Industry in Focus

Skies Without Limits

v3.0

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pwc

Contents

Skies Without Limits v3.0

An insight into the progress of the UK drone industry from the perspective of organisations featured in the Skies Without Limits v2.0 case studies

1 Overview

Introduction

PwC's report "Skies Without Limits v2.0"[1] (SWL2) described the potential for drones to positively impact the UK economy by 2030. It noted that drones are often faster, safer, cheaper and better for the environment than other options and that there were many barriers to overcome to unlock drone potential.

In this report, we offer an insight into the progress (or otherwise) of the UK drone industry from 2021 to 2024, through the lens of ten exciting organisations featured in the SWL2 case studies, along with PwC, which is an innovator and heavy user of drone services[2]. Drone applications range from BVLOS (Beyond Visual Line of Sight) surveillance and inspection to crop spraying and seeding, to last-mile delivery. Views on whether growth since 2021 has met expectations, and the level of progress against the potential barriers to growth identified in SWL2[3], are equally varied.

Growth and Commercial Volume

A handful of organisations report faster than expected growth since 2021 and we have some enticing headlines such as **daily BVLOS flights, routine BVLOS in unsegregated airspace, drones spraying chemicals** and **"automotive-like" drone production** in the UK.

However, if we look behind the headlines we find a more nuanced situation: BVLOS is severely restricted, chemical spraying is limited to uncontrolled substances and significant growth is usually driven by international rather than UK demand. None of the organisations focusing on BVLOS consider they have achieved commercial volume[4] in the UK and uncertainty about the timing of routine BVLOS operations in unsegregated airspace has, arguably, contributed to nervousness and funding challenges in the UK venture capital and private equity sectors.

Unlocking Drone Potential

We asked the organisations to evaluate whether the barriers to growth identified in SWL2 **(Perception, Implementation, Technology, Regulation, Skills[3])** were limiting their growth in 2021 and 2024. We used a simple RAG[5] rating to capture the organisations' perspectives: green indicated that the barrier did not present any issues in terms of growth, amber some issues and red signalled a significant issue. Overall, we found a positive outlook with 60% of all 2024 barrier responses marked green and 35% amber. In terms of trend, 44% of all barrier responses showed an improvement from 2021 to 2024, with 51% staying the same.

The most positive change is in **Perception** (client or stakeholder attitudes to, and openness towards the solution) with more than 70% noting an improvement since 2021 and more than 90% marking it as green in 2024. This reflects the increased acceptance and normalisation of drone solutions. We found that organisations which had faced regulatory challenges, such as BVLOS or chemical spraying, in 2021 often felt they had made the most progress. However, as mentioned above, this perceived progress did not enable them to reach commercial volume.

Conversely, **Regulation** (the extent to which current regulations facilitate the solution) garnered the lowest percentage of green responses (27%). Around a fifth of respondents marked it red (issue), while the majority marked it as amber (indicating some issues). Most respondents viewed **Regulation** as unchanged during the period. Notably, this category also showed the only decline in trends from 2021 to 2024, with one organisation's perception shifting from amber to red, leading them to focus investment offshore. This is not to suggest that no progress has been made; approximately a third of those marking it amber in 2024 viewed this as an improvement from red in 2021.

Another interesting finding was that a few organisations, particularly those innovating outside of BVLOS, gave the impression that they were in control of their own destiny and not constrained by the barriers to growth in 2021 or 2024. Their situations varied from facing internal funding challenges[6] to experiencing no significant growth issues.

We expand on **Regulation** and **Perception** and discuss **Technology**, **Implementation** and **Skills** in Section 3 below.

1. Skies Without Limits v2.0
2. Although we view these entities as representative and the findings are predominantly as expected, 11 is a small sample size, results should be seen in this context and reading the full case studies in Section 5 is recommended
3. Skies Without Limits v2.0, pages 6-10
4. Commercial volume refers to a drone solution that is sufficiently mature and has enough end client demand to result in a competitive market and profitable operations. For example, in 2021 we could have said that VLOS oil and gas drone inspection was at commercial volume.
5. RAG – Red, Amber, Green status for the barriers to growth where green represents no issues, amber some issues and red indicates the barrier is an issue in terms of growth
6. Internal funding challenges may be viewed as a **Perception** issue, but not by the organisation that reported them who marked **Perception** green

UK Versus the Rest of the World

We asked organisations with international operations to compare their experiences in the UK with those in other countries. A recurring theme was the UK regulators' particularly risk-averse attitude, which the organisations believed contrasts with the rest of the world and slows down the realisation of drone benefits, especially in areas such as BVLOS and chemical spraying. Another theme was that the UK regulator appeared less commercially focussed than other countries. Accordingly, many of the organisations that rely on BVLOS and/ or prioritise growth have expanded by looking for opportunities outside the UK.

Changes in the UK Approach

As you might expect from the previous points, when we asked organisations about the changes they wanted in the UK, they focused on regulations (BVLOS and chemical) and expressed a desire for a change in attitude towards risk, a commercial focus, and the simplification of flight permissions. Many of the organisations noted that the regulator had made progress and was planning further positive changes, such as SORA[7] and pilot competence[8]. We note that the aviation regulator's initiatives, outlined in the Future of Flight Action Plan[9] are now better funded and resourced than ever before and will have a transformative impact when implemented. We also note continuing progress in areas including, but not limited to, digitisation (DiSCO[10]), further BVLOS sandbox trials[11] (including last-mile delivery) and that the next phase of the Future Flight Challenge will be focussed on commercialisation of these exciting new technologies.

We continue to subscribe to the view that initiatives should be use-case led, with resources focussed on applications that have the most compelling combination of end-client pull, benefits and risk profile. Refer to our 2023 paper with the Department of Science, Innovation and Technology (DSIT), Building Trust in Commercial Drones (BTiCD)[12] and to Section 4, below. The responses also imply that that the UK should look to learn from other countries, particularly regarding attitude to risk, focus on commercialisation and, arguably, the foundational role that UTM[13] could play in safely increasing drone operations[14].

Conclusion

In conclusion, although this limited sample suggests that the UK drone industry has made notable strides over the past three years, it has not advanced at the pace required to achieve the adoption curve that underpins the figures in SWL2[15]. Quantifying this shift to the right is out of scope for this paper.

The next sections outline our methodology, present a summary of organisation responses and examine recurring themes in the PwC barrier to growth categories of **Perception**, **Regulation**, **Technology**, **Implementation** and **Skills**. The final section presents the case studies, and we extend our sincere thanks to the organisations for participating in this paper

Disclaimer: This document is based on the responses received from the organisations, with the opinions expressed being solely those of the respective respondents unless stated otherwise. Please note that the references are intended to be illustrative rather than exhaustive.

7. CAA Specific Operations Risk Assessment Update
8. CAA Pilot competence, the future Remote Pilot Competence (RPC) scheme
9. DfT Future of Flight Action Plan
10. CAA Digitising Specific Category Operations (DiSCO) project overview, also PDRA-01 tool
11. CAA New trials set to help unlock drone deliveries and inspections in the UK
12. DSIT and PwC, Building Trust in Commercial Drones
13. Unmanned or Uncrewed Traffic Management (not "Unified" in this paper)
14. Refer to Section 4, Technology which notes that some countries view UTM as foundational tech
15. Skies Without Limits v2.0, pages 2, 6, 54-56

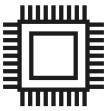
2 Methodology

SWL2, in collaboration with DSIT and DfT, described the potential for drones to positively impact the UK economy by 2030.

It noted that drones are often faster, safer, cheaper and better for the environment than other options and that there were many barriers to overcome to unlock drone potential. SWL2 noted 5 potential barriers to growth[16]:

Perception
Client or stakeholder attitudes to, and openness towards the solution

Implementation
Success in integrating the solution with business as usual



Technology
Availability and efficacy of technology required to facilitate the solution

Regulation
Degree to which current regulations facilitate the solution

Skills
Ability to find the appropriate mix of skills in the market

We asked the organisations whether these perceived barriers to growth were an issue in 2021 and whether this had changed in 2024. We used a simple RAG (red, amber, green) format: green (no issue), red (issue), and amber (some issues).

We asked a range of other questions in areas including achievements, business profile, limiting factors, BVLOS significance, views on UTM[17] and whether their business was at commercial volume[18]. Another key question for some organisations was whether their UK business was performing differently compared to their international business.

16. Skies Without Limits v2.0, pages 6-10
17. Unmanned or Uncrewed Traffic Management (not "Unified" in this paper)
18. Commercial volume refers to a drone solution is sufficiently mature and has enough end client demand to result in a competitive market and profitable operations. For example, in 2021 we could have said that VLOS oil and gas drone inspection was at commercial volume.

3 Organisation Summaries

Summary of Barriers to Growth Status

This section summarises the case study updates, refer to Section 5 for the full version.

Barrier	MCA	Windracers	Manna	sees.ai	Cyberhawk	Auto Spray	Drone Ag	EA	Team UAV	PC	PwC
Perception	↗ ■	↗ ■	↗ ■	↗ ■	↗ ■	↗ ■	→ ■	→ ■	↗ ■	→ ■	↗ ■
Implementation	↗ ■	↗ ■	↗ ■	↗ ■	→ ■	↑ ■	→ ■	→ ■	↗ ■	→ ■	↗ ■
Technology	→ ■	→ ■	↗ ■	↗ ■	→ ■	↗ ■	↗ ■	→ ■	↗ ■	→ ■	→ ■
Regulation	→ ■	↗ ■	↗ ■	↗ ■	↘ ■	↗ ■	→ ■	→ ■	→ ■	→ ■	→ ■
Skills	→ ■	→ ■	→ ■	↗ ■	→ ■	↑ ■	→ ■	→ ■	→ ■	→ ■	→ ■
BVLOS core	Yes	Yes	Yes	Yes	Partial	No	No	No	No	No	No
Prime use case	Surveillance	Middle Mile	Last Mile	Inspection	Inspection	Agriculture	Agriculture	Survey	Inspection	Survey	Survey
Territory	UK	Global	Global	UK	Global	UK	Global	UK	UK	UK	Global

Barrier and RAG definitions in the Methodology section above. Arrow indicates trend from 2021 to 2024. MCA is Maritime and Coastguard Agency, EA is Environment Agency and PC is Plowman Craven.

Maritime and Coastguard Agency (Surveillance)

Daily BVLOS for surveillance

SWL2 case study

Barrier		
Perception	↗	
Implementation	↗	
Technology	→	
Regulation	→	
Skills	→	
BVLOS core	Yes	
Prime use case	Surveillance	
Territory	UK	

The Maritime and Coastguard Agency (MCA) has made significant strides since 2021 and are now conducting daily BVLOS surveillance missions in the English Channel through their supplier Bristows. Despite these advancements, regulatory constraints continue to limit their coverage area, operating hours, and ability to respond swiftly to emergencies. MCA is actively advocating for regulatory changes and a shift in risk mindset to enable effective BVLOS emergency responses throughout their patrol area.

The most notable barrier to growth from 2021 to 2024 is regulation, which has remained flat and marked red, indicating it was and still is a significant issue.

Go to Section 5 to read the full case study update

Windracers (Middle Mile Delivery)

"Automotive-like" drone manufacturing in the UK

SWL2 case study

Barrier		
Perception	↗	
Implementation	↗	
Technology	→	
Regulation	↗	
Skills	→	
BVLOS core	Yes	
Prime use case	Middle Mile	
Territory	Global	

Windracers has made considerable progress since 2021, leveraging their UK achievements to seize international opportunities in both military and commercial sectors. They believe the Ukraine war has shifted the UAV market from a question of "if" to "when," driving increased international demand and enabling them to establish an automotive-style production facility in the UK. However, progress within the UK has been slower, prompting Windracers to urge regulators to expedite the approval process for BVLOS operations, especially those with strong end-customer demand in sparsely populated areas.

Notable views on barriers to growth from 2021 to 2024 include an improvement in perception from amber to green and regulation from red to amber.

Go to Section 5 to read the full case study update

Manna (Last Mile Delivery)

Last mile drone delivery with “positive unit economics”

SWL2 case study

Barrier		
Perception	↗	■
Implementation	↗	■
Technology	↗	■
Regulation	↗	■
Skills	→	■
BVLOS core	Yes	
Prime use case	Last Mile	
Territory	Global	

Manna has made significant progress in technology, regulation, and market penetration since 2021, with “positive unit economics” claimed. However, they are unable to operate in the UK due to more restrictive regulations compared to countries like Ireland and the USA. There is also uncertainty about whether Manna’s positive perception of delivery drones would hold true in the UK, as delivery drones were among the least supported use cases in the 2023 Building Trust in Commercial Drones (BTiCD)[19] report.

Notable views on barriers to growth from 2021 to 2024 show perception, implementation, and technology improving to green.

Go to Section 5 to read the full case study update

19. PwC and DSIT, Building Trust in Commercial Drones

Sees.ai (BVLOS Inspection)

Regular BVLOS inspection in unsegregated airspace

SWL2 case study

Barrier		
Perception	↗	
Implementation	↗	
Technology	↗	
Regulation	↗	
Skills	↗	
BVLOS core	Yes	
Prime use case	Inspection	
Territory	UK	

Since 2021, sees.ai has successfully implemented routine inspections of powerlines using remotely piloted drones. They secured the UK's first permission to conduct regular BVLOS flights in non-segregated airspace, facilitated by strong end-client demand. However, growth has been constrained by capital availability.

Notable views on barriers to growth from 2021 to 2024 show all categories trending up, with regulation improving to amber.

Go to Section 5 to read the full case study update

Cyberhawk (Inspection)

More than 100% drone service provider growth

SWL2 case study

Barrier		
Perception	→	
Implementation	→	
Technology	→	
Regulation	↘	
Skills	→	
BVLOS core	Partial	
Prime use case	Inspection	
Territory	UK	

Cyberhawk has seen impressive progress over the past three years, with global revenue increasing by more than 100% from 2021 to 2023 and headcount reaching around 200. Cyberhawk is arguably more focussed on **Implementation** than most and we can speculate that this was a key part of their success. However, growth has been driven primarily by the US and Middle East, as they feel constrained by the UK's regulatory approach, which they consider has become less progressive since 2021. Despite this, they are optimistic about the UK's new regulatory direction and believe that BVLOS could help reduce costs in the UK as it has in the USA.

Notable views on barriers to growth from 2021 to 2024 show a change in regulation from amber to red.

Go to Section 5 to read the full case study update

Auto Spray Systems and Drone Ag (Agriculture)

Spraying and seeding in the UK

SWL2 case study

Barrier	Auto Spray Systems		Drone Ag	
Perception	↗	■	→	■
Implementation	↑	■	→	■
Technology	↗	■	↗	■
Regulation	↗	■	→	■
Skills	↑	■	→	■
BVLOS core	No		No	
Prime use case	Agriculture		Agriculture	
Territory	UK		Global	

Scanning, spraying, and seeding are now a reality in the UK, thanks to progress made by Auto Spray Systems, Drone Ag, and others with the CAA and CRD (Chemicals Regulation Directorate) over the past three years. Although operations are currently small-scale, there is substantial potential to grow the market and contribute to UK food security with more approved chemicals and simplified flight permissions.

Notable views on barriers to growth from 2021 to 2024 show improvements in technology to green for both, with regulation amber, an improvement for Auto Spray and flat for Drone Ag.

Go to Section 5 to read the full case study update

Environment Agency (Survey)

Expanding internal drone use

SWL2 case study

Barrier	
Perception	→
Implementation	→
Technology	→
Regulation	→
Skills	→
BVLOS core	No
Prime use case	Survey
Territory	UK

The Environment Agency (EA) has continued to operate a 24/7, 365-day flood response service through a vendor. Since 2021, the EA has significantly increased its number of pilots and developed additional use cases. They have integrated drones from a project-based approach into their routine operations. The primary growth challenges faced by the EA are internal rather than external.

Notable views on barriers to growth from 2021 to 2024 show all categories remaining flat, with regulation staying at amber.

Go to Section 5 to read the full case study update

Team UAV (Internal Inspection)

Developing inspection in confined spaces

SWL2 case study

Barrier		
Perception	↗	
Implementation	↗	
Technology	↗	
Regulation	→	
Skills	→	
BVLOS core	No	
Prime use case	Inspection	
Territory	UK	

Team UAV has increased focus on internal inspections in confined spaces, driven by the ability to bypass many regulatory obstacles, enhance safety, and provide valuable data. Despite this transition suggesting largely unimpeded growth, they face challenges such as skill shortages and clients forming their own drone teams. They believe BVLOS operations in unsegregated airspace would enable them to expand their business in the UK.

Notable views on barriers to growth from 2021 to 2024 show regulation marked green due to their focus on VLOS and internal drones[20] and skills marked red.

Go to Section 5 to read the full case study update

20. Not subject to the same regulations as external drones

Plowman Craven (Survey)

Evolution of high accuracy solutions

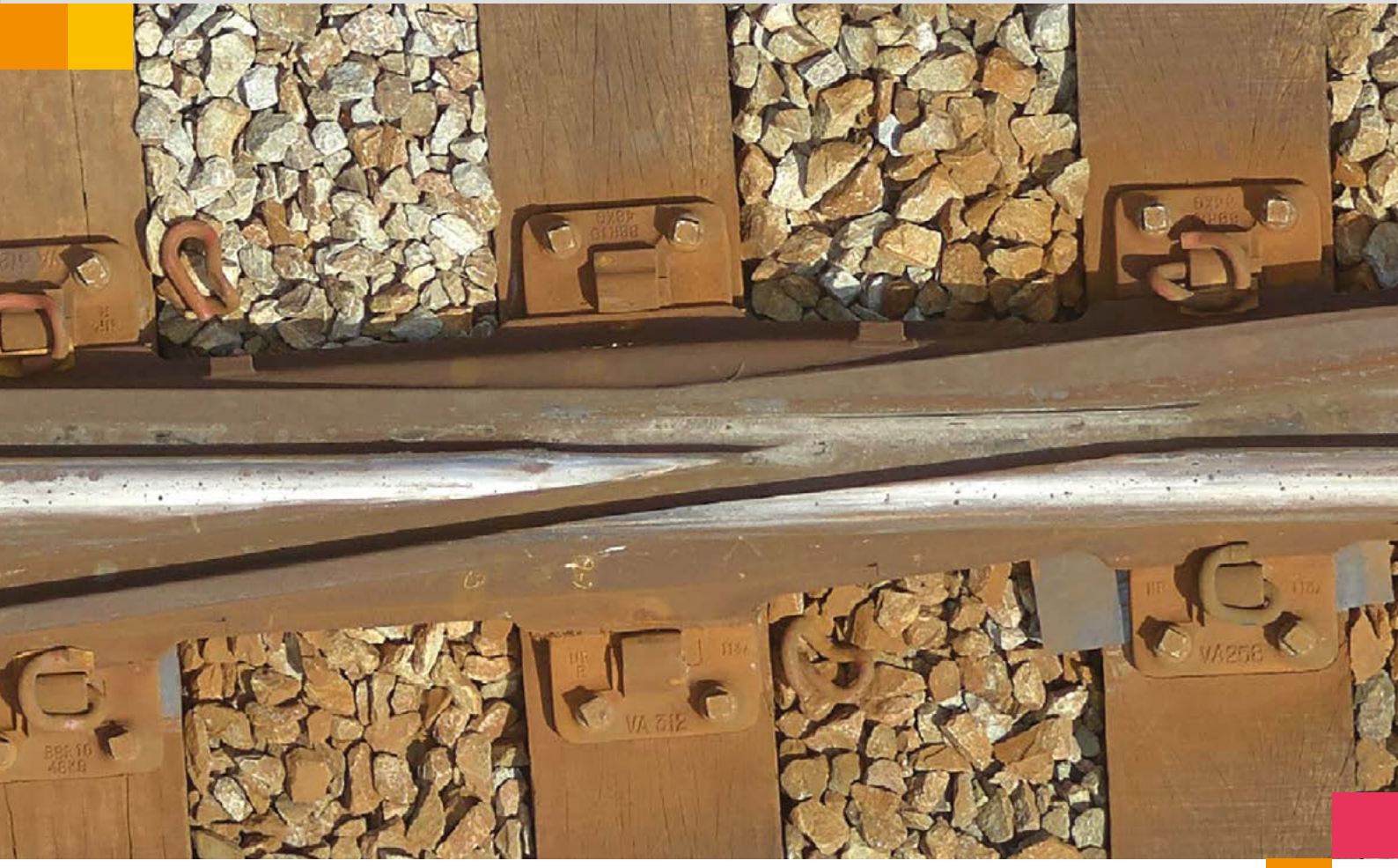
SWL2 case study

Barrier		
Perception	→	■
Implementation	→	■
Technology	→	■
Regulation	→	■
Skills	→	■
BVLOS core	No	
Prime use case	Survey	
Territory	UK	

Plowman Craven achieved remarkable accuracy in surveying railways in 2021, delivering significant safety, cost, and efficiency benefits. They are the only respondent to consider all barriers to growth as green in both 2021 and 2024, reflecting a company that believes it is in control of its own destiny. They view drone solutions as complementary to their traditional land survey business rather than an end in themselves.

Notable views on barriers to growth from 2021 to 2024 show all categories remaining flat and green.

Go to Section 5 to read the full case study update



PwC (Inventory Audit)

Integration of drones with business as usual

SWL2 case study

Barrier		
Perception	↗	■
Implementation	↗	■
Technology	→	■
Regulation	→	■
Skills	→	■
BVLOS core	No	
Prime use case	Survey	
Territory	Global	

PwC has been a pioneer in using drones for inventory auditing since 2018. Since 2021, they have fully integrated drones into their business operations, expanded the scope of inventory covered, and delivered services internationally. They have also adopted a flexible approach to aerial data, incorporating satellite capture.

Notable views on barriers to growth from 2021 to 2024 show improvements in perception and implementation to green.

Go to Section 5 to read the full case study update

4 Observations on Barriers to Growth

Perception

Client or stakeholder attitudes to, and openness towards the drone solution

In our discussion of barriers to growth in the first section, we noted that the most positive change is in **Perception**, with over 70% reporting an improvement since 2021 and more than 90% marking it as green. This reflects increased openness to drones. Organisations facing regulatory challenges in 2021, like BVLOS or chemical spraying (Windracers, Manna, sees.ai, Auto Spray), felt they had made the most Perception progress, but have not achieved commercial volume. This mirrors the findings in our 2023 Building Trust in Commercial Drones (BTiCD)[21] paper, where more than 80% of respondents thought that drones would be beneficial to their industry and positive feeling about commercial drones increased from 56% in 2019 to 72% in 2022.

However, in SWL2, we stated that

> "Although many thought that negative Public Perception could limit the adoption of drone technology, to date, it has not been a significant barrier to growth in Commercial Drone applications such as Inspection and Survey. Public Perception is likely to be a much more significant point when Last Mile Delivery of parcels and food starts to gain momentum and, to a lesser extent, when Drone-in-a-Box use cases such as security monitoring emerge."

With practically zero of the potentially more intrusive use cases (last-mile delivery, drone-in-a-box) in the UK, one could argue that this point has still not been tested. If we consider the Windracers (middle-mile) and Manna (last-mile) delivery applications, the companies themselves report very positive end-client perception, implying Perception may not be an issue.

Manna say:

> "Consumer surveys have indicated positive sentiment towards drone delivery for many years (88%+ of consumers are in favour of the service). Over the past 3 years, we have seen increased levels of acceptance and a sense of inevitability across investors and the business community that drone delivery will be part of the fabric of modern society in the near future."

However, there are some international examples where delivery drones have not been positively received, including a campaign in an Australian suburb of Canberra to ban Wing's delivery drones, which was ultimately successful[22]. However, this may be a blip – Wing were one of the exemplars we mentioned in SWL2 and claim "350K+ commercial deliveries across 3 continents," to date, with recent advances including a one pilot to 50 drones ratio[24].

21. PwC and DSIT Building Trust in Commercial Drones
22. Guardian, 10th August 2024, What opposition to delivery drones shows about big tech's respect for democracy
23. Wing.com, as at September 2024
24. Guardian, 25th August 2024, We don't stop for red lights': drone deliveries take off as Australian regulators prepare for air traffic boom.

Regulation

Degree to which current regulations facilitate your solution

There was a contrast to **Perception** in the **Regulation** category which had the lowest percentage of green responses (27%) and the highest proportion of reds (one fifth). More than half of the organisations considered **Regulation** flat from 2021 to 2024, but this included three that viewed it as green (Team UAV, Plowman Craven, PwC). These organisations, innovating outside of BVLOS, felt fully in control and unconstrained by this potential barrier to growth. In contrast, one organisation (Cyberhawk) reported the only deterioration in barriers to growth status; they felt that regulations were more challenging in the UK in 2024 than 2021 and much more complex than, say, the USA. The only organisation flying daily BVLOS (MCA) marked a red in **Regulation**, due to restrictions around their BVLOS operations which limited scope and did not enable them to respond to emergencies.

This is not to say there has been no progress, several organisations (Windracers, Manna, sees.ai, Auto Spray) marked progress from red in 2021 to amber in 2024. There were positive words about **Regulation** in several of the responses, including excitement about the potential for SORA[25] to simplify matters (Cyberhawk, Manna), pilot certification[26] (EA), spraying and seeding (Auto Spray, covering both CAA and CRD).

Auto Spray say:

> “The biggest changes, since the report was released, have been in the accessibility of the CAA and HSE/CRD. The CAA have been very responsive to our evolving licencing requirements and we have engaged very deeply with HSE/CRD on PPP[27] authorisations and are making good progress.”

25. CAA Specific Operations Risk Assessment Update
26. CAA Pilot competence, the future Remote Pilot Competence (RPC) scheme
27. Plant Protection Products or pesticides, HSE

That said, when we factor in the international comparison, the overwhelming impression given by organisations which operate abroad is that the UK is somewhat behind the rest of the world with a more conservative approach to risk and a more complex and lengthy process for obtaining permissions.

Cyberhawk say:

> “Regulatory oversight in the UK is not as progressive as other regions such as the US. Permissions we have held for over 15 years are now being eroded in the UK and we have gone backwards in some areas. Conversely, the ability to operate in atypical airspace in the US has accelerated our BVLOS operations and demonstrated a clear path to scaling our operations and delivering cost reductions. There is a clear difference in who is accountable for risk between the UK and US. In the UK it feels like the CAA own the risk whereas in the US the operator holds the majority of the risk. For example, we applied for a countrywide BVLOS permission in the US (in atypical airspace) and the submission was <50 pages and took 2 months to gain approval. In the UK our routing submission for an operational authorisation is 1600 pages. 5 months on we are working through the CAA Oversight Report.”

When it comes to BVLOS in the UK then, we are reminded of the quote from the 2021 Regulatory Horizons Council report we used in SWL2 which still applies:

> “BVLOS, however, remains “largely experimental” (Regulatory Horizons Council) and quite some distance from the Routine BVLOS required to unlock the projections in this report. It is also noted that the existing process for obtaining BVLOS permission is time consuming and there are opportunities for the CAA to increase automation and resourcing in this area.”

Regulations were also a primary concern in BTiCD, with the vast majority of respondents mentioning this topic in their responses, despite it not being a direct question. In fact, progress on regulation was the most requested action, more than four-fifths of respondents listing it among their top three actions.

However as we noted in Section 1, there are a plethora of initiatives in the Future of Flight Action Plan[28] and the CAA is considerably better funded and resourced than it was in 2021; we could argue that optimism and confidence is high. Progress could, perhaps, be accelerated by a use-case led approach and, in Section 1, we suggested that regulatory resources should be focussed on applications that have the most compelling combination of end-client pull, benefits and risk profile and other applications following later. We reached a similar conclusion in the BTiCD report.

28. DfT Future of Flight Action Plan

Consider these points from Windracers which touch on relative risk and end-client pull:

> Windracers would like to see that regulatory regimes for BVLOS operations of larger UAVs in all markets focus on low-populated areas. Setting rules for these areas would enable consistent BVLOS operation with lower risk (compared to operations over populated areas) and provide delivery services to populations that have not equivalent access and cost as those in populated areas"…"There is a true commercial need in the Orkney Islands – and many other areas across the world – for faster delivery of non-urgent parcel, post and cargo…If changes can foster more regular BVLOS operation of larger UAVs, a new market for delivery routine services could be created and the commercial use cases could be better understood and served."

Finally for this section, our understanding is that uncertainty around the timing and complexity of routine BVLOS operations has contributed (though it is by no means the sole issue) to funding challenges in the venture capital and private equity sectors. Examples may include sees.ai and Flylogix[29].

29. Energy Voice, Flylogix: BP-backed drone firm lands in administration

Technology

Availability and efficacy of technology required to facilitate the solution

Views on **Technology** are positive overall, with 64% green and the balance amber, but the majority (55%) view this as flat from 2021. The techs we highlighted in SWL2 were UTM (Unmanned rather than unified Traffic Management, including Electronic Conspicuity (EC)), Detect and Avoid (DAA), autonomy and infrastructure with honourable mentions for batteries/ fuel cells, sensors, swarming and touch.

If we drill into UTM, intrinsically linked to **Regulations** and the subject of one of the discrete questions we asked the organisations, we find a range of views. Global evidence suggests that UTM is an important factor in maximising drone adoption, refer to the PwC paper[30] on this topic which finds that UTM has a "pivotal role in enabling the drone sector".

When we asked the organisations "Do you feel that UTM technologies are required for UK BVLOS drone operations?", we had a wide range of answers which, perhaps, offer some insight into the UK approach to UTM. Unsurprisingly, organisations with mainly VLOS operations were usually neutral on this point.

Organisations with BVLOS-dependent businesses, ranged from very strong advocacy such as Manna:

> "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.
>
> Our experience with UTM initiatives in the United States, including participation in the FAA's[31] shared airspace implementation programme, underscores the importance of these technologies. Implementing UTM systems will enable more reliable and scalable BVLOS operations, promoting the growth of the drone industry and enhancing our operational capabilities by ensuring safety, efficiency, and regulatory adherence."

To equivocal support. sees.ai say:

> "UTM means different things to different people; is just one of many technologies that contribute to BVLOS; and definitely not the most important today."

Windracers say:

> "…a straight UTM only tool, may not add that much benefit."

30. PwC Strategic Insights for Thriving in the Unmanned Traffic Ecosystem
31. Federal Aviation Administration

It appears that, in the UK, UTM is seen as part of a suite of measures to facilitate routine BLVOS rather than a foundational technology which, when deployed and mandated, has the potential to simplify and accelerate drone adoption, including BVLOS. The Future of Flight Action Plan has UTM trialled in 2024 and regulations governing UTM in place by 2026. Consider the approach in Poland where UTM was deployed in 2020 and is viewed as a core element of their progress. We could consider this "build it and they will come", with almost 700K operations in 2023, of which around 23.5K were BVLOS[32], routinely approved in Poland in segregated airspace. While it is true that Polish airspace is rather less complex and involved than UK airspace, there are, perhaps, lessons to be learned from their approach, not least the importance they attached to UTM as a foundational tech.

DAA and EC feature in the Future of Flight action plan with ground-based DAA certifiable in 2024, on-board DAA and EC certifiable by 2025. We note that the Future Flight Challenge (FFC) Phase 3 Skyway project[33], a 165 mile drone superhighway with BVLOS in unsegregated airspace plans, includes ground-based DAA from consortium lead Altitude Angel.

Regarding autonomy, the CAA's AI team has done some positive initial work on the definitions[34]. Although AI is not required for autonomy, the approach the regulator adopts to certify AI-dependent systems, even if limited to deterministic AI[35], is likely to be critical to the growth of the drone industry.

Thorough AI testing and robust cybersecurity measures are expected to be crucial in safely enabling higher volumes of drones, Advanced Air Mobility (AAM) and commercial aviation. This cybersecurity must cover the entire digital ecosystem and distributed ledger technology such as blockchain could play a significant role. Refer also to our paper on the potential socioeconomic impact of AAM on the UK economy[36].

We understand that there has been little progress in terms of drone physical infrastructure since 2021 but BT's announcement in 2023 of the UK's first Drone SIM[37] indicates progress in one element of the digital infrastructure required for routine BVLOS. In a similar manner to **Perception**, digital and physical infrastructure will only become significant challenges when there is a step increase in drone flights, perhaps driven by last-mile delivery drones.

Lastly for this section, we will refer again to SWL2, linking back to the international commentary in the Regulation section:

> "There is also a view that much of the drone technology required to realise the potential for drone productivity benefits is already here, proven in trials, and that the limiting factor is the approach taken in the UK, compared to other countries."

32. 2023 figure of 668,786 is here (in Polish). The 2023 figures include 23.5K BLVOS flights (NSTS-05 to NSTS-08 at the linked page are BVLOS missions and NSTS is the acronym for National Standard Scenarios)
33. Altitude Angel, Project Skyway
34. CAA CAP2966, AI Terminology Paper
35. Deterministic AI is usually defined as an AI system where the same inputs will always result in the same outputs, it is not the same as, say, generative AI where the same inputs can result in different outputs
36. PwC and FFC Advanced Air Mobility UK Economic Impact Study
37. BT, BT connects the skies with the UK's first Drone Sim

Implementation

Client or stakeholder success in integrating the solution with business as usual

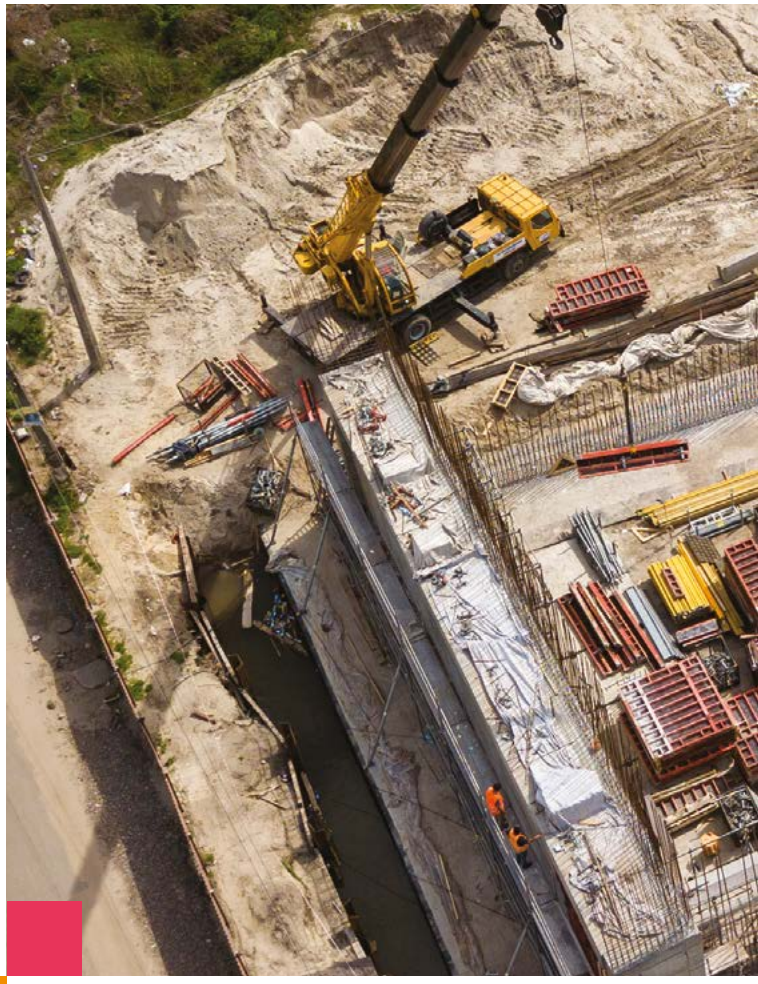
When we look at **Implementation** we have a mixed picture with 45% amber and 55% green, although the majority are trending up (64%) and the balance are flat. One organisation (Cyberhawk), arguably more focussed on this element than most, has grown by more than 100% from 2021 to 2023 and we can speculate that this was a part of this success. Other organisations have, perhaps, set the bar lower and marked **Implementation** green even when only sending data such as raw files and/ or pdfs, as that is what their client asks them for. This latter point could help to explain the higher-than-expected number of green scores in this category. Alternatively, this could reflect the different integration challenges associated with drone solutions that are not rooted in land survey or inspection, such as crop spraying and delivery.

In SWL2, we note

> “Simply flying a drone, capturing sensor data such as images and even processing this into 2D and 3D models is not enough to realise the potential of drone-powered solutions. Drone information must be fit-for-purpose and integrated with business-as-usual workflows and IT systems.
>
> One of the issues with implementing drones in an organisation is that the implementation is often considered “box ticked” when a vendor is selected or pilots are trained and drones are purchased – but this is only part of the story and, arguably, the easiest part. Effective drone implementations require a disciplined focus on capturing data that is of the appropriate quality, processing this data into actionable information that meets or exceeds existing information requirements, intuitively sharing the information with all stakeholders and integrating it with business as usual.
>
> In other words, effective drone implementation is not about buying services, training pilots and buying kit, it’s about engaging all relevant stakeholders in a change programme.”

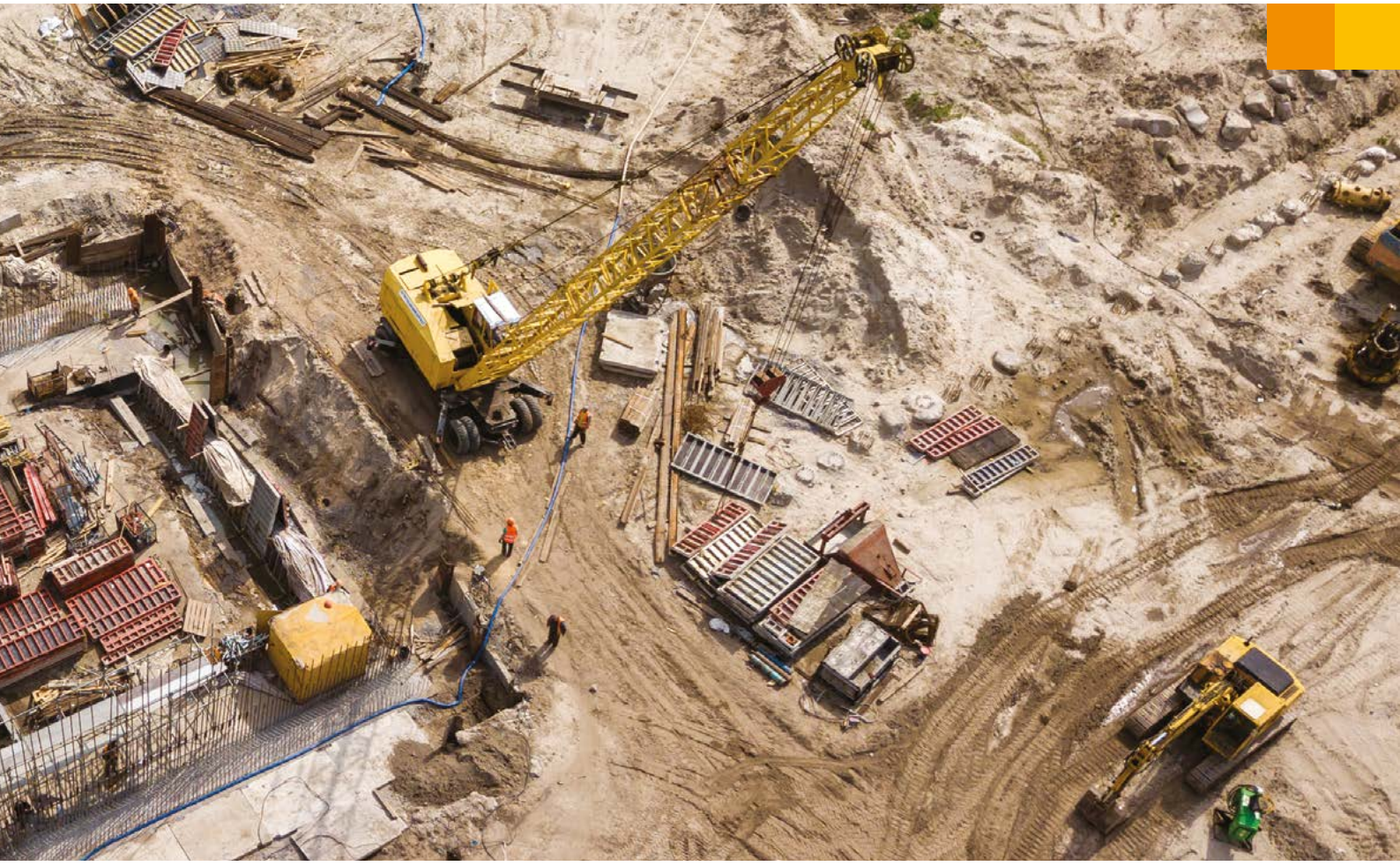
Successful drone implementation then, necessitates a precise focus on capturing fit-for-purpose drone data and integrating it with business as usual. We often describe this as “starting at the end”; not turning a propeller until there is a crystal-clear understanding of the specification of data capture required, how it will be processed into actionable information and how the information will be shared or integrated with business as usual.

This is captured in our 4-step drone workflow (below) which remains as relevant now as it was when we first drafted it in 2018. Refer also to the Cyberhawk case study.



1	2	3	4
Permission	**Capture**	**Processing**	**Sharing**
• All required authorisations are place for the mission. • Considerations include VLOS, EVLOS, BLVOS and congested area operations. • Pilot capability and currency system selection and maintenance validation.	• Flight planning, Risk Assessment and Method Statement mobilisation. • Drone is flown in accordance with the plan and applicable regulations. • Data (image, lidar, etc) is captured and uploaded	• Conversation from data to actionable information. • Usually commoditised photogrammetry software for survey deliverables. • Inspection deliverable processing may include computer vision AI, usually significant manual engineering.	• Processed information is shared with the client. • Ranges from PDF documents to interactive cloud-based **Visual Asset Management** (VAM) solutions. • Client systems integration is key, both existing processes and system such as BIM and ERP.
Fleet management sw		**Processing sw**	**VAM sw**

VLOS – Visual Line of Sight; **EVLOS** – Extended Visual Line of Sight; **BVLOS** – Beyond Visual Line of Sight; **BIM –** Building information Modelling: **ERP** – Enterprise Resource Planning; **sw** – software



Skills

Ability to find the appropriate mix of skills in the market

Skills in 2024 have been marked green by the majority (64%), with the balance finding issues or some issues finding qualified staff. There has been little change from 2021 to 2024, with more than four-fifths of organisations marking Skills the same in both years. However, the lack of significant issues is likely due to lower-than-expected growth rather than the core issue being resolved. BTiCD highlighted that qualifications were crucial, and one organisation was encouraged by the CAA's initiative to offer varied levels of pilot training.

EA say:

> "We are supportive of the proposed new levels (1 – 4) for drone operator qualifications. In addition a qualification for an assessor, who could re-asses in-house pilots that fall out of currency, could be useful for organisations like the EA with multiple drone operators."

Often the organisations which appeared to have the most growth reported the most issues with obtaining Skills and had to develop their own:

Manna say:

> "Acquiring specialised skills in drone manufacturing, unmanned aviation engineering, and AI technology has been a continuous challenge, particularly in local markets. However, we have made strides by implementing targeted training programs and forming strategic partnerships to attract and retain top talent in these emerging fields."

Cyberhawk say:

> "It has not proved easy to hire experienced pilots that can operate to the standard we expect. As a result we tend to train pilots from scratch. There are not many in the UK with the strong regulatory knowledge required to obtain BVLOS permissions. Engineering resource has also proved a challenge."

We can speculate that finding the right skills will become increasingly challenging as regulatory initiatives boost the volume of drone use. Reasons include other technologies such as (non-aviation) AI competing for candidates and an overall shortfall in the STEM pipeline which the Institute of Engineering and Technology estimated at 173K in 2022[38]. We note that the FFC are one entity addressing this through their "Closing the Skills Gaps" cohort[39].

38. Engineering and Technology, Government urged to plug STEM skills gap at earliest school age
39. Innovate UK, Future Flight Challenge announces "Closing the skills gap" cohort

5 Case Studies

Index

Original Case Study	Update	Organisation
Teaming Manned and Unmanned to Deliver Effective Search And Rescue in UK Waters	Daily BVLOS for surveillance	Maritime and Coastguard Agency
New Logistics Using Existing Infrastructure to Connect Communities	"Automotive-like" drone manufacturing in the UK	Windracers
Food, Parcel and Medical "Last Mile" Delivery – Could We Go a Little Faster?	Last-mile drone delivery with "positive unit economics"	Manna
Remote Piloting Paving the Way for Autonomous BVLOS	Regular BVLOS inspection in unsegregated airspace	sees.ai
The Criticality of Integrating Drones with Business As Usual	More than 100% drone service provider growth	Cyberhawk
Automating Traditional Agricultural Practices	Spraying and seeding in the UK	Auto Spray Systems/ Drone Ag
Rapid Response at Times of Environmental Crisis	Expanding internal drone use	Environment Agency
Reducing Leaks with Smart Solutions	Developing inspection in confined spaces	Team UAV
Highly Accurate Drones Keeping Passengers and Engineers Safe And Minimising Commuting Delays	Evolution of high accuracy solutions	Plowman Craven
Digital Transformation in Stockpile Auditing	Integration of drones with business as usual	PwC

Teaming Manned and Unmanned to Deliver Effective Search and Rescue in UK Waters

Surveillance/ BVLOS/ Maritime and Coastguard Agency

Original Case Study

Drone surveillance – drones replace manned aircraft for surveillance tasks, with equivalent IO/IR (Electro-Optical/Infra-Red) sensors. Comparison vs helicopters

Faster	■□□	Not faster but may have 2x fight endurance (vs helicopter)
Safer	■■■	Mass, no pilots onboard.
Cheaper	■■■	<10% of the hourly depreciation and fuel costs
Environment	■■■	<10% fuel consumption (lower emission fuel)

The Maritime and Coastguard Agency (MCA) has made substantial progress since 2021 and is currently conducting daily BVLOS surveillance missions in the English Channel via their supplier Bristow. While this is impressive, there are regulatory constraints that significantly restrict the coverage area, operating hours, and rapid emergency response capabilities. 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.

The MCA have taken some big steps since SWL2[40]. They advise that they are safely and effectively operating manned and unmanned aircraft in close proximity and flying BVLOS daily, including at night. Their supplier (Bristow) has obtained airworthiness certification for the Schiebel S-100 drone.

The challenge is that the daily BVLOS is based on a TDA (Temporary Danger Area) centred around Lydd. The space covered is a fraction (less than 0.1%[41]) of the MCA's total patrol area and the TDA approach has many limitations, including a cut-off time. It is also not possible for the MCA to quickly obtain flight permission for emergencies which limits drone use to routine patrol of the TDA area.

These factors collectively contribute to **Regulation** still being regarded as an issue (flat – red), see below.

We have upward trends in **Perception** and **Implementation** but there is still work to do (amber). **Perception** has improved internally but public perception can be challenging.

In terms of **Implementation**, although BVLOS is BAU (Business as Usual), the rest of the organisation has not embraced drones as much as it could have. Non-aviation staff are "scared off" by the paperwork and many expect drones and analytics to be more autonomous.

Technology is flat (amber). Significant gaps remain in the effective development of drone Detect and Avoid (DAA) systems and Unmanned Traffic Management (UTM) solutions. Additionally, the lack of progress by General Aviation in improving Electronic Conspicuity (EC) has been identified as a potential technological barrier to the growth of BVLOS. It could be argued that these issues are as much **Regulation** as **Technology** issues.

Finishing with a positive, the MCA remains confident that they have the **Skills** required to get the most out of drones (flat – green).

The change the MCA want to see in UK drone operations is clear: they want BVLOS in unsegregated airspace to give them the **"ability to perform time critical missions and tasks."** Their primary concerns include the CAA adopting a more proportionate approach to risk, especially in relation to short-notice BVLOS operations, and obtaining clear guidelines from the CAA on the necessary steps to expand the scope of BVLOS operations, such as operating drones under state aircraft regulations.

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	↗	
Implementation Success in integrating the solution with business as usual	↗	
Technology Availability and efficacy of technology required to facilitate the solution	→	
Regulation Degree to which current regualtions facilitate the solution	→	
Skills Ability to find the appropriate mix of skills in the market	→	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

40. PwC and DSIT, Skies Without Limits v2.0
41. UK Search and Rescue region is approximately 2 million square miles, Lydd TDA is approximately 1,000 square miles

New Logistics Using Existing Infrastructure to Connect Communities

Delivery/ Middle-mile/ Windracers

Original Case Study

Drone delivery, middle mile – mid weight (up to 350kg) packages are delivered from staging point to staging point, e.g. airport to depot. Comparison vs manned airfreight (drones are more expensive than road freight)

Faster	■□□	Slower than manned aircraft, more trips required for bulk
Safer	■■□	Unmanned, lower mass
Cheaper	■■□	Cheaper per trip, may be cheaper for bulk transport, e.g. 35%[42]
Environment	■■□	Significantly less fuel used, lower polluting fuel but more trips for bulk

Windracers have made remarkable progress since 2021, leveraging their UK achievements to capitalise on international opportunities in both military and commercial sectors. They believe that the Ukraine war has shifted the UAV market from a question of "if" to "when". This surge in international demand has enabled Windracers to transition from "lab to life" and has led them to establish an "automotive-like" production facility in the UK.

Progress within the UK has been more gradual. Windracers would like UK regulators to expedite the approval process for Beyond Visual Line of Sight (BVLOS) operations, especially those with strong end customer demand which fly over sparsely populated areas.

42. PwC and UKRI, Future Flight Challenge Socio-economic Study

Since 2021, Windracers' most significant achievement has been transitioning their business from "lab to life." They have advanced from a concept aircraft that completed several BVLOS trials in the UK to a fully developed enterprise, manufacturing drones on a commercial scale and expanding production to meet growing demand from international customers and prospects.

One of the drivers for this is the Ukraine war. Windracers say:

> "With the Ukraine war, there has been a general acceptance that drone technology will play a role in all areas of transportation. As Windracers ULTRA is deployed in Ukraine and has carried out missions for other organizations, what has also become apparent is the need for multi-mission capability of UAV platforms. Windracers ULTRA has been designed to carry out 3 core use cases – deliver, drop and detect – so that one ULTRA can carry out multiple missions depending on customer need."

Windracers' optimism is evident in their assessment of growth barriers. Perception (up – green) has improved to the extent that it is no longer a concern. This is not surprising for a startup that has successfully navigated the challenging transition to commercial scale. It is particularly impressive given that their business relies on BVLOS operations, a model others have struggled with.

Windracers say:

> "Unlike others in the same space, Windracers has moved well beyond prototype and is operating on 3 continents and in a wide range of environments."

Implementation has also improved (up – amber); however, the evolving nature of the technology means that clients are still adapting their existing systems to integrate these new solutions. As mentioned earlier, the company believes that "multi-mission" capabilities—delivery, drop, and detection—are the optimal use of their drones, which increases the complexity of integrating drone operations with regular business activities. This will not stop Windracers striving to be **"the Jeep of the sky."**

Windracers believe that **Technology** has not progressed since 2021 (flat – amber) and still has some way to go before it ceases to be a barrier to growth. This underscores opportunities for advancements in areas such as autonomy (including DAA and swarming) and UTM. However, there is a nuanced perspective on whether UTM is necessary for BVLOS, perhaps reflecting a healthy scepticism influenced by the middle-mile viewpoint. When asked whether UTM is required for BVLOS in the UK, Windracers state:

> "UTMs would provide a potential way forward for this, providing they can integrate easily into existing methods for airspace coordination. Typical operations for Windracers aircraft in UK Airspace is in two categories or phases: Local to Aerodromes (e.g. VLOS flights for testing purposes, or departure / arrival from operations that transit regions for logistics purposes) and BVLOS transit routes between Aerodromes. These have two different altitude considerations, but primarily all BVLOS phases of flight occur at above 1000ft, meaning a straight UTM only tool, may not add that much benefit."

It is noteworthy that UK-based Windracers is collaborating with a US university (Purdue University) on **"bringing more AI enablement into making the operation of their ULTRA drone more efficient and lower cost"**. They are also collaborating with the University of Bristol on swarming technology[43].

As with most BVLOS-dependent use cases, Regulation has progressed (up – amber). The company appears to be more understanding and positive than many regarding the actions of the regulator, although they acknowledge that further progress is needed.

Windracers say:

> Regulation has always been a challenge as the regulators, quite appropriately, are moving cautiously. As we are operating in the UK and other markets, Windracers has seen significant progress in the UK and noted that some countries are moving faster to establish regulatory frameworks than others to enable consistent BVLOS operation of larger UAVs. In Windracers' view, the countries that are moving faster to establish regulations that enable BVLOS operation of larger UAVs see a commercial competitive advantage in moving forward with a more permissive regulatory regime. While limited Beyond Visual Line of Sight (BVLOS) permissions have been obtained, unlocking the use case, additional regulatory progress is still required."

We will close with the changes Windracers would like to see in the UK. They suggest that regulatory regimes for BVLOS operations of larger UAVs in all markets should focus on low-populated areas which have clear end-client demand. Establishing rules for such areas would enable consistent BVLOS operations with lower risk (compared to operations over densely populated areas) and provide delivery services to populations that lack the same access and cost benefits as those in more densely populated areas.

Windracers state:

> Windracers believe that the driver for change should come from those places where there is true commercial need. As an example, from our experience in operating in the Orkney Islands, we understand that currently it takes days for Amazon packages to arrive to people in that area whereas for people in London, it takes hours, sometimes even the same day. There is a true commercial need in the Orkney Islands – and many other areas across the world – for faster delivery of non-urgent parcel, post and cargo…If changes can foster more regular BVLOS operation of larger UAVs, a new market for delivery routine services could be created and the commercial use cases could be better understood and served."

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	↗	
Implementation Success in integrating the solution with business as usual	↗	
Technology Availability and efficacy of technology required to facilitate the solution	→	
Regulation Degree to which current regualtions facilitate the solution	↗	
Skills Ability to find the appropriate mix of skills in the market	→	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

43. BBC, Drone swarms could stop wildfires, researchers say

Food, Parcel and Medical "Last-mile" Delivery, Could We Go a Little Faster?

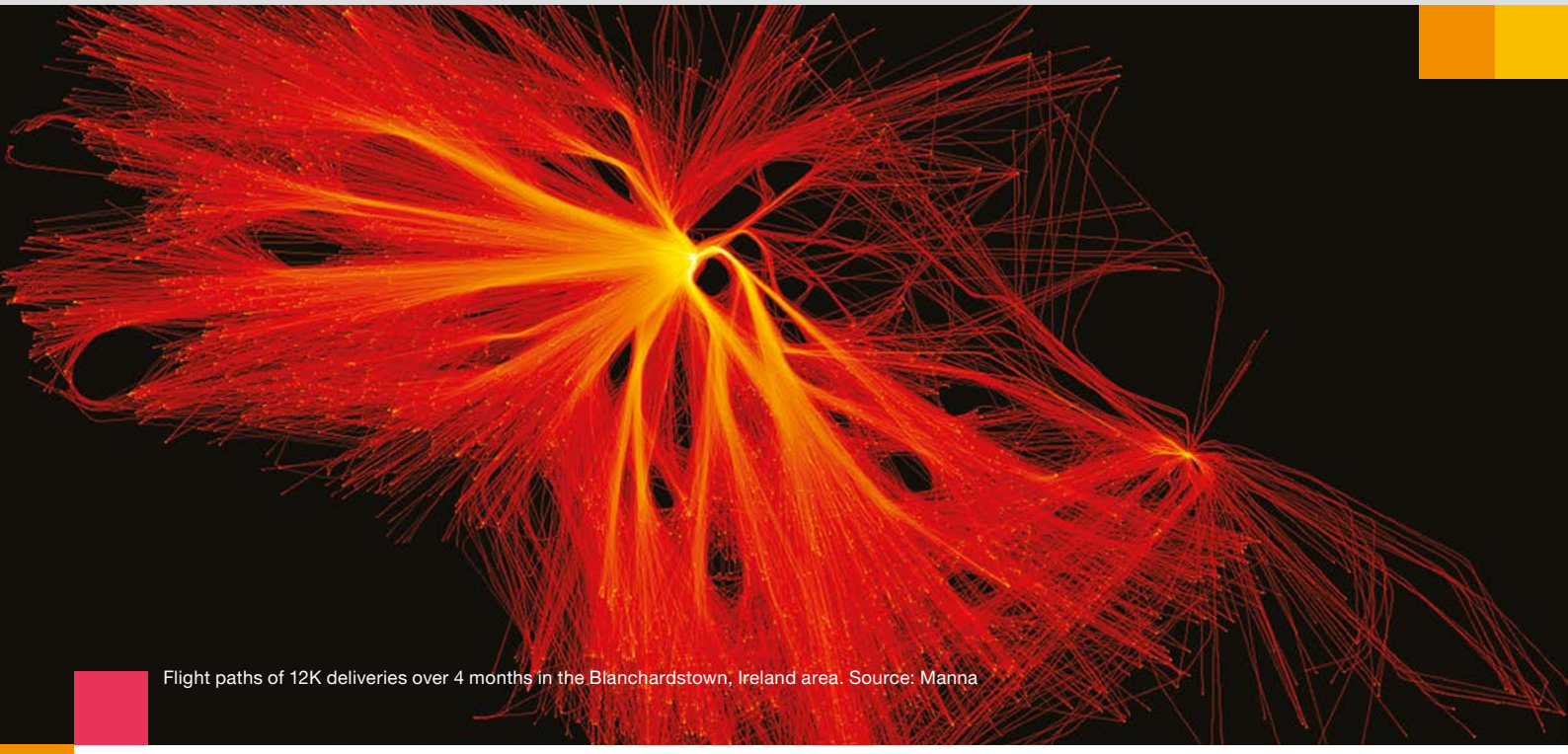
Delivery – last mile/ BVLOS/ Manna

Original Case Study

Last Mile Drone Delivery – Drones replace ground based, manned B2C delivery, taking items directly to the consumer's doorstep (comparison vs delivery by road)

Faster	■■■	Drones are able to deliver to a 5km radius in less than 3 mins[44]
Safer	■■■	Safer than (manned) road travel
Cheaper	■■□	Up to 90% cheaper than car based services assuming 8 deliveries/hour[45], but payload capacity limited
Environment	■■□	Batteries vs petrol. Benefit dependent on payload size

Manna has come a long way since 2021, with significant progress in technology, regulation and market penetration. This is even more impressive when we see it in the context of unit economics which Manna advises are "positive". They are not, however, able to operate in the UK due to more restrictive regulations than other countries, for example Ireland and the USA. We also wonder if Manna's positive view on perception would apply to the UK, as our 2023 Building Trust in Commercial Drones paper found that delivery drones were one of the least supported use cases.



Flight paths of 12K deliveries over 4 months in the Blanchardstown, Ireland area. Source: Manna

44. Per Manna
45. Per Manna

One of the most striking numbers In SWL2 was the £10bn TAM (Total Addressable Market) for UK last-mile delivery drones. However, at the time of writing, practically none of this has been realised. There are still no volume deployments of last-mile delivery drones in the UK, despite many successful trials such as Future Flight Challenge project Caelus[46] and some promising Royal Mail projects such as Orkney I-Port (Skyports) and Windracers collaboration.[47] In SWL2, we also noted that Amazon Prime Air had wrapped up their operations in the UK (2021), casting potential doubt on the viability of the industry. However, there is now evidence of another attempt by Amazon to enter the UK market and we note their participation in upcoming BVLOS trials[48].

Manna have progressed significantly in the last three years but this progress is elsewhere, including Ireland and the USA. In SWL2, we stated:

> If we look at the global picture for Last Mile Delivery drones, we can conclude that other countries such as Ireland, USA…have made more tangible progress than the UK. This does not appear to be due to technology (UTM, Electronic Conspicuity, Detect and Avoid and Drone Autonomy, etc) which is not notably different. It may be due to a different attitude to risk in the UK…"

Although there is still a noticeable difference in risk attitudes between the UK and other regions (refer to the Cyberhawk case study update for a USA/UK risk perspective), there appear to be additional areas where the UK was once on par but has since lagged. Over the past three years, Europe and the USA have made considerable advancements in **Technology** and **Regulation** (refer to Section 4, above), a progress not matched domestically. In **Technology** for example, Manna highlights the criticality of UTM to their business, particularly at scale.

Manna say:

> 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."

46. AGS, Caelus
47. SUAS News Skyports and Royal Mail to extend UK's longest running commercial drone delivery service
    Windracers, Royal Mail reveals ambitious vision for more than 50 new postal drone routes in partnership with Windracers Group
48. CAA New trials set to help unlock drone deliveries and inspections in the UK

As we note in Section 4, UTM appears to be viewed as a foundational technology in the USA and Europe but UTM in the UK is not planned until 2026 at the earliest, refer to the Future of Flight action plan[49].

Manna's perspectives on barriers to growth make for interesting viewing and paint a much more positive picture than we expected. They reflect Manna's impressive progress in the last 3 years and their achievements include:

- **Unit Economics** Manna has achieved "positive unit economics"[50] and are operating at commercial volume in Ireland (Blanchardstown) from Q1 2024. Manna claims that the operation covers 42K households and 150K people
- **Regulation** Manna can fly in Europe and the USA: EASA (European Union Aviation and Safety Authority) BVLOS LUC (Light UAS Operator Certificate) attained; FAA (Federal Aviation Administration) Part 107 waivers obtained to operate in Dallas, Texas[51]
- **Technology** Manna claim significant progress in their proprietary drone's autonomy, weather tolerance, carrying capacity and endurance; they have also progressed flight planning and one-to-many piloting

The positive view of the **Perception** barrier (green – up) is interesting but reflects countries other than the UK. In the UK, drone deliveries continue to be one of the least supported use cases according to our recent survey (BTiCD[52] 2023, 61%). However, this represents a substantial increase compared to our earlier market research (BTiD[53] 2019, 26%) but it is important to note that the respondent populations differed between these surveys.

Manna states that:

> 88%+ of consumers are in favour of the service…Over the past 3 years, we have seen increased levels of acceptance and a sense of inevitability across investors and the business community that drone delivery will be part of the fabric of modern society in the near future."

Changes in **Implementation** (green – up) are based on Manna's movement from serving 10K people in one location in 2021, to multiple locations around the world in 2024. This includes Blanchardstown where 150K people are in the delivery area, and the start of new operations in Dallas, Texas.

It is a slightly different story on **Regulation** (amber – up). Manna's achievements in this area are noted above but there is still more progress required in the EU and USA to scale up and in the UK to start operations.

In Manna's words:

> 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. We also welcome recent communications from the FAA, which will soon publish the new Part 108 unmanned aviation requirements, and the UK CAA, which announced the adoption of a SORA-style approval framework by late 2024 or early 2025. These regulatory developments are crucial for facilitating the widespread adoption and scalability of our drone delivery solution."

49. DfT, Future of Flight Action Plan
50. Per Manna, this reflects cost per delivery being lower than revenue per delivery, assuming utilisation is more than 55%
51. Per Manna, the part 107 waivers set the stage for them to pursue a Section 44807 airworthiness waiver and a waiver to FAR 91.113 (allowing BVLOS flight). These allowances will enable them to fly BVLOS drone delivery under a UAS Part 135 certificate, which will be acceptable to scale until the FAA's Part 108 recommendations become law
52. PwC and DSIT, Building Trust in Commercial Drones
53. PwC, Building Trust in Drones

Manna's view on **Skills** (up – amber) is, perhaps, what we would expect from a company pushing technology and regulatory boundaries. Finding skills in drone manufacturing, unmanned aviation engineering and AI has been particularly challenging, but they are taking steps to address this.

We will close with Manna's thoughts on the changes they would like to see in the UK.

Manna says:

"We see several key areas for improvement in how the UK handles drone operations. Firstly, there is a need for streamlined regulatory processes that can adapt to rapid advancements in drone technology, including more efficient procedures for obtaining BVLOS permissions and integrating new technologies such as detect-and-avoid systems. Secondly, increased investment in Unmanned Traffic Management (UTM) infrastructure is crucial to ensure safe and efficient airspace management as drone traffic continues to grow. Additionally, there should be a greater emphasis on public education and awareness campaigns to improve the perception of drones and highlight their benefits to society. Enhancing training programs and certifications for drone operators will ensure high standards of safety and professionalism across the industry. Finally, closer collaboration between regulatory bodies, industry stakeholders, and technology providers is essential to facilitate the development of robust frameworks that support innovation and the safe integration of drones into UK airspace. These changes will enhance safety and efficiency, support the growth and integration of drone delivery services in the UK."

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	→	
Implementation Success in integrating the solution with business as usual	→	
Technology Availability and efficacy of technology required to facilitate the solution	→	
Regulation Degree to which current regualtions facilitate the solution	→	
Skills Ability to find the appropriate mix of skills in the market	→	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

Remote Piloting Paving the Way for Autonomous BVLOS

Inspection/ BVLOS/ sees.ai

Original Case Study

Drone inspection – inspection of assets against set criteria, usually to determine maintenance requirements. Comparison is against helicopters (powerlines)

Faster	■□□	BVLOS drone capture is comparable to helicopter
Safer	■■■	Drones are significantly safer than helicopters
Cheaper	■■□	similar capture cost to helicopters but drones deliver more detailed and comprehensive inspection, resulting in lower total cost (note that BVLOS may be 34% cheaper than VLOS[54])
Environment	■■■	Batteries vs jet fuel

Since 2021, sees.ai has successfully implemented routine inspections of powerlines using remotely piloted drones. They have secured the UK's first permission from the Civil Aviation Authority (CAA) to conduct Beyond Visual Line of Sight (BVLOS) flights regularly in non-segregated airspace on live transmission towers owned by National Grid Electricity Transmission (NGET). End client appetite for the solution has been key to this progress but sees.ai's growth has been constrained by the availability of capital.

54. PwC and UKRI, Future Flight Challenge Socio-economic Study

In SWL2, we reported that sees.ai had received authorisation to operate in non-segregated airspace. Building on this achievement, they have expanded their inspection solution from trials to commercial operations for a major client, NGET. This includes securing the UK's first permission from the CAA to fly BVLOS routinely in non-segregated airspace over live grid assets. This accomplishment is particularly noteworthy given the many UK BVLOS projects that have stalled at initial trials. It is also encouraging to see pragmatic AI practitioners like Keen AI contributing to the solution.

However, sees.ai believes their growth may have been constrained by limited capital availability due to a challenging fundraising environment.

sees.ai's impressive progress is reflected in their assessment of potential barriers to growth. They have seen increasing interest and support from network operators, partly driven by heightened government pressure to upgrade the grid (**Perception** – up – green). This clear demand from end-clients has also led to regulators becoming more receptive to the use case. sees.ai note that what started as an incremental improvement has now become a necessity:

> "Since we started working…on this problem in 2021, the urgency to find a solution has intensified significantly, in line with government announcement of ambitious renewable targets[55]; a flurry of reports calling for coordinated and massive action to upgrade the grid[56] and rapidly mounting negative impacts for not doing so (e.g. curtailment costs reached a record £920m in 2022)."

Implementation has jumped from red to amber (as noted above), and sees.ai anticipates reaching Business as Usual (BAU) mode, operating at or above break-even on a unit economics basis, by 2026. Significant **Technology** progress has been made, addressing key technical challenges and enhancing engineering, system reliability, and robustness (up – green). sees.ai is optimistic about **Skills** and believes that their team, along with key clients, primarily from NGET, possesses the necessary expertise to execute the project successfully.

As with all BVLOS-dependent use cases, **Regulation** has progressed but further advancements are needed (up – amber).

sees.ai say

> "While limited Beyond Visual Line of Sight (BVLOS) permissions have been obtained, unlocking the use case, additional regulatory progress is still required."

Going forward, sees.ai would like to see increased levels of government involvement and enthusiasm for the sector and cite the Smart Machines 2035 – Robotics Growth Partnership[57] as an example.

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	↗	
Implementation Success in integrating the solution with business as usual	↗	
Technology Availability and efficacy of technology required to facilitate the solution	↗	
Regulation Degree to which current regualtions facilitate the solution	↗	
Skills Ability to find the appropriate mix of skills in the market	↗	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

55. A five-fold increase in solar capacity by 2035 and increasing the offshore wind capacity target to 50GW by 2030 in British Energy Security Strategy, 2022
56. NGESO's Future Energy Scenarios, 2021; UK Government's British Energy Security Strategy, 2022; NGESO's Pathway to 2030 Holistic Network Design, 2022/23; National Grid, Delivering for 2035, 2023 and ENA Industry Action Plan, 2023
57. Robotics Growth Partnership, Smart Machines 2035 Strategy

The Criticality of Integrating Drones with Business-as-Usual

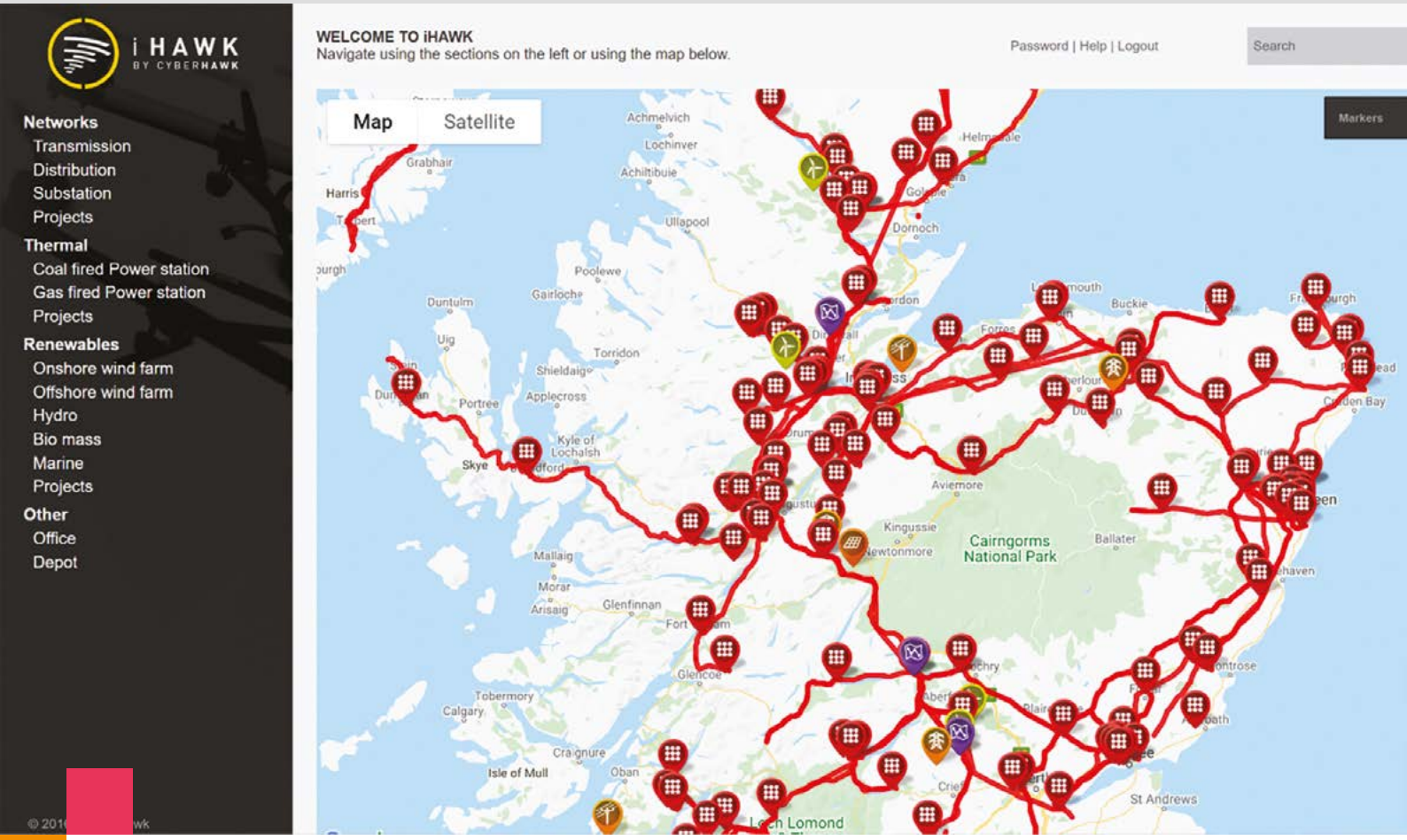
Inspection – Visual Asset Management/ Cyberhawk

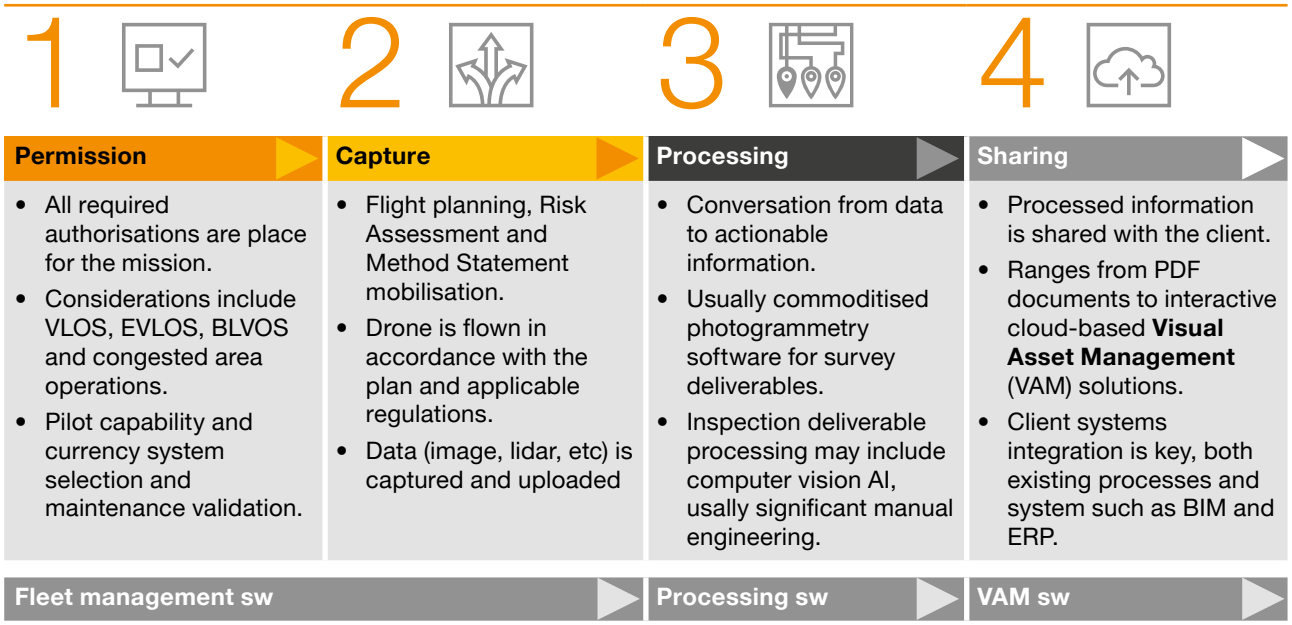
Original Case Study

Drone inspection – inspection of assets against set criteria, usually to determine maintenance requirements. Comparison is against helicopters (powerlines)

Faster	■□□	VLOS drone capture is slower than helicopter
Safer	■■■	Drones are significantly safer than helicopters
Cheaper	■□□	Although capture costs can be similar, total cost is less
Environment	■■□	Batteries vs jet fuel, partially offset by 4x4 travel to site

In our last report, we emphasised that the full potential of drone technology could only be realised if data capture was fit-for-purpose and seamlessly integrated with business as usual. Cyberhawk embodies this approach, and it is likely to have been a key factor in their impressive progress over the past three years, with global revenue increasing by more than 100% from 2021 to 2023 and headcount reaching around 200. However, the primary drivers of growth have been the US and Middle East, rather than the UK, where Cyberhawk feels constrained by the regulatory approach. They note that the UK's regulatory approach has become less progressive compared to other regions and has deteriorated since 2021, making them the only case study respondent to report a decline in the regulations barrier to growth. That said, they are optimistic about the UK's new regulatory direction, including the implementation of SORA, and believe that BVLOS could help reduce costs in the UK, as it has in the USA.





VLOS – Visual Line of Sight; **EVLOS** – Extended Visual Line of Sight; **BVLOS** – Beyond Visual Line of Sight; **BIM –** Building information Modelling: **ERP** – Enterprise Resource Planning; **sw** – software

A key message in SWL2 was that successful drone implementation necessitates a precise focus on capturing fit-for-purpose drone data and integrating it with business as usual. We often describe this as "starting at the end"; not turning a propeller until there is a crystal-clear understanding of the specification of data **capture** required, how it will be **processed** into actionable information and how the information will be **shared** or integrated with business as usual. This is captured in our 4-step drone workflow above which remains as relevant now as it was when we first drafted it in 2018.

Drone Service Provider Cyberhawk was one of the emerging companies that embodied this approach with their iHawk Visual Asset Management (VAM) software and a focus on end client requirements. This philosophy, embedded in Cyberhawk for many years, may be a key part of their success and they have grown their global business by more than 100% from 2021 to 2023, reaching a headcount of around 200.

The story is, perhaps, less encouraging when we consider that this growth is mainly in the USA and Middle East rather than the UK and take account of Cyberhawk's comments on the differing regulatory approach between these countries as well as the associated impact on investment decisions.

Cyberhawk say:

> "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.
>
> In the US it feels like the FAA wants us to succeed and the attitude is how can we make this happen safely.
>
> In the UK it feels like we have to constantly argue the case as to why we should be operating.
>
> Thankfully there are signs that changes at the CAA are being made to improve the situation."

That said, Cyberhawk believes that **"The UK market is close to commercial volume in some areas"** implying that market saturation may be the limiting factor for UK growth in their focus areas of Oil and Gas, Utilities, Renewables and Construction, rather than solely regulations. However, price-sensitive markets such as distribution tower inspection (Utilities) could be more effectively addressed if BVLOS was attainable, as this would improve unit economics, a benefit Cyberhawk observed in the USA. The company also states that BVLOS can improve public perception due to less land access being required.

These points are reflected in Cyberhawk's perception of UK barriers to growth below. If we start with the "elephant in the room," Cyberhawk are the only SWL3 respondent to note a downward trend from 2021 to 2024. This is in **Regulation** (down – red).

Cyberhawk say:

> "We have less flexibility to operate close to people than 3 years ago despite a long track record of documented safety. Regulations have become overly complex and do not facilitate real world practical operations."

When asked about the biggest changes since 2021, Cyberhawk continue:

> "Regulatory oversight in the UK is not as progressive as other regions such as the US. Permissions we have held for over 15 years are now being eroded in the UK and we have gone backwards in some areas. Conversely, the ability to operate in atypical airspace in the US has accelerated our BVLOS operations and demonstrated a clear path to scaling our operations and delivering cost reductions. There is a clear difference in who is accountable for risk between the UK and US. In the UK it feels like the CAA owns the risk whereas in the US the operator holds the majority of the risk. For example, we applied for a countrywide BVLOS permission in the US (in atypical airspace) and the submission was <50 pages and took 2 months to gain approval. In the UK our routing submission for an operational authorisation is 1600 pages. 5 months on we are working through the CAA Oversight Report."

Cyberhawk's view on **Perception** (up – green) is encouraging and reflects a growing willingness from their client base to trial new technology and collection methods. Given the introduction to this case study, it will come as little surprise that Cyberhawk remains positive about **Implementation** (flat – green) due to successful integration with client workflows. They consider **Technology** to be somewhat of an issue (flat – yellow) and note that the combination of tech (including UTM) required for BVLOS is more advanced in other countries. **Skills** have the same perception as Technology (flat – yellow).

Cyberhawk notes that skilled pilots and engineers have been difficult to find, resulting in them training the former. We expect that increasing drone and analytics automation will ease these **Skills** issues in the future.

We'll close with Cyberhawk's thoughts on the changes they would like to see in the UK. Although positive about the upcoming changes in regulation, including the introduction of SORA, Cyberhawk think their growth would be maximised if the UK attitude to risk were adjusted and the regulatory approach was consistent year on year.

Cyberhawk says:

"The introduction of SORA methodology will help provide more consistency across applications for operational authorisations but there needs to be a shift in mindset at the CAA as to how they can support businesses to grow.

There also needs to be a fresh look at the level of risks involved in operating drones, particularly in rural areas. CAA inspectors need to spend time with commercial operators to gain a better understanding of where the greatest risks occur. On our risk register, the greatest risk of harm is the pilot driving to site! Proportionately, how many drivers cause physical harm to uninvolved people compared to drone operators?

We need to stop trying to have zero risk and instead accept and manage the risk. They are not passenger carrying aircraft and therefore the level of risk and subsequent harm is very different."

"It would be useful to get some consistency in assessments of our submissions to the CAA from year to year. Each time the assessment is different and asks for something else even though the permission has been in place for years. Suggested ways forward presented by the CAA are then taken back in subsequent oversight reports.

In the US a consistent and progressive message from the FAA means we can go to market knowing exactly what services we can offer in the years to come. In the UK we have less of an idea of what will be possible and our expectation now is our operational flexibility will continue to reduce further despite our continued improvements in procedures, training, safety management, and maintenance."

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	→	
Implementation Success in integrating the solution with business as usual	→	
Technology Availability and efficacy of technology required to facilitate the solution	→	
Regulation Degree to which current regualtions facilitate the solution	→	
Skills Ability to find the appropriate mix of skills in the market	→	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

Automating Traditional Agricultural Practices

Precision Agriculture/ VLOS/ Auto Spray Systems and Drone Ag

Original Case Study

Drone agriculture – drone data to assess crop health; drones replace manned aircraft and/ or ground crop spraying; drones replace traditional methods of seeding

Faster	■■■	Examples include 5x faster spraying (drone vs manual)
Safer	■■□	Safer than manned aircraft, more precise targeting
Cheaper	■■■	c.30% less chemical volume vs traditional, less site time
Environment	■■□	More precise targeting/ fewer chemicals, battery power

Scanning, spraying and seeding is now a reality in the UK, thanks to the progress Auto Spray Systems, Drone Ag and others have made with the CAA and CRD (Chemicals Regulation Directorate) over the last 3 years. Although operations are currently small-scale, there is huge potential to grow the market, catch up with the rest of the world and contribute to UK food security when more chemicals are approved for spraying, and flight permission is simplified.

In this update, we're going to look at the progress of two case study companies, Auto Spray Systems and Drone Ag.

Auto Spray Systems have progressed significantly since 2021 and are now scanning, spraying and seeding crops in the UK. Highlights over the last 3 years include:

- Operational Authority (OA) for large spray/spreading drones from CAA in (2022)
- Lantra training certification for spray drone training (2023)
- Listed as a productivity item in the Farming Equipment and Technology Fund (FETF)[58] (2024)
- Applied liquid and granular PPPs[59] (regulated chemicals) with HSE approval and led other PPP initiatives[60] (2024)

Drone Ag have also progressed significantly since 2021:

- Onboarded several sizeable agronomy firms to their Skippy Scout platform (app-based crop monitoring using drones, refer to the original case study or Skippy.farm) which is being used in 21 different countries
- After allowing their 2015 permissions to elapse, Drone Ag have also obtained new permissions, but focus more on training, case studies and hardware supply, rather than direct drone services for clients

Auto Spray Systems and Drone Ag have different views on whether their business has grown at the rate expected in 2021. Auto Spray Systems claim to have exceeded their planned rate of growth and Drone Ag state that their growth has continued to trend up, despite a **"difficult economic landscape."**

Drone Ag believes that their Skippy Scout platform has reached commercial volume both in the UK and globally, evidenced by several large clients utilising their solution. In contrast, Auto Spray Systems notes that there are various limiting factors, primarily authorisation to spray PPPs, which have prevented them from reaching commercial volume in the UK. However, they can understand the rationale and say:

> "approvals for PPP application by drone are coming through now which will allow the market to grow in a manageable way that will allow best practice to be established rather than a "free-for-all" rush that would happen if those restrictions were not in place. In many ways, these limiting factors are what will make this roll out successful in the long run."

Both companies agree that agricultural drone implementations are at a small scale and have considerable potential to grow, thereby increasing food security and land use efficiency. Growth potential could be realised if chemical regulations were less restrictive (compared to other countries) and the complexity and cost of obtaining flight permissions was reduced significantly.

The diagram on page 49 compares Auto Spray Systems and Drone Ag's perception of barriers to growth.

Overall, both companies are positive about where they find themselves in 2024. Auto Spray Systems (focussed on spraying and seeding over the last 3 years) ratings indicate significant progress from 2021 with all trends up. In contrast, Drone Ag, which has focussed mainly on their crop monitoring software in this period (but has continued to offer drone spraying/spreading hardware and training), believes only **Technology** has trended up (green).

Drone Ag say:

> "Technology development has massively outpaced British demand since 2021 and legislation lags behind."

58. A grant scheme designed to support farmers by facilitating access to advanced farming technologies and supporting the agricultural industry's overall growth and sustainability
59. Plant Protection Products or pesticides, HSE
60. Other PPP related activities from Auto Spray: trials underway to change PPP labels to list drone application methods as standard (2024); developing a roadmap for commercial PPP approvals in progress with CRD (2024) with the aim to have 30 products approved for drone application in 2025

Regulation (amber – up for Auto Spray Systems, flat for Drone Ag), as mentioned above, is limiting growth. Both companies believe that agricultural drone use will only begin to scale once PPP authorisation is coupled with simplified, lower-cost flight permissions. This may be achieved by establishing simpler processes for obtaining flight permission such as a Pre-Defined Risk Assessment (PDRA) for agricultural applications.

Auto Spray Systems note that many other countries operate under less restrictive chemical regulations than the UK and highlight two significant differences.

Auto Spray Systems say:

> "Firstly, they [other countries] can apply any PPP onto the crops, because there is less regulation.
>
> Secondly, they can use Ultra Low Volume of water rates when applying these chemicals. So typical application rates will be in the region of 10-15L/Ha as opposed to 200L/Ha in the UK. We have to make approximately 15 times as many flights as our global equivalents."

Drone Ag agrees that chemical regulations are restrictive and expensive.

Drone Ag say:

> "…chemical approval for drone sprayers remains frustratingly out-of-reach"
>
> "They [the CRD] make a point of stating that they are "open for business" but the path to approval that they have laid out is costly and slow. Stakeholders (drone companies, their representatives, and chemical manufacturers) must work together with the CRD to trial each individual chemical with drone sprayers. Each trial requires that stakeholders pay the UK government in order to conduct it. This process requires replication for each individual formulation of controlled chemical."

They add that flight permissions are complex and expensive.

Drone Ag say:

> "the current largest stumbling block to non-chemical drone spraying operations (i.e. operations that can be done right now) in the UK; is the necessity of an OSC…OSCs are very much a "one size fits all" solution, designed to allow complex and fairly niche operations in high-risk environments…OSCs are built from the ground up on a case-by-case basis, and require a well of knowledge and resources in order to complete. They are also restrictively expensive for most.
>
> Our priority focus on crop monitoring as opposed to spraying drones, is in part due to the difficult regulatory landscape we find ourselves in. Auto Spray's work in this arena is therefore very encouraging and greatly appreciated.
>
> Agriculture is so different from the kinds of work OSCs are mostly designed to facilitate… [and] Agriculture …should be treated as a totally separate kind of operation. A separate type of licensing or permission such as an agri-specific PDRA should be created for these kinds of operations, that facilitates the adoption of beneficial tech…farms are almost entirely in the countryside, this seems obvious, but this is important because although they may border infrastructure or built up areas, the vast majority of field areas are in completely rural settings, meaning risk to people and property is very low."

Auto Spray systems note significant progress since SWL2.

Auto Spray Systems say:

> The biggest changes, since the report was released, have been in the accessibility of the CAA and HSE/CRD. The CAA have been very responsive to our evolving licensing requirements and we have engaged very deeply with HSE/CRD on PPP authorisations and are making good progress. However, this is just the beginning. Until there is a PDRA for agri drone operations from the CAA, drone take up will be slow due to the complications of the OSC route… until key PPP products for drone application become commercially approved, the market will remain small"
>
> "If these could be addressed we would reach "commercial volume" within 12 months."

All of this indicates that it is now time to act and build upon the progress made so far. We are addressing an issue as essential and fundamental as food security.

Drone Ag say:

> Agriculture is under extreme and increasing pressure to increase efficiency, in order to feed a growing population with fewer and fewer resources."

Potential barrier to growth	Auto Spray		DroneAg	
	Trend	2024	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	↗		→	
Implementation Success in integrating the solution with business as usual	↑		→	
Technology Availability and efficacy of technology required to facilitate the solution	↗		↗	
Regulation Degree to which current regualtions facilitate the solution	↗		→	
Skills Ability to find the appropriate mix of skills in the market	↑		→	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

Rapid Response at Times of Environmental Crisis

Surveillance/ VLOS/ Environment Agency

Original Case Study

The Environment Agency (EA), an early adopter of drone solutions, continues to operate a 24/7, 365, 6-hour flood response service from drone vendor RUAS. Since 2021, EA has succeeded in substantially increasing its number of in-house pilots, developed additional use cases and transitioned drones from a project-based approach to business as usual. The main growth challenges faced by EA are internal rather than external.

The Environment Agency (EA) was among the first government entities to recognise the potential of drones, working with vendors for their 24/7, 365-days-a-year, 6-hour flood response service since 2017. While this crucial service remains operational, the EA has further leveraged drone technology by training an increasing number of their existing staff as drone pilots. This has led to exciting new applications, such as culvert inspections, and other applications like water sampling are currently being explored. In 2024, the EA plans to transition from a project-based approach to integrating drones into their routine operations. To achieve their ambitions, the EA will need to address their primary challenges, which are mostly internal, such as IT and software issues. This contrasts with other organisations, where challenges often revolve around external regulatory constraints from entities like the CAA.

EA believes that potential barriers to growth have remained unchanged from 2021 to 2024 (all trends flat, see below). This is an unusual take, as most other respondents have at least one change.

This reflects EA's view that **Perception**, **Implementation**, **Technology** and **Skills** did not hinder their drone deployments in 2021 and continue to pose no issues, a refreshing perspective.

While the EA currently considers their **Implementation** of drones to be in the green, it is important to note that the expansion of drone use cases and increased frequency will result in a corresponding increase in data volume. Consequently, software capabilities for drones and integration with existing systems will need to be enhanced. As noted above, this is a significant internal challenge for EA but not one which they perceive as a barrier to growth.

The **Technology** and **Skills** categories are also green, reflecting the scope of use cases and the way EA has embraced a hybrid model which combines internal and external drone operations. They note that the CAA's proposed 4 levels of drone operator qualifications will have a positive impact on **Skills** going forward, and:

> "a qualification for an assessor, who could re-assess in-house pilots that fall out of currency, could be useful for organisations like the EA with multiple drone operators."

However, the Regulation category remains amber due to the current Beyond Visual Line of Sight (BVLOS) situation. The EA believes that "close" BVLOS (flying behind nearby objects) would be most beneficial for them in the short term. They think BVLOS would also be beneficial for services they would most likely purchase from specialist drone vendors such as:

> "Incident management and the potential to fly along many kilometres of a river, mapping the flood waters."

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	→	
Implementation Success in integrating the solution with business as usual	→	
Technology Availability and efficacy of technology required to facilitate the solution	→	
Regulation Degree to which current regualtions facilitate the solution	→	
Skills Ability to find the appropriate mix of skills in the market	→	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

Reducing Leaks with Smart Solutions

Survey – Water/ Team UAV

Original Case Study

Drone inspection (internal) – collision tolerant drones used to inspect confined space, often using LiDAR for navigation and generating 3D models

Faster	■■□	Approximately 2x faster[61]
Safer	■■■	Minimises the need to enter hazardous confined spaces
Cheaper	■■□	Up to 40% cheaper (rope access/ scaffolding minimised)
Environment	■■□	Fewer trips to site

In 2021, Team UAV was featured in a case study for their work in leak detection within the water industry. They have since increased their focus on conducting internal inspections in confined spaces. This is motivated, amongst other things, by the fact that internal drone inspections bypass many regulatory obstacles that can hinder other applications. They also enhance safety by keeping personnel out of hazardous situations and provide compelling data. Although this may suggest that Team UAV's growth is largely unimpeded, they do face challenges such as skill shortages and the increasing trend of clients forming their own drone teams. Team UAV also believes that BVLOS operations in unsegregated airspace would enable them to expand their business.

61. Flyability, sewer drones

Following SWL2, Team UAV has increased its focus on inspections in confined spaces within the water and environmental sectors. Although clients are expressing greater interest in their solutions, the company has not yet achieved commercial volume.

Team UAV states:

> Since 2021, our most significant achievement has been introducing confined space drone services into the water and environmental sectors. This innovation has greatly enhanced our ability to conduct detailed visual inspections and gather geospatial information from point cloud data derived from onboard LiDAR sensors."

Team UAV has collaborated with the Environment Agency to deliver precise 3D models and high-resolution imagery of underground culverts, which they claim has facilitated accurate mapping, advanced data analysis, and improved decision-making. This solution has significantly enhanced safety by reducing the need for human entry into hazardous environments. Team UAV believes that this achievement has set a new benchmark for environmental monitoring, opened new opportunities for growth and collaboration, and solidified their reputation as an industry pioneer.

This perspective is reflected in Team UAV's view of their solution's market **Perception** (up – green).

Team UAV say:

> The growing acceptance and trust in drone technology among clients have also played a crucial role, enabling us to undertake more complex and diverse projects."

Perhaps unsurprisingly, Team UAV have found that their clients have a very positive attitude towards deploying drones instead of personnel in confined spaces.

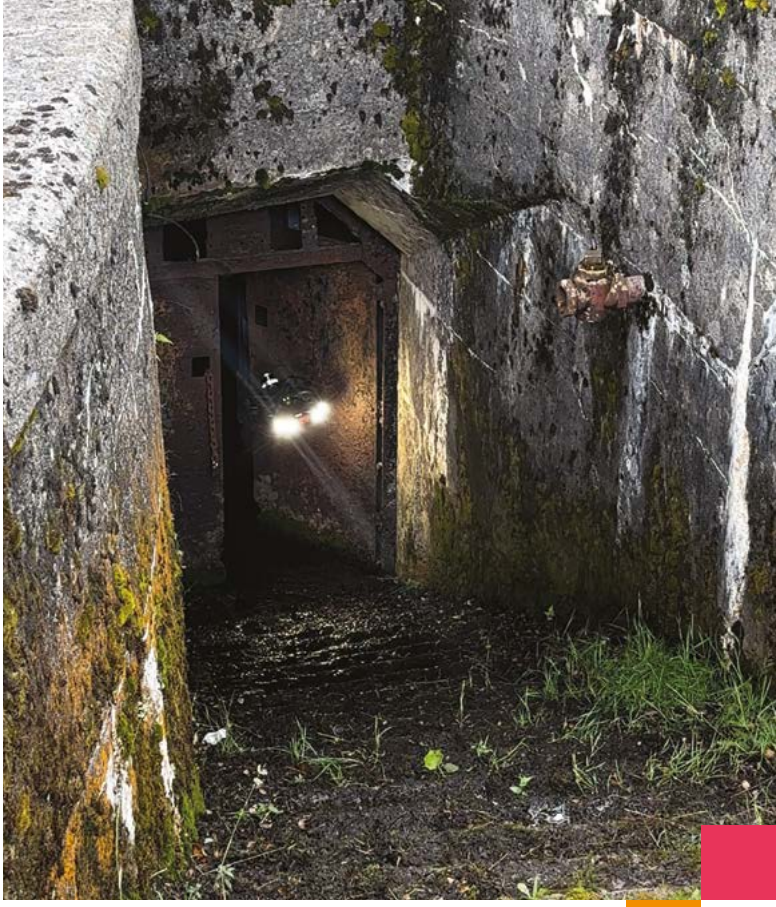
The **Implementation** and **Technology** barriers share the same trend and perception (up – amber). The reason for the **Implementation** progress has been covered above. The amber rating is due to the difficulties clients have adopting services at scale.

Team UAV believe that **Technology** has advanced, delivering longer battery life and improved sensors. However, some technological challenges are impeding growth. The cost of drones is significant, especially considering the high risk of losing them. Additionally, the absence of ATEX-certified[62] drone solutions restricts Team UAV's ability to operate safely in explosive or hazardous environments, which is key for certain industries.

Regulation (flat – green): There are no regulatory barriers to the growth of internal inspections. However, in the context of their overall business, Team UAV points out that routine Beyond Visual Line of Sight (BVLOS) operations in unsegregated airspace could

> unlock new growth opportunities, drive innovation, and improve safety by reducing the need for manual interventions in hazardous environments."

62. HSE, ATEX and explosive atmospheres



Concluding with the only red indicator on the board, Team UAV mentions that finding pilots with confined space experience is very challenging, necessitating in-house training for pilots (**Skills** – flat, red). This perspective is intriguing, as some respondents who also needed to train their pilots in-house rated their skills as green, indicating it did not limit their growth.

When asked about the changes they would like to see in the UK's approach to drone operations, Team UAV responded:

> Streamlining the regulatory processes, particularly for BVLOS approvals, would encourage more widespread use and innovation. Establishing robust training and certification programmes for operators would ensure safety and professionalism. Clearer guidelines for urban operations are needed to address privacy, safety, and operational restrictions. Supporting research and development through incentives and funding, along with public awareness campaigns, would reduce misconceptions and increase acceptance of drone technology. Additionally, investing in infrastructure, such as dedicated drone corridors, and enhancing international collaboration to harmonise regulations would facilitate easier cross-border operations and global growth. These changes would create a more supportive and enabling environment for drone operations in the UK, fostering innovation, safety, and industry growth."

They are also worried about DJI's low-cost, high-spec drones being removed as an option for political reasons, a concern shared by others.

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	↗	
Implementation Success in integrating the solution with business as usual	↗	
Technology Availability and efficacy of technology required to facilitate the solution	↗	
Regulation Degree to which current regualtions facilitate the solution	→	
Skills Ability to find the appropriate mix of skills in the market	→	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

Highly Accurate Drones Keeping Passengers and Engineers Safe and Minimising Commuting Delays

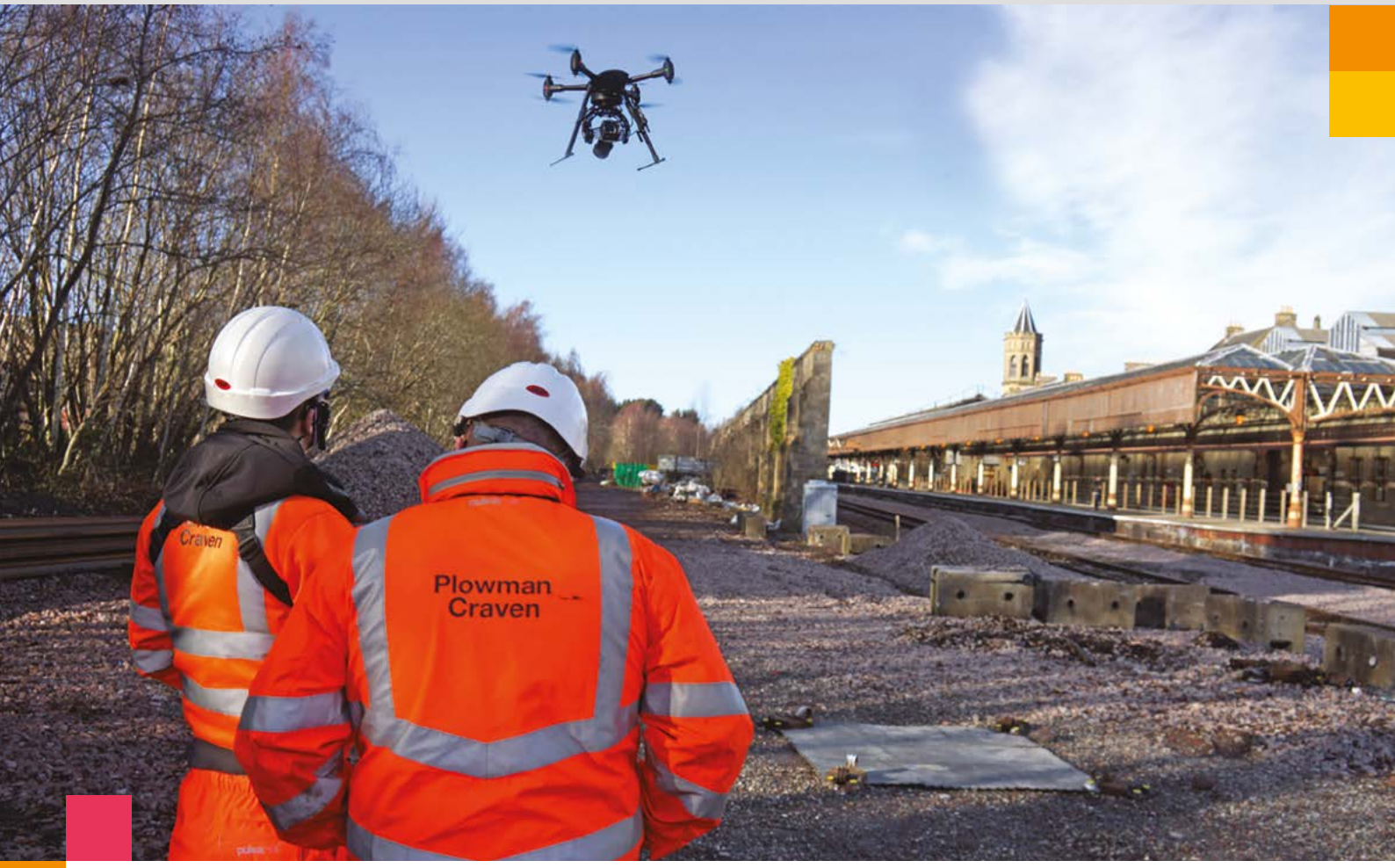
Inspection – Rail/ Plowman Craven

Original Case Study

Drone survey (railway) – drones used to capture data at Network Rail Band 1 accuracy. Comparison is against traditional approaches (source: Plowman Craven).

Faster	■■□	20% faster claimed, trains can still run during capture
Safer	■■■	Safer than walking the track, no possession, fewer heads
Cheaper	■■□	30% cheaper claimed
Environment	■■■	85% lower emissions claimed (fewer trips to site)

The remarkable thing about Plowman Craven's solution in 2021 was the absolute accuracy they achieved while surveying railways which enabled them to deliver a host of safety, cost and efficiency benefits. Their perception of the status of the barriers to growth identified in SWL2 is equally remarkable, they are the only respondent to consider that all barriers were green (no issue) in 2021 and are still green in 2024. This reflects a company whose belief that it is in control of its own destiny has allowed them to develop and expand their drone solution over the past three years – they see drone solutions as complementary to their traditional land survey business rather than an end in themselves.



Since SWL2, Plowman Craven have improved and rebranded their highly accurate drone solution. What was previously Vogel R3D is now Vogel Freedom and flight height for the Network Rail band 1 accuracy (+/-5mm absolute accuracy) is now 10m higher at 35m vs 25m. They claim that, with their solution, there is no need to have "boots on ballast" (people on the track), nor to interrupt rail traffic (no "possession" of the track required) and, as a result, the following benefits are delivered:

"

20% faster, dramatically cutting the typical labour and time intensive track-based tasks such as the installation of ground control points. This means that mobilisation times are now faster than ever, down from weeks to days, and the programme's speed of delivery enhances the client journey, delivering valuable data quicker;

30% cheaper, reducing the need for extensive hours of work for safety critical staff, allowing work to take place during daylight hours (as opposed to midweek nights and weekend possessions) and reducing the overall time spent on site. This results in major savings across project lifecycles;

85% lower carbon, due to a vastly lower number of staff needed on site. In turn, less site time means fewer shifts required across projects and reduced travel (and associated emissions) to and from sites. This is aligned with the decarbonisation targets for the UK's rail networks and wider net zero ambitions in the UK."

They also note that business has grown at the rate they expected in 2021 and **"UAV operations service a large portion of PCL [Plowman Craven] revenues."**

Plowman Craven's atypical scoring of the SWL2 barriers to growth (all green, all flat) suggests a company that feels in control of its own destiny and does not perceive its growth to be constrained by these factors.

The **Perception** traffic light (flat – green) looks encouraging on the face of it but Plowman Craven say:

"

Clients are open to our solution or sometimes indifferent."

We found the "indifferent" point fascinating. As long-time advocates and heavy users of drone solutions we were surprised some of Plowman Craven's clients felt this way. We can speculate that in the land survey market, where Plowman Craven operate, clients are looking for a survey of a given accuracy at a given price point and do not care whether this is delivered by drones or using traditional methods such as ground-based laser scanning or GPS pole. We could also say that, in the land survey field, drones are very much considered business as usual, as reflected in Plowman Craven's views on the barriers to growth.

We have the same trend and rating for **Implementation** and Plowman Craven notes that **"deliverables are easily accepted."** If we dig a little, however, drone reports are being delivered in the same manner as traditional land survey reports with files often shared using cloud storage and then manually uploaded to the end clients' systems. This, though effective and acceptable to the client, is quite different to seamless delivery through a Visual Asset Management (VAM) system which is integrated with the client's systems, refer to the Cyberhawk case study above.

Technology (flat – green) reflects Plowman Craven's pioneering development and evolution of the Vogel system noted above, along with their work on machine learning analytics. If we combine this with **Regulation** (flat – green), a picture emerges of a company who **"currently fly multi-rotor drones over discrete sites"**. They do, however, note that **"CAA regulations which enable "Drone in a Box" solutions"** would be desirable, but this is not enough of an issue to consider the barrier to be amber. Closing with **Skills** (flat – green), Plowman Craven trains their own pilots, completing the picture of a company very much colouring within the lines while still innovating, growing, and delivering faster, safer, more cost-effective, and environmentally friendly solutions for their clients.

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	→	
Implementation Success in integrating the solution with business as usual	→	
Technology Availability and efficacy of technology required to facilitate the solution	→	
Regulation Degree to which current regualtions facilitate the solution	→	
Skills Ability to find the appropriate mix of skills in the market	→	

Change from 2021 and 2024 status, red indicates and 'issue' and green 'no issue'

Digital Transformation in Stockpile Auditing

Survey/ VLOS/ PwC

Original Case Study

Drone survey – replaces traditional land survey approaches including manual (e.g. GPS pole) and semi-automated (terrestrial laser scanning)

Faster	■■□	Eg quarry – traditional 1 day, drone 0.5 days.
Safer	■■□	Fewer trips, less site time, fewer set ups, no pile contact
Cheaper	■■□	Similar capture pricing if duration of traditional capture <= 1 day, lower audit team cost
Environment	■□□	Similar environmental if both only require 1 site trip

PwC was a trailblazer in adopting drones for inventory auditing in 2018. Since 2021, they have fully integrated drones with business as usual, expanded the scope of inventory covered and delivered services internationally. PwC has also taken a flexible approach to aerial data, incorporating satellite capture in addition to drones.

In 2018, PwC pioneered the use of drones for inventory auditing, significantly enhancing audit quality and efficiency through technology integration. As a company who frequently talks about the criticality of integrating drones with business as usual, it was important for PwC to walk the talk and they added drone inventory testing to their official Audit Guide in October 2021. The process includes a checklist for auditors to determine whether drones are suitable and establishes a clear methodology for testing stockpile inventory using drones. Drone inventory auditing has also been incorporated into PwC's auditor training programmes.

The success of PwC's drone initiative is evident from the increasing number of audits using drones annually, with many now in their fifth year.

PwC's drone scope has also expanded to include more than just stockpile volumetrics. Examples include counts of inventory as diverse as fences and cattle. The company has also used satellite analytics, including multispectral imagery, to determine planted tree area and health.

This normalisation of operations is reflected in a full set of green traffic lights. Since 2021, both **Perception** and **Implementation** have improved. This indicates success in the internal PR efforts required to integrate drone solutions within an organisation and in writing drones into business-as-usual processes.

Technology and **Regulation** have remained fit-for-purpose and, while advancements in autonomous drone technology and beyond visual line of sight (BVLOS) Regulations could further enhance efficiency, they are not currently impediments to growth. PwC is well-equipped with internal expertise and collaborates with approved vendors for data capture and processing, ensuring that **Skills** are not a concern.

PwC says:

> "Through embedding drone technology in our audit methodology, we're transforming audit quality and efficiency by providing accurate, real-time inventory assessments. Embracing emerging technology, including integrating AI and satellite data into our drones approach, is crucial as we build our vision for the Audit of the Future. It is also aligned to our Human-Led, Tech-Powered global strategy and enables us to enhance trust in the audit and keep pace with our clients' own digital journeys."

Potential barrier to growth	Trend	2024
Perception Client or stakeholder attitudes to, and openness towards the solution	↗	
Implementation Success in integrating the solution with business as usual	↗	
Technology Availability and efficacy of technology required to facilitate the solution	→	
Regulation Degree to which current regualtions facilitate the solution	→	
Skills Ability to find the appropriate mix of skills in the market	→	

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Contact us

Craig Roberts
Head of Drones, PwC UK
T: +44 (0)7771 930 482
E: craig.roberts@pwc.com

Ben Evans
Manager, Drones, PwC UK
T: +44 (0)7742 457 634
E: benjamin.evans@pwc.com

Joanne Murray
Head of Audit Innovation, PwC UK
T: +44 (0)7525 281 052
E: joanne.y.murray@pwc.com

pwc.co.uk

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