control during a training flight and crashed through a third-floor window. One person inside sustained minor injuries[130]
- **August 2023, Crete (Greece):** A Frontex Heron 1 surveillance drone lost its satellite link and fell into the sea during a border patrol mission. No injuries; investigation ongoing[131]

No serious injuries or fatalities linked to commercial drone operations were reported in Europe.

127. https://nsia.no/Aviation/Published-reports/2023-04
128. https://aerossurance.com/air-accidents-incidents/schiebel-s100-engine-failure
129. https://aaiu.ie/aaiu_report/final-report-accident-involving-a-unmanned-aircraft-gen-3-8-at-tankardstown-balbriggan-co-dublin-on-14-july-2022-report-2024-011
130. https://nsia.no/Aviation/Published-reports/2024-04
131. https://digit.site36.net/2023/08/27/second-frontex-drone-crashed-near-crete-airbus-was-allowed-to-fly-the-heron-1-alongside-civilian-aircraft/

Canada

Investigated incidents are logged on the Transportation Safety (TSB) website[132] which, unfortunately, lacks keyword search functionality. We did not find a record of investigated drone incidents for 2022-2024 and web scraping appears to confirm this.

The Civil Aviation Daily Occurrence Reporting System (CADORS)[133] does not have a category for drones but, using several word search combinations (drone, unmanned, UAS, UAV, RPAS) and filtering out likely hobby use and lines that are not incidents, we have the following incident counts.

Incident Category	2022	2023	2024
Airspace Violation or Evasive Action	3	4	3
Loss of Control or Link	4	1	2
Operational Diversion or Cancellation	0	0	0
Technical Failure or Damage	2	0	0
Other / Unclassified	1	0	0
Total	**10**	**5**	**5**

No serious injuries or fatalities linked to commercial drone operations were reported.

Singapore

Singapore has no publicly searchable database of drone safety incidents. CAAS collects mandatory reports through the Safety and Incident Reporting System (SAIRS) and voluntary reports through "Tell Sarah" but neither system is open to the public. Only serious events are investigated by TSIB. TSIB publishes individual final reports on the Ministry of Transport website but there's no central index or search function. Two significant incidents occurred:

- **July 2024, One-North Drone Estate: Hexadrone Tundra 2** drone malfunctioned during flight, became out of control and crashed into a condominium building. No injuries were reported. The drone model was grounded nationally.[134]
- **February 2024, Sentosa: ST Engineering DroNet DrN-35LS** drone lost GNSS signal during a maritime flight, crashed offshore and was not recovered. No injuries[135]

No serious injuries or fatalities linked to commercial drone operations were reported.

132. https://www.tsb.gc.ca/eng/rapports-reports/aviation/index.html
133. https://wwwapps.tc.gc.ca/Saf-Sec-Sur/2/cadors-screaq/m.aspx
134. https://www.mot.gov.sg/docs/default-source/about-mot/hexadrone-tundra-2-urban-uncontrolled-flyaway-on-19-july-2024-final-report.pdf
135. https://www.mot.gov.sg/docs/default-source/about-mot/loss-of-ua-at-sea-19-feb-24-final-report.pdf

Hobbyist drone context

Across all five Comparable Countries, hobbyist drone incidents remain problematic and primarily relate to airspace intrusions near airports and emergency sites. Canada, USA and EASA countries notably reported enforcement actions against hobbyists, including significant fines and legal charges. Hobbyist incidents typically arise from ignorance or deliberate disregard for rules, highlighting the importance of education and enforcement.

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