DRONES AND ROBOTICS IN THE HIGHLANDS AND ISLANDS

MARKET ASSESSMENT

REPORT

HIE
Highlands and Islands Enterprise
Iomairt na Gàidhealtachd 's nan Eilean

reid consulting
Innovating Policy

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1. Introduction

1.1. Scope and objectives

This study, commissioned by Highlands and Islands Enterprise (HIE) assesses the market potential for drones and robotics in the Highlands and Islands, with particular focus on the emerging cluster in Oban and North Lorn. Its purpose is to identify how this area specifically can capitalise on current and emerging opportunities, what is needed to support growth, and how the region more broadly can position itself as a leading location for the development, testing and commercialisation of uncrewed systems and related robotics. The study is set in the wider Highlands and Islands context, while giving specific attention to Argyll and the Islands and specifically Oban and North Lorn, including the interplay between local assets, sectoral strengths, infrastructure, skills, and policy support. It also recognises that other parts of the region, notably Orkney, are also progressing related activity, with some points of overlap. This creates synergies which add to rather than detract from the overall regional proposition.

The study covers drones and robotics in a broad sense (see section 2.1 for more details on these technologies and their applications):

- **Air**: aerial drones, also known as Uncrewed Air Vehicles (UAVs)
- **Maritime**: Above water drones known as Uncrewed Surface Vessels (USVs); under water drones known as Remotely Operated Vehicles (ROVs), Uncrewed Underwater Vehicles (UUVs) or autonomous underwater vehicles (AUVs)
- **Ground:** Land-based robots / uncrewed ground vehicles (UGVs, autonomous machinery, industrial/mobile robotics).

UAVs, UUVs and ground robotics have applications spanning offshore renewables, marine science, environmental monitoring, agriculture, logistics, emergency response, infrastructure inspection and training services.

The study has **four main objectives.** They are to:

- provide an overview of the global, UK, Scottish and regional market for drones and robotics, including market size, forecasts, key trends, growth areas, opportunities, competitors and sectoral applications, alongside the economic, social, technological and environmental factors shaping demand.
- map the current regulatory and policy landscape in the UK and Scotland, identifying barriers to adoption or expansion and possible mitigations.
- assess the strategic fit of Argyll and the Islands, especially Oban and North Lorn, examining competitive advantages, assets, research facilities, workforce, skills and training provision.
- draw on the evidence and relevant international learning to identify what may be required for the region to capture market opportunity, including policy levers, investment needs, and practical enablers for cluster development.

The report aims to provide HIE with a robust evidence base to inform future decisions on cluster development, investment priorities and regional positioning.

1.2. Research methods - summary

A PESTLE framework (Political, Economic, Social, Technological, Legal and Environmental) was used as the overarching analytical structure for the study (see Annex B methodology). It provides a systematic way to assess the external factors shaping the development of an unmanned systems cluster in Oban/North Lorn and the wider Highlands and Islands. The framework served three complementary purposes:

- Desk research (see Annex A references / footnotes) review of literature, data and project reports (e.g. use cases), technology and market trends, regulatory guidance, and web-based materials relevant to UAV/UUV/UGV deployment in the region.
- Stakeholder and specialist interviews (see Annex C list of interviewees) to inform the development of a structured interview guide, ensuring consultations consistently explore regulatory barriers, market demand, skills capacity, infrastructure gaps, environmental impacts and cluster development conditions.
- Regional stakeholder / user survey (see annex D survey tables) – to shape the survey questions that tested market need, adoption readiness, perceived barriers, and potential applications across key sectors (e.g. offshore wind, aquaculture, land management, healthcare logistics).

The PESTLE framework ensured that the assessment captured not only the market opportunity, but also regulatory feasibility, social acceptance, environmental contribution and strategic alignment with regional transformation priorities in Argyll and the Islands and the Highlands and Islands. An emphasis was given to whether and how an unmanned systems cluster in Oban could act as a catalyst for wider Highlands and Islands policy goals (including blue economy, renewables, rural services, skills, net zero).

The study was carried out during February-March 2026 and the evidence derived from the three methods (desk research, interviews and the survey) was collected and triangulated as the evidence base for this report.

1.2.1. Stakeholder interviews

We conducted interviews with representatives from 13 organisations represented by 19 individuals, across public, private and research sectors. The organisations were selected in consultation with HIE based on a long-list drawn up from suggestions by HIE and from our own research (see annex C).

The interviews were semi-structured and followed a common interview guide, with a tailored set of questions depending on whether the interviewee was a policy stakeholder, a current or potential user, or a market/technology specialist. Interviews were conducted via Teams (generally lasting 45 minutes to one hour), recorded for analysis only, transcribed, and anonymised; all participants were sent a briefing and consent form in advance and were asked to give informed consent before taking part.

To support the analysis of qualitative data, we used Perplexity Pro to generate AI-assisted summaries of the interview transcripts. The anonymised transcripts were securely uploaded to a private Space, with no data sharing outside the project environment and no use of the data for model training. Within this controlled setting, the AI was used solely to produce concise summaries and to highlight recurring themes and illustrative quotations, which were then reviewed, refined and interpreted by the research team as part of the wider qualitative analysis.

1.2.2. Stakeholder survey

The survey portion of the project aimed to understand current and future use of drones/robotics as well as implications for an Oban/Argyll hub specifically, in addition to a wider Highlands and Islands cluster. It also served as a recruitment tool for the stakeholder interviews.

The research team, in consultation with HIE, developed a questionnaire covering the topics described above, which was scripted using the SurveyMonkey online platform. HIE disseminated the survey to organisations which are active in or linked to Argyll/Oban and the wider Highlands and Islands. The survey was also promoted on LinkedIn, and through HIE's social media channels to capture a broader range of stakeholders' views, such as those in the rest of Scotland and the UK who may be interested in drones and unmanned systems in the Highlands and Islands.

The fieldwork period was from 6th to 30th March, and the survey achieved 49 responses. Seven in 10 (71%) respondents were from businesses, while one in 10 (10%) were from universities/research institutes and fewer than one in 10 were public sector bodies (6%), third sector/social enterprises (4%) or another type of organisation (8%). About one in four (26%) were based in Oban, Lorn and the Argyll islands and one in three (36%) were based in the Highland area. One in four (23%) were based outside the Highlands and Islands but in Scotland; while one in 10 (10%) were based outside Scotland but within the rest of the UK.

2. Global, UK, Scottish and regional markets

2.1. Technology and application overview

2.1.1. Uncrewed Air Vehicles

The Highlands and Islands region presents a strong strategic opportunity for drone (UAV) technology investment due to:

- Challenging geography that increases the value of remote sensing and aerial automation.
- Growth in key sectors such as offshore renewables, agriculture, infrastructure, and emergency services.
- Policy alignment with net-zero, environmental monitoring, and regional economic development.

UAV services represent a rapidly expanding global market, particularly in:

- Asset inspection
- Precision agriculture
- Emergency management
- Environmental mapping
- Logistics
- Defence

In the Highlands and Islands, specifically, UAVS are relevant for:

- Renewables — accelerating offshore wind and tidal projects demand frequent inspections.
- Tourism and land management — UAVs can enhance safety and environmental stewardship.
- Public sector monitoring — coastguard, search and rescue services and environmental agencies can reduce operational costs while increasing coverage.
- Logistics – time sensitive deliveries, deliveries to difficult to access communities.

Table 2-1: Relevant UAV example use cases

Offshore Renewables	Infrastructure & Utilities
• Substation thermal imaging	• Telecom tower inspection
• Offshore asset mapping	• Public building thermal imaging
• Net integrity inspection	• Bridge and road condition surveys
• Environmental compliance monitoring	• Powerline and grid monitoring
• Turbine blade inspection	**Agriculture & Land Management**
• Cable landfall coastal monitoring	• Livestock tracking
Emergency Services	• Carbon stock verification
• Flood and wildfire mapping	• Biodiversity surveys
• Disaster pre-planning surveys	• Crop health monitoring (NDVI)
• Incident scene documentation	• Forestry and peatland condition mapping
• Search and rescue thermal imaging	**Environmental and Climate Monitoring**
Aquaculture & Marine Farming	• Coastal erosion mapping
• Algal bloom detection	• Long-term climate dataset capture
• Shoreline condition surveys	• Marine protected area monitoring

2.1.2. Marine robotics

The Highlands and Islands is well positioned to become a key region in Scotland and the UK for marine robotics deployment, testing, and commercialisation. Through coordinated investment in ROVs, USVs, and UUVs, the region can:

- Strengthen offshore renewables and aquaculture competitiveness
- Support oil and gas decommissioning
- Enhance environmental monitoring and climate resilience
- Create high-skilled jobs in autonomous marine systems
- Establish exportable marine robotics services

The Highlands and Islands possess a combination of unique conditions:

- World-class marine energy activity (offshore wind, tidal, wave)
- Strong aquaculture and marine farming sector
- Harsh maritime conditions ideal for real-world autonomy validation
- Established research and marine testing infrastructure
- Expanding demand for subsea inspection and environmental compliance

Marine robotics directly addresses key regional challenges:

- High cost of vessel-based inspection
- Diver safety risks
- Increasing environmental reporting requirements
- Labour shortages in offshore industries
- Net-zero transition pressures

Global demand for marine autonomy is accelerating, particularly in inspection, monitoring, logistics and climate science.

Table 2-2: Relevant UUV example use cases

Offshore Renewables (Wind, Tidal, Wave)	Ports & Maritime Logistics
• Subsea cable inspection via UUV	• Autonomous harbour surveys
• Foundation and scour monitoring	• Hull inspection robotics
• USV environmental baseline surveys	• Sediment mapping
• Post-storm structural assessment	• Autonomous pilot support vessels
Oil & Gas Decommissioning	**Environmental & Climate Monitoring**
• Pipeline integrity surveys	• Long-duration UUV oceanographic surveys
• Structural corrosion mapping	• Marine protected area monitoring
• Subsea debris mapping	• Seafloor biodiversity mapping
• ROV-based pre-removal inspections	• Carbon sequestration measurement
Aquaculture & Marine Farming	
• ROV net inspection	• Seabed waste accumulation monitoring
• UUV water quality profiling	• Lower inspection costs
• USV perimeter patrol	

2.1.3. Ground-based autonomous systems / robotics

Unmanned Ground Vehicles (UGVs) are a segment of land robotics: they are ground-based systems that operate without a person on board, either by teleoperation, autonomy, or a mix of both. UGVs and, more broadly ground robotics, have particularly strong relevance in the Highlands and Islands due to the region's combination of remote geography, sparse population, harsh weather, and infrastructure challenges. These characteristics make many traditional operations costly, risky, or logistically complex - conditions where autonomous or remotely operated systems offer clear advantages.

One of the most immediate and already demonstrated use cases is inspection and maintenance of critical infrastructure.[1] In the Highlands and Islands, this includes energy assets (onshore wind, hydro, substations), transport networks, and coastal or subsea infrastructure linked to renewables and telecommunications. Ground robots - alongside related systems like remotely operated vehicles - can access hazardous or hard-to-reach environments to carry out repeatable, high-resolution inspections without exposing personnel to risk. This aligns with broader industry practice, where robotic platforms are used for condition monitoring, data capture (e.g. Light detection and ranging (LiDAR), thermal imaging), and predictive maintenance in infrastructure systems.

A second major application area is precision agriculture and land management, which is highly relevant to crofting, upland farming, and estate management across the region. UGVs can support tasks such as crop and soil monitoring, targeted spraying, weed control, and livestock management. Research in Scotland[2] already shows robotics being trialled for crop health monitoring, soil assessment, and targeted input application, often enabled by improved rural connectivity (e.g. private 5G networks). More broadly, agricultural robots are expected to improve productivity while reducing labour requirements and environmental impact. This is important in

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[1] https://alps-robotics.com/en/applications.html
[2] https://www.hutton.ac.uk/blog/collaborative-robotics-test-bed-at-the-james-hutton-institute-shortlisted-for-industry-prize/

regions facing labour shortages and challenging terrain. In uplands, UGVs could complement aerial drones by operating under cloud cover or in high winds, providing persistent ground-level data collection.

The Highlands and Islands also presents strong opportunities for environmental monitoring and conservation. Ground robots can be deployed for peatland monitoring, biodiversity surveys, forestry inspection, and tracking of invasive species. Their ability to traverse rough, uneven terrain and operate autonomously over long durations makes them well-suited to large estates and protected landscapes. Compared to manual surveying, UGVs can provide higher-frequency data collection with lower human disturbance, which is particularly valuable in sensitive ecosystems.

Another important use case is emergency response and resilience. Remote communities in the Highlands and Islands can face delayed response times due to geography and weather. UGVs can support search and rescue, disaster assessment, and delivery of supplies in scenarios such as flooding, landslides, or severe storms. In line with wider global use, ground robots are already used in hazardous environments (e.g. search and rescue or explosive disposal) because they can operate where it is dangerous or impossible for humans to go. In the Highlands and Islands context, this could extend to winter resilience, coastal incidents, and supporting isolated communities.

Finally, there is growing potential in logistics and last-mile delivery, particularly for islands and remote rural settlements. UGVs could enable autonomous transport of goods within local areas, linking harbours, airstrips, and communities, and reducing reliance on scarce labour and improving service reliability. While still emerging, this aligns with broader UGV development in logistics and material transport, where autonomous systems are used to move goods efficiently across challenging environments.[3]

The Highlands and Islands offer a compelling real-world testbed for UGV deployment. The region's constraints (distance, terrain, weather, and workforce limitations) map closely onto the strengths of ground robotics. As enabling technologies (connectivity, autonomy, sensing) continue to mature, the area is likely to see increasing adoption across energy, agriculture, environmental management, emergency services, and rural logistics, with both economic and societal benefits.

2.2. Market trends and perspectives for the Highlands and Islands

2.2.1. Global market trends in autonomous systems

The main market research firms top-line figures provide a market framing. The spread in UAV figures (from $26B to $73B for 2024/25) reflects different scopes: some include only the OEM hardware market, while others incorporate services, software, and aftermarket components. Forecast of growth in the three markets vary as well ranging from 9-16% for UAVs, 8-13.5% for UUVs and 3.6-8% for UGVs.

[3] *https://alps-robotics.com/en/applications.html*

Table 2-3: Estimated global market scale for UAVs, UUVs and UGVs

Segment	Market Size	Forecast	CAGR*	Source
UAVs (Global)	~$26B (OEM, 2025)	$40.6B by 2030	9.2%	MarketsandMarkets
UAVs (Global)	~$73B (2024, broader definition)	$163.6B by 2030	14.3%	Grand View Research
UAVs (Global)	$47.6B (2026)	$160.4B by 2034	16.4%	Fortune Business Insights
UUVs (Global)	$5.93B (2025)	$8.72B by 2030	8.0%	MarketsandMarkets
USVs (Global)	$0.82B (2025)	$1.59B (2030)	14.1%	MarketsandMarkets
UUVs (Global)	$4.26B (2025)	$9.85B by 2034	9.4%	Fortune Business Insights
UGVs (Global)	$9.0B (2025	$43.2 by 2034	18.7%	Fortune Business Insights
UGVs (Global)	3.33B (2024)	7.73B by 2033	10.1%	Grand View Research
UGVs (Global)	$3.21B (2024)	$5.05B by 2030	7.9%	TechSci Research
UGVs (Global)	$2.7B (2024)	$3.98B by 2035	3.6%	Market Research Future
Unmanned Systems (all)	$27.13B (2024)	$43.54B by 2030	8.2%	MarketsandMarkets
Military Drones	$17.26B (2025)	$29.57B by 2030	11.3%	Research and Markets

Source: authors based on available market research reports, * Compound Annual Growth Rate

According to Drone Industry Insights,[4] the commercial market share by segment of the global drone market in 2025, was dominated by services, with hardware and software representing together only slightly more than a fifth of the market.

Figure 2-1: estimated trends and market share by segment for UAVs (drones)

Commercial drone hardware encompasses drone platform manufacturers, components, and systems manufacturers. Meanwhile, software includes companies working on flight planning, navigation, data analytics, and fleet management. Lastly, the service segment features all types of drone companies who provide services to other companies such as inspections, mapping, deliveries, or any other type of service.

The marine robotics market is expanding rapidly as defence modernisation, offshore energy inspection, ocean monitoring, and AI-enabled autonomy drive adoption across underwater and surface platforms. Market reports consistently show that the sector is moving from niche deployments toward mainstream maritime operations, while high costs, cybersecurity risks, and limited collision-avoidance capability remain key constraints.

Within this broader market, UUVs are the larger and more established segment: Fortune Business Insights estimates the global UUV market at USD 4.26 billion in 2025, rising to USD 9.85 billion by 2034 at a 9.40% compound annual growth rate (CAGR), with North America holding 41.50% of the market in 2025 and Europe benefiting from defence and commercial demand. USVs are growing even faster from a smaller base, with MarketsandMarkets estimating USD 0.82 billion in 2025, rising to USD 1.59 billion by 2030 at a 14.1% CAGR; North America leads at 36.1% in 2025, but Europe is clearly represented through major players such as Exail Technologies and Thales, alongside other European industrial and naval autonomy strengths.

[4] *See : https://droneii.com*

Land robotics is a much larger market than air or sea robotics, but that headline figure is broader than UGVs alone because it also includes teleoperated systems, industrial mobile robots, and collaborative robots (cobots). In that wider context, UGVs are the fastest-growing autonomous and remotely operated segment, with demand strongest in military applications, where UGVs are utilised for reconnaissance, supplies (logistics), and explosive ordnance disposal. Moreover, UGVs are used for civilian applications such as nuclear plant operations, research and rescue, agricultural harvesting & spraying, firefighting, etc.

For the UGV market, the most recent estimate of Fortune Business Insights, which is a large jump from previous forecasts, is USD 9.06 billion in 2025, rising to USD 43.23 billion by 2034 at an 18.7% CAGR. This is very much the high end of the market forecast estimates and, for example, Grand View Research estimates USD 3.33 billion in 2024, rising to USD 7.73 billion by 2033 at a 10.1% CAGR. While this reflects differences in scope and segmentation, estimates from other market research firms tend to suggest that a reasonable central band for the global UGV market is roughly US$3–6 billion in the mid-2020s. All market research firms note that North America is the largest market region, but that Europe is also a major market and capability base, with Grand View Research forecasting more than 11% CAGR for Europe and highlighting defence modernisation, border surveillance, counterterrorism, and disaster response as key drivers.

2.2.2. UK market trends and forecast growth

In the UK, the market for uncrewed systems is expanding rapidly across both aerial and underwater domains, driven by defence modernisation, offshore energy demand, and growing adoption of autonomous technologies in civil infrastructure. In the case of uncrewed aerial vehicles (UAVs), the UK is now one of the largest drone markets in Europe, with current estimates placing market value between approximately USD 0.84 billion and USD 1.1 billion in 2025, and forecasts suggesting growth to between USD 1.5 billion and USD 2.7 billion by the early 2030s. Growth rates are generally projected at 10–13% CAGR, reflecting strong momentum across both military and commercial applications. Defence remains the dominant segment, accounting for most of the spending through intelligence, surveillance, reconnaissance, and tactical support platforms, while commercial demand is accelerating in infrastructure inspection, energy asset monitoring, surveying, emergency response, and logistics.

Within the UAV sector, the strongest growth is occurring across three broad platform categories. Fixed-wing systems continue to dominate long-endurance and defence-oriented applications because of their range and efficiency, particularly for surveillance and maritime patrol roles. Multirotor systems are increasingly used in commercial operations, especially where short-duration but highly precise inspection tasks are required, such as utility networks, telecom towers, and construction sites. Hybrid vertical take-off and landing systems are emerging as one of the most strategically important growth areas because they combine endurance with deployment flexibility, making them particularly attractive for offshore missions, remote logistics, and military resupply. The UK's competitive position in UAVs is strongest not in mass hardware manufacturing, but in high-value areas such as autonomous flight control, secure communications, sensor integration, and mission software.

PwC's "Skies Without Limits" report explores the transformative potential of drones in the UK, highlighting their economic impact and advancements in the drone industry. Skies Without Limits v2.0: Released in 2022, estimated that drones could contribute up to £45 billion to the UK economy by 2030. It emphasised the potential for drones to enhance productivity, reduce carbon emissions, and create approximately 650,000 jobs in a fully adopted drone economy. The report identified various barriers to drone adoption, including regulatory challenges and public perception.

Skies Without Limits v3.0,[5] their most recent report from 2024, provided an updated insight into the progress of the UK drone industry from 2021 to 2024. It discussed advancements in drone applications, such as BVLOS (Beyond Visual Line of Sight) operations, and highlighted the ongoing challenges that the industry faces. The report indicated that while there have been significant developments, many barriers remain, particularly in achieving commercial viability for BVLOS operations in the UK.

Of note, the reports collectively underscore the potential for drones to revolutionise various sectors, including logistics, agriculture, and emergency services, by providing faster, safer, and more cost-effective solutions. They also highlighted that the drone industry is witnessing innovations that could lead to routine BVLOS flights and the establishment of production lines for drones, indicating a shift towards more integrated drone operations within the UK. They also emphasised the importance of collaboration between industry stakeholders and government to address the regulatory and technological challenges that hinder drone adoption.

The underwater autonomy market, while less transparently measured at UK level, is equally significant and increasingly strategic. Global military unmanned underwater vehicle (UUV) markets are forecast to grow strongly over the next decade, with growth rates close to 12% annually, and the UK represents an important specialist contributor within this wider market through defence procurement, offshore subsea engineering, and marine robotics capability. UUV demand in the UK is concentrated in defence programmes, subsea inspection for offshore energy infrastructure, harbour and port security, and environmental survey work. In practice, the underwater market is split between remotely operated vehicles (ROVs), which remain dominant in industrial offshore work, and autonomous underwater vehicles (AUVs), which are growing fastest due to their use in seabed mapping, persistent surveillance, and autonomous inspection missions.

The UK market for UGVs is currently modest in scale but shows steady growth. Estimates suggest the market was worth approximately USD 132 million (£100 million) in 2023 and is projected to reach around USD 179 million (£140 million) by 2030, reflecting a CAGR of roughly 4–5%.[6] This relatively moderate growth is largely driven by defence, security, and niche industrial applications such as inspection in hazardous environments. As a result, standalone UGV platforms remain a developing segment rather than a mass commercial market.

However, significantly stronger growth is evident when UGVs are considered within broader robotics and automation sectors. In particular, the UK agricultural robotics market, which is highly relevant to rural regions such as the Highlands and Islands, is forecast to grow from approximately USD 855 million in 2023 to over USD 3.1 billion by 2030, representing a CAGR of over 20%.[7] This includes autonomous and semi-autonomous ground-based systems used for crop monitoring, precision spraying, and livestock management. Similar growth dynamics are seen in adjacent sectors such as energy infrastructure inspection and logistics automation, where ground robotics form part of wider autonomous systems rather than standalone products.

While Scotland-specific forecasts are limited, the Highlands and Islands region is likely to represent a disproportionately strong opportunity for UGV adoption. This is due to its geographic and economic characteristics, including remote and sparsely populated areas, challenging terrain, and a concentration of sectors such as agriculture, renewable energy, and environmental management. These conditions align closely with the strengths of ground robotics, suggesting that although the absolute market size may be small, adoption intensity could exceed the UK average in key verticals.

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[5] Skies Without Limits v3.0 - PwC UK

[6] *NextMSC, UK Unmanned Ground Vehicle Market Forecast, 2023–2030*

[7] *Grand View Research, UK Agricultural Robots Market Size & Forecast, 2023–2030*

Overall, the evidence indicates that the most meaningful market opportunity for UGVs in Scotland lies not in the direct sale of platforms, but in their integration into rapidly growing robotics ecosystems. Framing the opportunity in terms of sector transformation, particularly in agriculture, energy, and rural logistics, provides a more accurate representation of future demand and economic impact.

As noted previously, a major driver of both UAV and UUV growth in the UK is the transition occurring in offshore energy systems. Offshore wind expansion, subsea cable installation, and legacy oil and gas infrastructure all require increasingly sophisticated inspection and maintenance capabilities, creating strong demand for autonomous platforms that reduce cost and improve safety in hazardous environments. This is especially important because some operators increasingly prefer to explore integrated autonomy solutions that combine aerial inspection, surface communication relays, and underwater inspection into a single operational architecture. As a result, value is shifting away from vehicle hardware alone towards software, autonomy, data interpretation, and mission integration systems.

2.2.3. Scottish capabilities in autonomous systems and robotics

Scotland holds a particularly important position within this wider UK market because it combines several structural advantages that support autonomous systems development. Offshore energy activity, remote geography, strong marine engineering capability, and access to demanding environmental test conditions make Scotland disproportionately influential in both aerial and underwater autonomous systems despite its relatively smaller market size. In UAVs, Scotland has emerged as a strong application environment for offshore wind inspection, remote logistics, and emergency response, particularly where conventional transport remains costly or difficult. These operational challenges create ideal conditions for trialling beyond-visual-line-of-sight drone operations and autonomous logistics services.

In underwater systems, Scotland has one of Europe’s most important marine robotics clusters. Orkney, in particular, has become internationally recognised because of its role in testing marine autonomous technologies under real operating conditions. The presence of the European Marine Energy Centre (EMEC) has created a significant test environment for autonomous marine systems, particularly where subsea robotics intersect with renewable energy operations. Aberdeen also remains highly important because of its offshore subsea engineering base, while Glasgow and Fife contribute through defence engineering, systems integration, and specialist maritime technologies.

Looking ahead, the strongest growth opportunities across both UAVs and UUVs are expected to concentrate in defence autonomy, offshore wind support, long-range inspection, and integrated multi-domain autonomous operations. For investors and policymakers, the most strategically valuable part of the market is increasingly not the physical vehicle itself, but the enabling systems around autonomy, sensing, communications, and mission management. This is particularly relevant in Scotland, where the convergence of offshore energy, defence applications, and marine robotics creates unusually strong potential for integrated autonomous systems that operate across air, surface, and subsea domains.

A policy paper (National Robotarium / Heriot-Watt University[8]) highlights that the global robotics market could be worth approx. £218 billion by 2030, and that Scotland needs to accelerate efforts to support adoption to capture this value. It emphasises Scotland’s strengths in research, engineering and cross-sector collaboration. However, dedicated Scottish market size figures (e.g. £ for robotics revenue in Scotland and more specifically the Highlands and Islands) are not readily available in current public market data.

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[8] *See: https://thenationalrobotarium.com/reaping-the-rewards-of-the-robotics-revolution-our-manifesto/*

There are ecosystem initiatives such as the Scottish Robotics and Autonomous Systems (RAS) Cluster pilot,[9] aiming to grow robotics innovation across Scotland, plus there are local efforts to support robotics adoption in areas such as industrial productivity and aquaculture/automation. So, whilst formal robotics market size data for the Highlands and Islands region specifically is not available, the regional economic strategies emphasise technology, innovation and sustainable growth, which can create enabling conditions for robotics and autonomous systems adoption (see section 3.4).

[9] *See: https://thenationalrobotarium.com/industry/scottish-robotics-cluster/*

3. Regulatory and policy landscape

This section sets out briefly the regulatory and policy landscape for the use of uncrewed systems in the air, in the maritime environment and on land.

3.1. UAV regulation and BVLOS roadmap

UK UAS operations are regulated under UK Regulation (EU) 2019/947, the Civil Aviation (Air Navigation Order), and the Unmanned Aircraft (Amendment) Regulations 2025, with the UK Civil Aviation Authority (CAA) providing guidance, compliance standards, and enforcement.

3.1.1. Regulatory Framework

The UK's drone regulations are structured under a hierarchy of primary and secondary legislation. Primary legislation, such as the Civil Aviation Act 2012, grants the CAA authority to regulate civil aviation, including UAS operations. Secondary legislation translates these broad principles into enforceable rules, including:

- UK Regulation (EU) 2019/947: Sets out operational rules for unmanned aircraft, including categories of operations, pilot competency, and risk assessment requirements.
- Civil Aviation (Air Navigation Order) 2016 (ANO): Provides the main civil aviation requirements applicable to UAS.
- Unmanned Aircraft (Amendment) Regulations 2025: Updates operational and product safety requirements, introduces remote identification (RID), geo-awareness, and new pilot registration and training requirements.

The CAA also issues Acceptable Means of Compliance (AMC) and Guidance Material (GM) to illustrate ways to comply with regulations and provide additional explanations, though GM is advisory and non-binding.

In 2023, the Department for Transport (DfT) sponsored the Civil Aviation Authority (CAA) to review the regulation of UAS in the UK. As part of this review, the CAA published the "Review of UK UAS Regulations /consultation" (CAP 2610).[10] This consultation set out proposals to simplify regulation, deliver greater education for UAS users, improve safety and security, and support the UAS sector transition to new regulations.

In response to the consultation, the CAA published CAP 3105[11] which contains 5 sets of recommendations, with dates to adoption. The aim of these is to: simplify regulation for users; improve the knowledge of UAS regulations; ensure that UAS have an effective minimum level of safety, security and performance; and mitigate the likelihood of UAS posing safety and security issues to ensure a safe and secure airspace.

Categories of UAS Operations

UK UAS operations are divided into three main categories:

- Open Category: Low-risk operations with minimal restrictions, typically for recreational use. Drones must meet weight and operational limits, and pilots must follow basic safety rules.

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[10] Review of UAS regulations | UK Civil Aviation Authority

[11] CAP3105: Review of UK Unmanned Aircraft Systems (UAS) Regulations: Consultation Reply Document | UK Civil Aviation Authority

- Specific Category: Medium-risk operations requiring a UK Specific Operational Risk Assessment (UK SORA) and CAA authorisation. This applies to commercial or higher-risk flights.
- Certified Category: High-risk operations, similar to manned aviation standards, requiring certification of the aircraft, operator, and pilot.

3.1.2. CAA BVLOS Roadmap

In October 2025, the CAA published its Future of Flight: BVLOS Roadmap (CAP 3182),[12] setting out how Beyond Visual Line of Sight (BVLOS) drone operations will become routine across the UK by 2027. The roadmap provides a detailed look at how drones will transition from today's tightly controlled trials to full integration with crewed aviation, paving the way for scalable commercial and public service use.

BVLOS – the ability for drones to operate beyond a pilot's direct line of sight – is seen as the key to unlocking widespread applications in healthcare logistics, infrastructure inspection, and emergency response. According to the roadmap, these capabilities will be delivered "iteratively between now and 2027" in close collaboration between government, industry and the regulator.

The CAA's strategy is built on gradual, data-driven progress. The document outlines four guiding principles:

- Segregation as a stepping stone: early BVLOS operations will take place in segregated airspace to build experience and evidence.
- Iterative policy development: interim "Concepts of Operations" (ConOps) will evolve alongside industry practice.
- Outcome-focused progress: regulations will be shaped by live operational data and specific industry use cases.
- Operational pathways: similar operations will be grouped together to streamline approval and safety case processes.

This incremental approach reflects the CAA's intent to balance technology adoption with public safety, ensuring that each stage of BVLOS evolution is informed by real-world performance. The roadmap divides BVLOS development into three major "operational pathways", each representing a different level of airspace integration:

1. **Atypical Air Environment (AAE)**

The first pathway focuses on operations in what the CAA calls the Atypical Air Environment — low-level airspace close to specific ground infrastructure. These are the most common early BVLOS use cases: inspecting power lines and railways, monitoring perimeter security, or conducting agricultural spraying.

- **Now**: single-operator trials authorised.
- **By 2027**: multi-operator AAE environments supported by Uncrewed Traffic Management (UTM) for strategic deconfliction.

At present, these operations are limited to single operators under tightly defined conditions. However, by 2027, the CAA expects to enable multiple operators to work within the same area simultaneously, supported by emerging UTM systems that can provide strategic deconfliction between flights.

[12] CAP3182: Future of Flight BVLOS Roadmap | UK Civil Aviation Authority

Over time, the definition of "atypical" will also expand, allowing such operations to take place across a broader range of environments and altitudes.

2. Low-Level Urban BVLOS

The second pathway covers BVLOS operations in urban environments below 500ft, where drones operate alongside other airspace users above populated areas. These missions include last-mile delivery services - such as medical supplies, pathology samples, or consumer goods - which have been trialled in controlled corridors like the London Health Bridge project linking two hospitals.

- **Now**: limited "bespoke" operations in Temporary Reserved Areas (e.g. the London Health Bridge trial between hospitals).
- **By 2027**: multiple operators in controlled airspace.
- **Beyond 2028**: fully routine operations in uncontrolled airspace.

By 2027, the CAA anticipates that multiple operators will be able to conduct routine BVLOS flights in controlled airspace under standardised procedures. Beyond 2028, this capability will extend to uncontrolled airspace, marking a major step toward truly scalable urban drone logistics.

3. Fully Integrated BVLOS

The third and most advanced pathway, Fully Integrated BVLOS, represents the ultimate goal of seamless integration between uncrewed and crewed aviation across all classes of airspace. This includes offshore inspections, middle-mile freight logistics between distribution centres, and emergency air service missions such as search and rescue or disaster response.

- **Now**: segregated test operations.
- **By 2027**: controlled airspace integration.
- **Post-2028**: national coverage in both controlled and uncontrolled airspace.

Beyond 2028, fully integrated BVLOS flights will operate freely across both controlled and uncontrolled airspace - a milestone that would make routine, national-scale drone logistics a reality in the UK.

The CAA highlights several enablers that will underpin BVLOS expansion:

- Electronic conspicuity (EC): automatic dependent surveillance-broadcast (ADS-B)[13] in/out for drones and crewed aircraft (978/1090 MHz) will become standard.
- Detect and avoid (DAA): systems will progress from testing to approval for higher-risk categories by 2028.
- UTM integration: moving from flight planning to real-time tactical deconfliction.
- Ground infrastructure: rollout of situational awareness stations and data feeds.
- System Wide Information Management (SWIM) interoperability: linking drone traffic management with traditional air traffic control systems.

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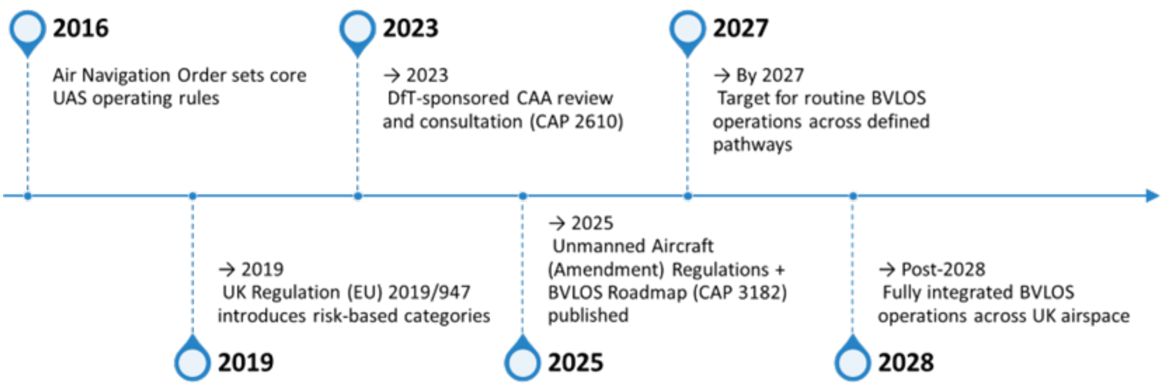
[13] *Automatic Dependent Surveillance–Broadcast (ADS-B) is an aviation surveillance technology and form of electronic conspicuity in which an aircraft determines its position via satellite navigation or other sensors and periodically broadcasts its position and other related data, enabling it to be tracked.*

The roadmap is closely tied to the UK's wider Airspace Modernisation Strategy (AMS),[14] which charts the evolution of national airspace to 2040. The CAA plans to publish its airspace architecture proposals in 2026, providing the framework for full integration of uncrewed and crewed operations.

Figure 3-1 :UK UAS Regulation & BVLOS Timeline



Source: authors based on available documentation

CAA Pre-assessed Test Sites

In November 2025, the CAA introduced its Policy Concept for Pre-assessed Test Sites, providing a faster and more predictable regulatory pathway for drone testing. Details are provided in document CAP 3145.[15] Any drone flying site or Test and Evaluation (T&E) facility can apply to become a CAA Pre-assessed UAS Test Site.

A pre-assessed site will have already completed, documented, and had approved by the CAA the key elements of the Specific Operations Risk Assessment (SORA) methodology:

- Ground risk assessment
- Air risk assessment
- Containment requirements

Since the risk profile of the site has been pre-validated, the regulatory burden for visiting organisations - UAS designers, manufacturers, or operators - is significantly reduced. Instead of a full SORA submission, they can simply submit a variation to their existing SORA Operational Authorisation, adding the validated location.

The CAA's current pre-assessment test site process may only be used for UAS operations within the following parameters:

- Aircraft characteristic dimension (size) must not exceed 20m.
- Aircraft maximum speed must not exceed 125m/s.
- Operations must not involve the carriage of dangerous goods.

[14] https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-modernisation-strategy/about-the-strategy/
[15] CAP3145: UAS Operations at Test Sites - Policy Concept | UK Civil Aviation Authority

A pre-assessed UAS test site provides a structured and efficient framework for uncrewed aircraft testing, with its value dependent on aircraft weight and operational context. For UAS manufacturers operating aircraft below 25kg, lightweight privately built systems may often be tested under the Open Category A3, provided operations are conducted in remote locations and at a sufficient distance from uninvolved persons. Nevertheless, access to a designated pre-assessed site remains beneficial where repeatable test conditions, defined operational procedures, or additional risk mitigations are required. For UAS exceeding 25kg, testing requires authorisation through a SORA, making pre-assessed sites particularly valuable and agile in supporting and expediting the approval process.

3.2. Regulations for ROVs, UUVs and Uncrewed surface vessels

The UK regulatory landscape for uncrewed maritime systems prioritises safety, environmental protection and practical operations, but treats underwater and surface vehicles differently. ROVs and UUVs lack a dedicated national code, instead falling under a patchwork of maritime law, health and safety obligations, and sector-specific environmental rules. Operators must comply with Maritime and Coastguard Agency (MCA) vessel safety standards where applicable, HSE duties for workplace risks, and controls on acoustic emissions or seabed disturbance under marine licensing regimes. Practical interviews highlight that underwater operations often hinge on site-specific risk assessments, with few hard barriers beyond wildlife protection or collision avoidance.

Uncrewed surface vessels benefit from more targeted guidance. Marine Guidance Notice 705 (M), effective 31 December 2024, provides a general exemption for remotely operated uncrewed vessels (ROUVs) measuring 2.5–4.5 metres in length overall, valid until 31 December 2027 pending review. To qualify, vessels require continuous human supervision from a dedicated remote operator, adherence to speed and visibility limits, and robust safety assurance processes including hazard identification and ALARP (As Low as Reasonably Practicable) risk reduction. These craft must still observe core maritime rules such as COLREGS (Convention on the International Regulations for preventing collisions at sea) for collision avoidance, SOLAS (International Convention for the safety of life at sea) safety standards, Merchant Shipping navigation regulations, accident reporting, pollution prevention, and training requirements.

For smaller uncrewed surface vessels under 2.5 metres, MGN 702 (M) offers a parallel exemption pathway, while vessels exceeding 4.5 metres typically need Workboat Code Part 3 certification, MCA approval under MGN 664, or equivalent. Industry self-regulation plays a key role via the Maritime Autonomous Surface Ships (MASS) UK Code of Practice, which outlines principles for governance, cyber resilience, crew training, environmental compliance, and safe interaction with manned vessels. Notably, it clarifies that fully autonomous underwater vehicles (AUVs), tethered ROVs and aerial systems follow separate guidance.

Operators often draw on International Marine Contractors Association (IMCA) standards[16] for ROV-specific practices, including proximity to divers, electrical safety, competence certification and dynamic risk management. Evidence from Scottish marine robotics users gathered through this study, confirms minimal underwater-specific red tape for small-scale work, though scaling up surface autonomy may trigger fuller MCA scrutiny. Overall, the framework enables testing in areas like Oban by applying evidence-led exemptions and industry codes.

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[16] *https://www.imca-int.com/committees/divisional/marine/marine-autonomous-surface-systems/ & https://www.imca-int.com/committees/divisional/remote-systems-rov/*

3.3. Regulations for Uncrewed Ground Robots

UK regulation of uncrewed ground robots (UGVs) varies by context, with no unified framework but reliance on health and safety law, road vehicle rules and sector codes. HSE leads for workplace deployments (e.g. ports, harbours, factories), requiring risk assessments under the Health and Safety at Work etc. Act 1974 and Provision and Use of Work Equipment Regulations 1998 (PUWER). Operators must ensure safe integration, emergency stops, collision avoidance and human oversight where risks persist.

For road use, the Automated Vehicles Act 2024 establishes authorisation for self-driving road vehicles meeting the "self-driving test" - safe, legal autonomous operation without human control or monitoring. Authorisation covers individual vehicles or types, with initial and ongoing requirements plus an Authorised Self-Driving Entity (ASDE) liable for compliance. User-in-charge (UiC) features demand safe transition demands; no-user-in-charge (NUiC) vehicles need licensed operators.

Sector-specific guidance applies elsewhere. Ports and harbours fall under the UK Port Marine Safety Code (PMSC), Harbour Byelaws and local directions, mandating safe navigation and risk reviews for UGVs amid manned traffic. Forestry and agriculture use voluntary codes like BS 8646:2024 for autonomous mobile machinery, covering hazard identification, training and interoperability. Defence autonomous systems will benefit from a Regulatory Innovation Office fast-track, easing testing amid geopolitical needs.[17]

Industry standards (e.g. IMCA for ports) emphasise competence, cyber security and ALARP risks, mirroring maritime approaches. Interviews noted minimal bespoke rules for non-road UGVs, prioritising practical safety over certification. HITRANS have tested a Dutch unmanned logistics vehicle at the Orkney Research and Innovation Campus (ORIC) at Stromness through the European Planning for Autonomous Vehicles (PAV project),[18] plus two trials with UK company Aurrigo[19] and a longer-term trial of a French Navia shuttle at Inverness campus.[20] There is some interest in driverless passenger transport, like Waymo, with fewer regulatory layers than aviation but speed limits (e.g. 15 mph) constraining utility. The existing regulatory framework could support pilots in controlled sites (airports, harbours, campus, industrial parks, etc.) but scaling rapidly in rural areas seems unlikely.

3.4. Scottish, UK and regional policy context

This section briefly overviews the policy landscape in the UK and Scotland, both in terms of direct interventions in favour of uncrewed systems (drones and robotics) and other broader policy frameworks that may indirectly act as barriers to adoption and deployment of the technologies.

3.4.1. UK policy initiatives in favour of drones and robotics

From Strategy to Deployment

The UK has moved beyond setting strategic intent for robotics and autonomous systems and is now actively enabling deployment across defence, energy, transport and maritime sectors. Policy, funding and procurement are increasingly aligned to support real-world applications rather than isolated innovation. Organisations such as UK Research and Innovation (UKRI) and Innovate UK are directing investment into demonstrators and regional clusters, while the CAA is

[17] *https://www.gov.uk/government/news/red-tape-to-be-slashed-for-british-robotics-and-defence-innovators*
[18] *See: https://northsearegion.eu/pav/index.html*
[19] *See: https://www.bbc.com/news/articles/cedz09gxjy8o*
[20] *See: https://hitrans.org.uk/launch-of-scotlands-first-av-pilot-project-at-inverness/*

progressing regulatory frameworks that allow BVLOS operations. At the same time, the Department for Transport is advancing both Future of Flight and maritime autonomy programmes, and the Royal Navy is accelerating the operational testing of uncrewed systems.

This shift creates a clear structural requirement. The UK now needs environments where autonomous systems can be tested, validated and integrated under real operating conditions. As a result, regional proving grounds are becoming a critical component of national capability rather than an optional part of the innovation system.

Table 3-1: UK Funding and Programme Alignment

UK Policy / Programme	What It Funds or Enables	Direct Alignment with Argyll and the Islands
UK Research and Innovation – Strength in Places Fund, Robotics & AI, Future Flight	Large-scale regional innovation clusters and real-world demonstrators, particularly where there is strong place-based advantage	Argyll and the Islands provides a rare multi-domain environment (air, surface, subsea) with existing marine industries, making it a strong candidate for a place-based autonomy cluster rather than a purely academic centre
Innovate UK – Smart Shipping, Offshore Robotics, Autonomous Systems Competitions	TRL 4–7 projects focused on validation, prototyping and early deployment with industry partners	The area offers immediate access to end users in aquaculture, maritime operations and offshore energy, allowing funded projects to move quickly from prototype to operational trial
Department for Transport – Future of Flight & Maritime Autonomy	UAV integration, drone logistics, autonomous vessels and smart shipping corridors	Low-density airspace and complex coastal geography enable safe BVLOS drone trials and realistic maritime autonomy testing, particularly for inter-island logistics and coastal transport
CAA – BVLOS and Regulatory Sandbox Programmes	Development of regulatory frameworks for safe drone integration and advanced operations	Argyll and the Islands provides a controlled but realistic environment for regulatory trials, where BVLOS operations can be tested over water and sparsely populated areas without the constraints of urban airspace
Royal Navy / NavyX – Autonomous Systems Experimentation	Rapid testing and deployment of uncrewed maritime and subsea systems for defence applications	West Coast conditions closely resemble North Atlantic operational environments, making the region highly suitable for testing USVs and UUVs in defence-relevant scenarios, including subsea infrastructure protection

UK Policy / Programme	What It Funds or Enables	Direct Alignment with Argyll and the Islands
North Sea Transition Authority – Offshore Energy Automation	Technologies supporting remote operation, inspection and decarbonisation of offshore energy systems	Proximity to offshore and coastal energy activity allows Argyll and the Islands to act as a testbed for drone and robotic inspection, particularly in harsh marine conditions representative of wider UK offshore environments
National Shipbuilding Office – National Shipbuilding Strategy (Refresh)	Innovation in vessel design, including autonomous and digitally enabled ships	The area can support testing of next-generation vessels and systems in real sea conditions, linking shipbuilding innovation with operational validation rather than purely design-led development
Home Office – Border Security & Maritime Surveillance Tech	UAVs and maritime systems for monitoring, search and rescue, and security operations	Coastal geography and dispersed population provide a realistic environment for surveillance, SAR and monitoring applications, particularly in challenging weather and visibility conditions

Source: authors based on desk research

Why Argyll and the Islands Fits the UK deployment model

Across these programmes, a consistent pattern emerges. UK funding is not aimed at abstract innovation but at deployment in real environments with clear sector demand. Argyll and the Islands aligns because it combines three characteristics that most regions cannot offer together: a complex and realistic marine environment, low-congestion airspace suitable for drone operations, and established businesses that can act as early adopters. Although it should be noted, that while this report is focusing on the proposition for Argyll and the Islands, other parts of the Highlands and Islands – notably Orkney – also show strong alignment with the UK deployment model.

This means that for multiple funding streams, the region is not just eligible but structurally relevant. It allows projects to meet core funding criteria around real-world validation, cross-sector application and pathway to adoption.

3.4.2. Scottish policy initiatives relevant for drones and robotics

National Direction: Place-Based, Mission-Led Innovation

Scotland’s policy environment is particularly well aligned with marine robotics and autonomous systems because it emphasises mission-led innovation anchored in natural assets and regional strengths. Rather than concentrating activity in a single national centre, the Scottish Government has consistently prioritised distributed innovation models that connect research, industry and geography. This approach is visible across economic strategy, innovation funding and sectoral policy, where the focus is on translating capability into real-world deployment in sectors such as offshore energy, aquaculture and maritime operations. In this context, places like Argyll and the Islands are not peripheral; they are central to delivery. Orkney is also important in this regard.

Table 3-2: Scottish Policy and Funding Alignment

Scottish Policy / Programme	What It Funds or Enables	Direct Alignment with Argyll and the Islands
Scottish Government	National economic framework focused on innovation clusters, productivity, net zero and high-value exports	Argyll and the Islands offers a location where robotics and autonomy can directly support productivity in marine industries, generate exportable technologies and contribute to net zero through environmental monitoring and offshore operations
Scottish Government	Development of sustainable marine industries, marine data systems and offshore innovation	The area's aquaculture, coastal operations and marine environment create immediate demand for UAV, USV and UUV systems for seabed monitoring, inspection and environmental compliance, making this one of the strongest thematic alignments
Scottish Government	Mission-led innovation, regional innovation nodes and academia–industry collaboration	Argyll and the Islands fits the model of a distributed specialist hub, complementing national assets such as the National Robotarium by providing a real-world marine testing environment rather than duplicating centralised facilities
HIE – Innovation and Cluster Development Funding	Regional economic development, innovation infrastructure and business support in rural and coastal areas	Directly supports the creation of a robotics hub in Argyll and the Islands, with a focus on strengthening local industries such as aquaculture, marine services and energy through technology adoption
Scottish Enterprise – Net Zero and Innovation Funding	Scaling innovation in energy transition, advanced manufacturing and technology sectors	Offshore energy and marine robotics applications in the region align with net zero priorities, particularly in inspection, maintenance and monitoring of marine infrastructure
Scottish Funding Council	Investment in further and higher education, skills pipelines and research capacity	Enables the development of FE and HE pathways in marine robotics, supporting technician and engineering roles aligned with local industry demand
Skills Development Scotland	Workforce development, apprenticeships and future skills planning	Supports the creation of a robotics and autonomy skills pipeline in a rural context, addressing critical gaps in technical workforce availability

Scottish Policy / Programme	What It Funds or Enables	Direct Alignment with Argyll and the Islands
Crown Estate Scotland – Innovation and Marine Investment	Leasing and investment in seabed use, offshore energy and marine innovation projects	Provides a route for deploying and testing subsea and surface robotics linked to offshore infrastructure and environmental monitoring in waters around Argyll and the Islands
Scottish Government	Expansion of offshore wind and associated supply chains	Drives demand for autonomous inspection, maintenance and monitoring systems, which can be tested and validated in the region's coastal and Atlantic-facing environments

Source: authors based on desk research

Why Argyll and the Islands Fits the Scottish Model

Across these policies and funding streams, a consistent principle emerges. Scotland is not seeking innovation in isolation, but innovation that is embedded in place and directly connected to economic activity. Argyll and the Islands exemplifies this model because it combines a globally relevant marine environment with sectors that are already active and growing. It can also benefit from other regional assets and activities, such as those in Orkney.

Aquaculture provides an immediate commercial use case for drones and robotics in monitoring, inspection and environmental management. Offshore energy and the wider net zero transition create demand for autonomous systems capable of operating in harsh marine conditions. Maritime operations and coastal logistics offer further opportunities for the deployment of UAVs and USVs in transport, surveillance and infrastructure support.

At the same time, Argyll and the Islands' geography, including its complex coastline and exposure to Atlantic conditions, provides a natural testing ground that aligns with Scotland's emphasis on using natural assets as a foundation for innovation. Argyll and the Islands should also be viewed in the context of the wider Highlands and Islands opportunity set identified through HIE's Regional Transformational Opportunities work. The region's proposed investment pipeline across offshore wind, marine energy, hydrogen and supporting infrastructure reinforces that marine robotics and autonomy are not niche capabilities but enabling technologies with relevance across multiple transformational sectors. Argyll and the Islands and Orkney can therefore both be seen as strategically defined delivery locations within a much broader regional growth system, with the potential to support demonstration, deployment and skills development that benefit the wider Highlands and Islands economy.

3.4.3. Highlands and Islands policy and investment context

Regional Direction: Technology as a Tool for Economic Resilience

Across the Highlands and Islands, policy is less about abstract innovation and more about economic survival, transition and long-term resilience. The combined priorities of HIE, the Highlands and Islands Regional Economic Partnership (HIREP),[21] and individual local authorities emphasise the use of advanced technology to stabilise and develop fragile rural economies. This

[21] *See: https://highlandsandislandsrep.scot/*

creates a distinctive policy environment in which robotics, autonomy and digital systems are not niche sectors, but enabling tools for core industries such as aquaculture, offshore energy, transport and environmental management.

In this context, Argyll and the Islands is positioned not as a peripheral location but as a delivery landscape, where UK and Scottish ambitions can be translated into real-world application. Argyll and the Islands' (and both Orkney and the wider Highlands and Islands') combination of marine activity, research presence and geographic complexity aligns directly with the type of place-based innovation that regional policy is designed to support.

Table 3-3: Regional Policies and Funding Alignment

Regional Policy / Programme	What It Enables or Funds	Direct Alignment with Argyll and the Islands
HIE – Regional Economic Strategy & Innovation Support	Place-based economic development, innovation infrastructure, marine industries, net zero transition and high-value job creation	Strong alignment with marine robotics as a diversification pathway, supporting aquaculture, offshore energy and marine science while creating skilled employment in a fragile rural economy
Argyll and Bute Council – Outcome Improvement Plan & Local Development Strategy	Population retention, inward investment, skills development and blue economy growth	A robotics hub acts as an anchor institution that supports graduate retention, attracts investment and diversifies the economy beyond tourism and public sector employment
HIREP	Coordination between local authorities, enterprise agencies, academia and industry to support regional growth sectors	Reinforces the model of distributed innovation and legitimises locations like Oban as nationally significant testbeds outside the central belt
Scottish Government and Transport Scotland initiatives	Investment in connectivity, ferries, aviation and integrated transport solutions in remote regions	Creates opportunities for UAV logistics, autonomous maritime transport and drone-supported connectivity between islands and mainland services
Scottish Government	Addressing housing constraints that limit workforce growth in rural areas	Supports the scaling of a robotics hub by tackling one of the key structural barriers to attracting and retaining skilled workers
Crown Estate Scotland – Marine Investment & Innovation	Leasing and investment linked to offshore energy, aquaculture and marine assets	Provides a direct route for deploying and testing USVs and UUVs linked to seabed infrastructure, offshore wind and environmental monitoring

Regional Policy / Programme	What It Enables or Funds	Direct Alignment with Argyll and the Islands
Scottish Government	Implementation of the Blue Economy Vision through investment in marine innovation and sustainability	Strong alignment with robotics applications in aquaculture, seabed monitoring and offshore inspection, particularly in a region with active marine industries

Source: authors based on desk research

Integration Across Argyll and Bute Region Growth Deal Projects

The Argyll and Bute Growth Deal is the local delivery framework for a wider package of investment intended to address the area's structural challenges, including depopulation, limited connectivity, workforce shortages and over-reliance on seasonal or public-sector employment. It brings together projects across infrastructure, skills, housing, transport, innovation and business development, with the aim of creating more resilient, higher-value economic activity in the region. The proposed robotics and autonomy hub should be understood as enabling infrastructure within that wider programme. It is envisaged as a UAV logistics, research, testing and training facility at Oban Airport, supporting drone operations, flight trials, maintenance, indoor testing and skills development, with potential applications in marine science, offshore energy, healthcare logistics and island connectivity. Its value lies in how it amplifies existing investments across defence, housing, energy, tourism and regional economic development, rather than competing with them.

Moreover, another central anchor of the Argyll economy is HM Naval Base Clyde also known as Faslane (located within the Argyll and Bute local authority area), which is both a strategic defence asset and one of the largest employment centres in Scotland. The base supports thousands of highly skilled jobs directly and through its supply chain and has been designated the UK's submarine centre of specialisation. This concentration of advanced engineering, maritime operations and security capability creates a natural alignment with robotics and autonomous systems. A regional robotics hub can support this ecosystem by providing testing environments for maritime autonomy, subsea monitoring and security technologies, while also offering pathways for skills transition between defence and civilian sectors. In effect, it helps translate defence investment into wider regional economic benefit.

The Argyll and Bute Growth Deal also places strong emphasis on housing and population retention, recognising that workforce availability is a critical constraint on growth. Investment linked to Faslane has already highlighted the importance of accommodation and infrastructure to support expanding employment. A robotics hub contributes directly to this agenda by creating high-value, year-round employment that supports demand for housing and justifies further development. Unlike seasonal sectors, it provides a more stable economic base, helping to retain graduates and attract skilled workers into the area.

In the context of the energy transition, Argyll and the Islands is well positioned to contribute to Scotland and the UK's net zero ambitions, particularly through offshore and marine energy systems. Robotics and autonomous systems are increasingly essential for inspection, maintenance and monitoring of offshore infrastructure. A hub located in Oban or the wider west coast can act as a testing and validation site for these technologies, linking directly to investment in seabed leasing, offshore wind and marine energy. This creates a bridge between policy ambition and operational deployment, ensuring that regional waters become part of the national energy innovation system.

Tourism, while a major component of the local economy, is characterised by seasonality and volatility, with significant fluctuations in employment and income. The Argyll and Bute Growth Deal seeks to enhance tourism through infrastructure and visitor experience, but there is also a clear need to diversify the economic base. A robotics hub supports this by introducing a complementary, non-seasonal sector that stabilises local economies. At the same time, it can enhance tourism indirectly through environmental monitoring, marine conservation technologies and smart infrastructure that protect and showcase the area's natural assets.

More broadly, the project aligns with the Argyll and Bute Growth Deal's ambition to drive innovation-led inward investment and economic diversification. The local economy is currently heavily weighted towards services and seasonal industries, with relatively limited presence in high-value manufacturing or technology sectors. By positioning the area as a centre for marine robotics and autonomy, the hub creates a new economic pillar that complements existing strengths in aquaculture, marine science and coastal operations.

The key insight is that a future drones and robotics hub in Oban could act as a connecting layer across Argyll and Bute Growth Deal investments. It links defence capability at Faslane with civilian innovation, supports housing and population objectives through high-value employment, enables the energy transition through offshore technology deployment, and stabilises a tourism-dependent economy by diversifying income sources. In doing so, it strengthens the overall coherence of the Growth Deal, ensuring that individual projects contribute to a shared, long-term economic transformation rather than operating in isolation.

4. Current and future use of drones and robotics in the Highlands and Islands

This section provides a summary of the evidence collated on the current use of uncrewed systems in the Highlands and Islands based on documentary evidence, survey results and interview conclusions. The first section summarises the evidence from recent regional trials of UAVs. The following sections provide insights from the survey and consultations.

4.1. Recent regional trials

This section summarises the evidence from a series of regional trials of UAVs which help to inform the potential for the future deployment of drones and automated systems.

4.1.1. Argyll and Bute Council and Skyports Drone Services (Skyports) flight demonstrations

In November 2022, the UK Government awarded Argyll and Bute Council a grant of £250,000 via the Regulators' Pioneer Fund (RPF) to collaborate with drone specialists Skyports. The funding aimed to explore the potential of creating a dedicated airspace over rural areas to enhance drone delivery services for remote communities and businesses. The council planned to conduct a series of trials, including inspections and demonstrations, to assess the feasibility of integrating drones with general aviation and improve essential public services.

In Summer 2024, the council and Skyports used UAVs to undertake trials for various operations that are vital to the local authority and the communities it serves. These trials included river inspections, food sample collections, and samples from private water supplies. In addition, the council, in collaboration with Skyports, supported other organisations like the Royal Mail, NHS, Network Rail, and Scottish and Southern Electricity Networks (SSEN) to improve the provision of critical services in the area. The collaborative effort aimed to demonstrate how these organisations could improve the safety, efficiency and sustainability of their operations and better serve customers by implementing electric drone services.

The council previously worked with Skyports in 2022, when it became the first local authority in the UK to trial the feasibility of school meal delivery via drone. The trials were also utilised to monitor and evaluate the use of UAVs in visual maintenance surveys.

4.1.2. Project CAELUS

Project CAELUS (Care and Equity - Logistics UAS Scotland) sought to demonstrate how drone technology could enhance access to essential medical supplies, particularly in rural parts of Scotland, and establish what would be the UK's first national distribution network serviced by drones. The project was part funded through UKRI Future Flight Challenge Fund. CAELUS carried out live and digital flight demonstrations, proving that operating a network of multiple drones could integrate safely with existing flight operations and therefore regulatory needs and social acceptance issues could be resolved.

The project team, led by AGS Airports (which owns and manages Aberdeen, Glasgow and Southampton airports) and formed of 16 partners including NHS Scotland, Strathclyde University and NATS Ltd (the UK's leading provider of air traffic control services) brought together a diverse range of technical and industry experience and expertise to support CAELUS in achieving its aims and objectives. The project had three main workstreams:

- Developing new concepts for drones to integrate with others using Scotland's airways.
- Demonstration of these concepts through implementation and operation of physical and digital flight demonstrations of drone deliveries by multiple drone operators and an innovative digital twin model to optimise the network.
- Demonstration of innovative new ways of proactively engaging with communities, airspace users and potential customers.

The vision for CAELUS is a comprehensive national network, realising the potential of drones to revolutionise medical logistics in the UK, scaling to achieve an efficient, economical service. This will involve a range of aircraft both large and small alongside multiple service offerings to support the needs of the diverse regional and national health boards within Scotland.

4.1.3. Sustainable Aviation Test Environment (SATE) project

The SATE project established the UK's first operationally based low-carbon aviation test centre, based at Kirkwall Airport. Led by the Highlands and Islands Transport Partnership (HITRANS), it has evolved to become a major regional asset. Recent consortium partners include Hybrid Air Vehicles, Skyports Deliveries, Streamline Shipping Agencies, EMEC, University of the Highlands and Islands (UHI), Urban Foresight, Windracers, Regional and Business Airports Group, Loganair, Shetland Islands Council, Cormorant SEAplanes and Cranfield Aerospace Solutions.

Use cases developed in SATE have been supported by Orkney, Shetland, Na h-Eileanan an Iar and Highland councils. Use case projects from the initial phase include serving the NHS, NatureScot, Orkney Food and Drink, Streamline Shipping and Royal Mail.

In February 2026, Windracers, signed a memorandum of understanding (MoU) with HITRANS to accelerate the use of air cargo drone operations in some of the most remote regions of the UK. The MoU will see Windracers work closely with HITRANS to identify use cases where unmanned aircraft systems (UAS) can deliver social, economic and environmental benefits for people and businesses across the Highlands and Islands.

This partnership has been enabled by ongoing support from Innovate UK, whose SATE programme brought Windracers and HITRANS together through a series of funded operations to demonstrate how UAS cargo can address transport challenges in remote regions. The MoU marks the next step in that relationship, moving from programme led collaboration towards a long term, locally led operational model.

4.1.4. Lessons from the trials for future policy

These projects collectively demonstrate that drone systems in Scotland have moved beyond proof-of-concept toward operational validation and early commercial readiness, particularly in healthcare logistics and rural service delivery. The main remaining challenges relate to airspace integration, regulation, and scaling infrastructure, rather than core technology capability.

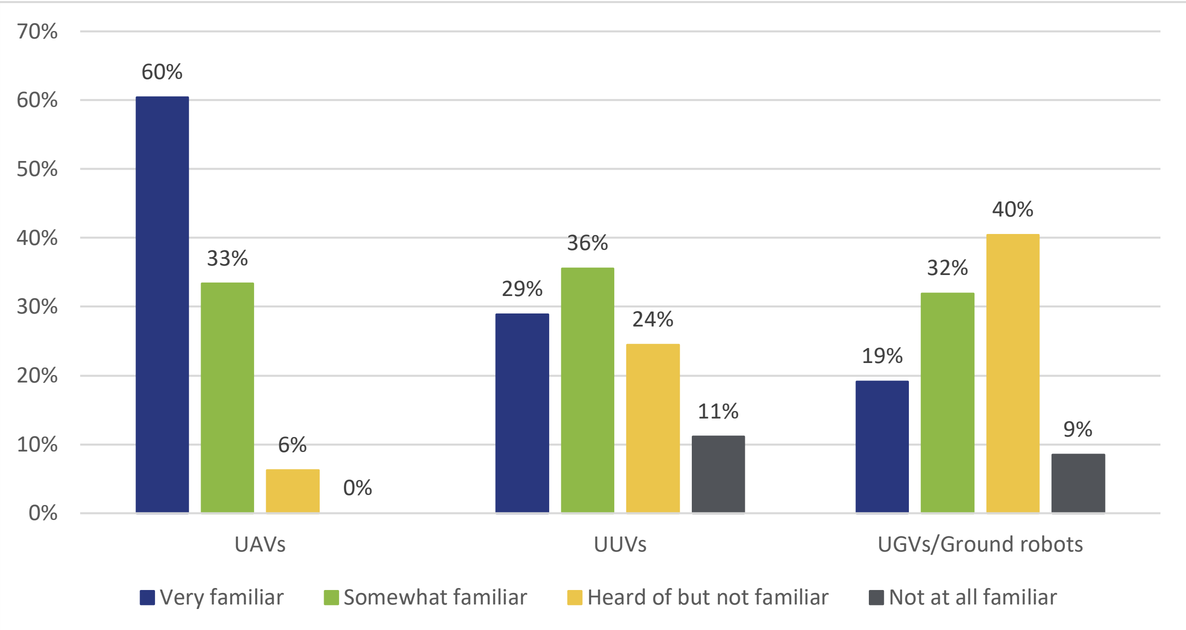
4.2. Current use of drones and robotics in the H&I

Given the lack of data on the market for drones and robotics in the Highlands and Islands, the study draws on the survey and consultation evidence to assess the current level of use of uncrewed systems. The survey included several questions to gauge current awareness and use of drones and other uncrewed systems.

4.2.1. Familiarity with unmanned systems

Survey responses suggest strong baseline awareness of UAVs, more limited familiarity with UUVs, and lowest familiarity with ground robots. This pattern indicates that respondents are most comfortable with aerial systems, while underwater and ground-based applications may require more explanation, demonstration or sector-specific engagement to build confidence and understanding (Figure 4-1).

Figure 4-1: Familiarity with the use of unmanned systems (Base: 48)



Source: Survey conducted by authors

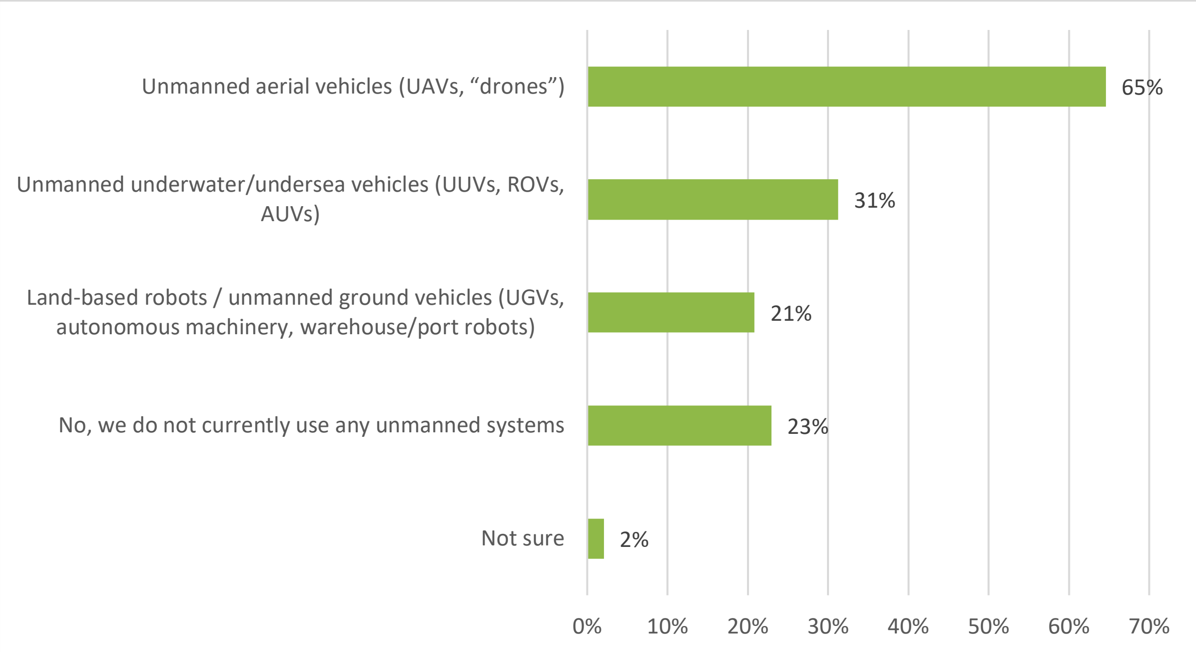
Consultation evidence suggests that familiarity with unmanned systems is relatively widespread across the Highlands and Islands, but it is uneven in depth and shaped by sectoral proximity. Respondents working in aviation, marine science, aquaculture, energy and public-sector innovation generally spoke from direct experience of projects, trials or operations, while others were more familiar with the technology through procurement, strategy or innovation roles. Several interviewees explicitly said they were not specialists in drones but were confident discussing unmanned systems in a broader sense because they had worked with related technologies such as ROVs, AUVs, surface vessels, robotics, automated inspection systems or digital modelling tools.

A second theme is that familiarity is often practical rather than abstract: interviewees tended to know unmanned systems because they have seen them solve a concrete operational problem. This was especially evident in sectors where access is difficult, weather-sensitive or hazardous, such as offshore energy, mountain rescue, hydro infrastructure, aquaculture and inter-island logistics. Interviewees also noted that awareness has grown through previous trials and demonstrators in the region, including NHS-related flights, airport-based testing, marine robotics activity and drone hub discussions, which has helped move the technology from novelty toward something more recognisable and discussable in local planning and service-delivery conversations.

4.2.2. Current use of unmanned systems

Survey responses indicate that three in four respondents already use some form of unmanned system, with UAVs the most commonly used and UUVs and UGVs less prevalent. This suggests that aerial applications are currently the most established technology, while underwater and ground-based systems remain more niche (Figure 4-2), which is consistent with the relative levels of familiarity with each type of unmanned system (Figure 4-1).

Figure 4-2:Current use of unmanned systems (Base: 48)



Source: Survey, analysis by authors

The stakeholder consultations also confirm that unmanned systems are already in use across the region, but current use is still concentrated in specialist, high-value tasks rather than broad routine deployment. Aerial drones are being used for site surveys, topographic mapping, inspections of bridges, power lines, wind turbines and other infrastructure, while marine systems are already embedded in seabed survey, underwater inspection, fish-farm monitoring and environmental measurement. In several cases, respondents described these as established operational tools rather than experimental ones, especially where the technology reduces the need for people to enter hazardous or hard-to-reach environments.

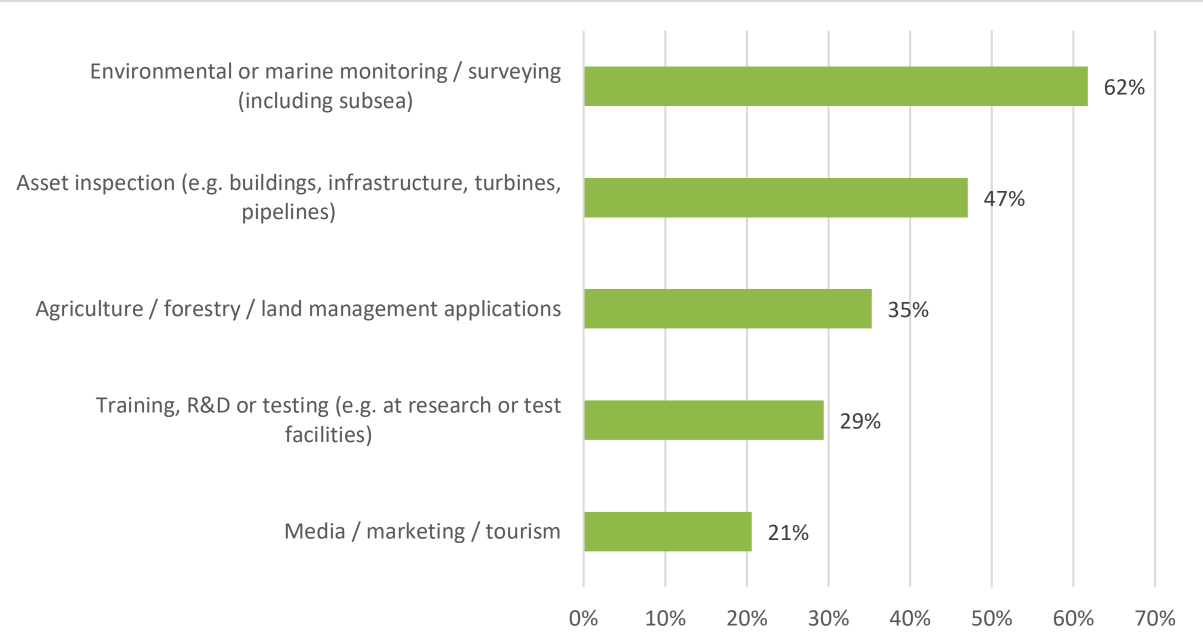
In the marine and research context, the Scottish Association for Marine Science (SAMS), which is based in Dunstaffnage, near Oban, described everyday use of robotics across underwater, surface and aerial platforms, while other interviewees referred to established use in environmental monitoring, ocean science, marine surveys and equipment testing.

At the same time, the interviews suggest that current use is still often structured around project-based deployment, outsourced specialist providers or mixed in-house/external arrangements. Some organisations, such as utilities and hydro operators, already have trained staff and equipment internally for recurring inspection work, while others rely on external contractors or specialist service providers for more complex tasks. In public services, current use is more uneven: NHS-related respondents described active interest, modelling and prior trials, but also made clear that most uses remain limited to test activity, demonstrators or targeted operational niches rather than full-scale service integration.

4.2.3. Current applications of unmanned systems

Among respondents using unmanned systems, current use is most concentrated in environmental and marine monitoring, with asset inspection the next most common application. Agriculture and land management are also important use cases, while training, R&D and media/tourism appear to be more niche at present. Overall, the pattern suggests that adoption is strongest where unmanned systems support monitoring, inspection and operational decision-making (Figure 4-3).

Figure 4-3:Current applications of unmanned systems (Base: 34)



Source: Survey, analysis by authors

This survey finding was confirmed by the stakeholder interviews where the most common current applications identified are inspection, monitoring and survey work. Across the aerial, marine and ground domains, respondents repeatedly returned to the same core functions: inspecting infrastructure, mapping terrain or seabeds, collecting environmental data, checking asset condition and reducing the need for manual visits in risky locations. In the aerial domain, this includes bridge inspection, power-line inspection, wind-turbine inspection, search and rescue,[22] site mapping and transport-related survey work; in the marine domain, seabed scanning, fish-farm inspection, cable and foundation inspection, current measurement and water-quality work; and in the ground domain, hazardous-terrain support, site access, etc.

[22] *See: https://www.bbc.com/news/av/uk-scotland-61101225*

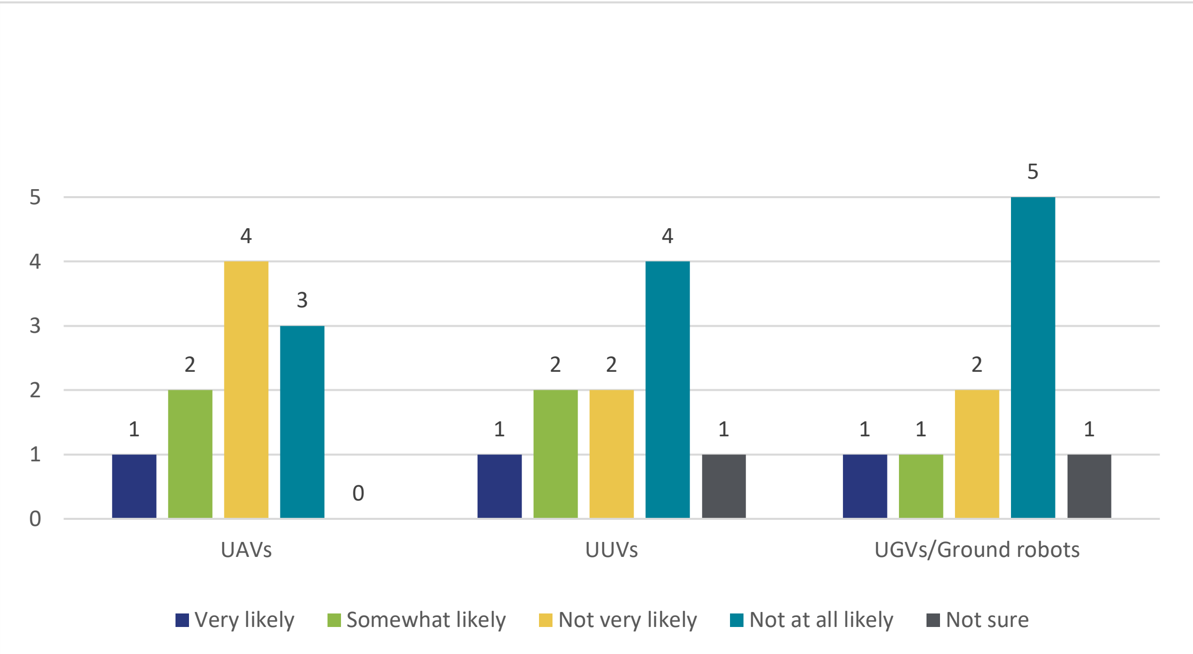
A second strand of current application is service support in sectors where geography makes conventional delivery difficult. The NHS and Royal Mail were repeatedly mentioned as strong use-case areas for aerial systems because of the distance, weather and timetable constraints affecting inter-island and remote-rural service provision. Marine focused respondents made a similar point for aquaculture and offshore energy, where repeated visits by boat or diver are costly and time-consuming, and where robotics can support safer, more regular and more data-rich operations. Ground applications are currently less mature, but the interviews show emerging interest in forestry, mountain rescue, remote construction and industrial sites and automated support around airports and other controlled facilities.

4.3. Future use and opportunities in the Highlands and Islands

4.3.1. Future demand for unmanned systems

Among organisations not currently using unmanned systems, there is some future interest in adoption, particularly for UAVs and UUVs. UGVs attract slightly less anticipated demand, suggesting that future uptake is likely to be strongest in aerial and underwater applications rather than land-based robotics (Figure 4-4).

Figure 4-4: Use of unmanned systems in the next 2-3 years (Base: 10)



Source: Survey conducted by the authors

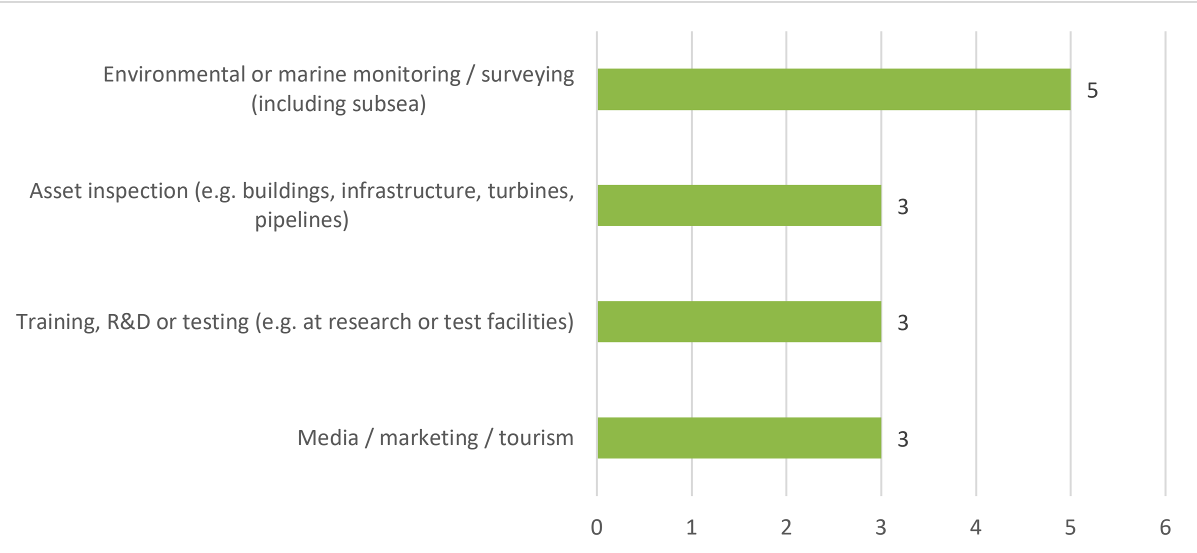
The stakeholder interviews point to clear latent demand for unmanned systems, but also to a gap between technical possibility and customer readiness. Interviewees across aviation, health, marine and energy sectors consistently argued that the Highlands and Islands has strong structural conditions for future demand because of its dispersed geography, weather exposure, low-density settlement patterns and reliance on inter-island and remote-rural logistics. In that sense, the interviews support the view that demand is not created automatically; rather it is being held back by the need for customers to understand the service, commit to procurement, and build the operating model around it.

The interviewees pointed to strong future demand in healthcare, utilities, offshore energy and public logistics. NHS interviewees described future interest in pharmacy, oncology, pathology, defibrillator deployment and other clinical-support logistics, while commercial operators highlighted future routes for Royal Mail, remote sample movement, inspection networks and offshore servicing. Marine and energy interviewees similarly described future demand for more frequent and better-integrated underwater inspection, offshore wind support, environmental monitoring and digital survey work, particularly where current practice still depends on boats, divers, helicopters or long road journeys.

4.3.2. Future applications of unmanned systems

Future applications identified by non-users are closely aligned with current market demand, particularly environmental and marine monitoring and asset inspection. This suggests that the most immediate growth potential lies in operational and monitoring uses, with training, R&D and media/tourism playing a secondary role (Figure 4-5).

Figure 4-5: Potential future applications (current non users) (Base: 10)



Source: Survey, analysis by the authors

However, stakeholder interviewees suggested that future applications are likely to expand from today's narrow inspection and survey uses into more routine service delivery and networked operations. Aerial systems are the clearest example: interviewees envisaged drone-in-a-box monitoring, longer-range logistics, routine medical delivery, postal routes, emergency-response support, port surveillance and more integrated hub-and-spoke service models. One recurring idea was that the region could move from isolated trials to a multi-user drone ecosystem, where the same infrastructure supports different customers and different mission types over time.

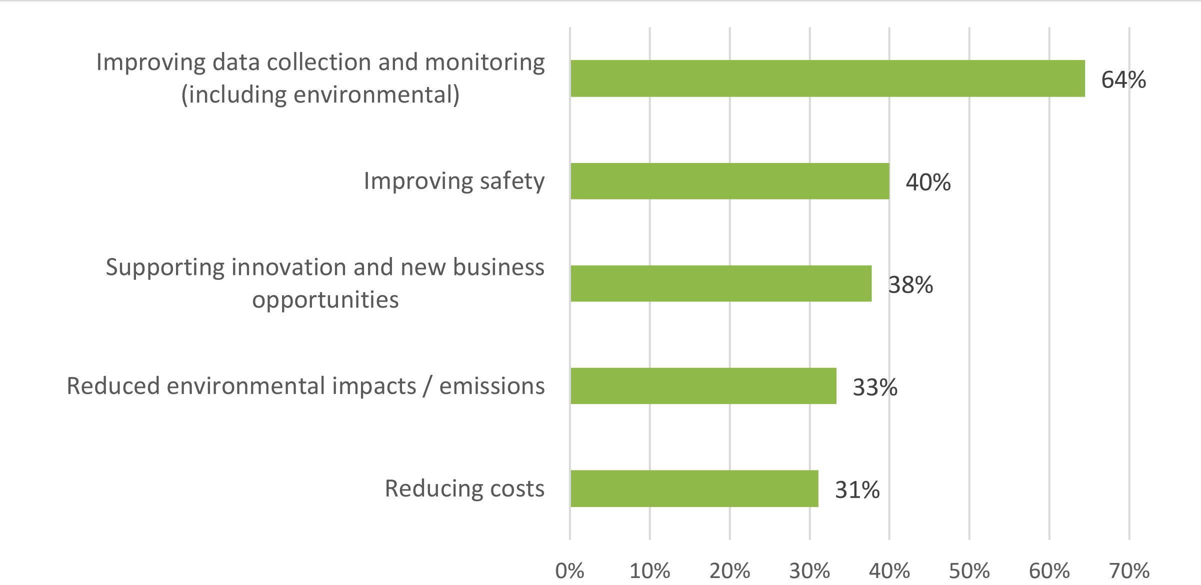
Marine future applications are similarly broadening, especially in aquaculture and offshore energy. Interviewees described the potential for more autonomous fish-farm monitoring, remote feeding support, net inspection, fouling detection, seabed mapping and offshore asset servicing, with better use of data and sensors likely to be as important as the vehicles themselves.

Ideas for ground robotics applications were less developed in the interviews, but the strongest prospects were in forestry, emergency services (inspection and firefighting robotics), mountain rescue (exoskeleton-assisted movement[23] which may also have tourism applications[24], hazardous terrain (construction[25]), airport and port operations and maintenance tasks where automation could reduce labour intensity and improve safety.

4.3.3. Primary benefits of unmanned systems

All survey respondents were asked to identify the main benefits of using unmanned systems, selecting up to three options (Figure 4-6). The most frequently cited benefit was improved data collection and monitoring (including environmental), followed by improved safety and support for innovation and new business opportunities.

Figure 4-6:Main realised or potential benefits of unmanned systems (Base: 45)



Source: survey, analysis by the authors

The stakeholder interviews show that the main expected benefits of drones and robotics are not simply cost reduction, but a wider package of speed, reach, safety and service continuity. Several respondents stressed that drones and robotics should not be sold only on being more inexpensive than existing methods, because in many contexts they are not always cheaper on a direct like-for-like basis; rather, their value lies in doing things that are slow, risky, weather-limited or impossible using standard methods. This is particularly true for healthcare, where shorter transport times can improve patient pathways, and for remote logistics, where drones can bypass ferry schedules, road delays or access constraints.

A second benefit is the ability to “shrink geography” in ways that matter in the Highlands and Islands. Interviewees repeatedly described unmanned systems as a way of making distance less of a constraint, whether that is distance between islands, distance to offshore assets, or distance to hard-to-reach infrastructure in mountains, lochs or remote valleys. Respondents also highlighted safety as a major benefit, particularly where drones or ROVs remove the need for people to work in cramped shafts, dangerous slopes, harsh weather, underwater spaces or operational environments with active equipment.

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[23] An interviewee who is also a member of a local mountain rescue team reported that exoskeltons have been tested and a future use is expected (see also https://www.bbc.com/news/videos/c0l9e4jgr2zo)

[24] See: https://www.advnture.com/features/rise-of-the-machine-i-just-hiked-the-uks-highest-mountain-in-hypershells-new-exoskeleton

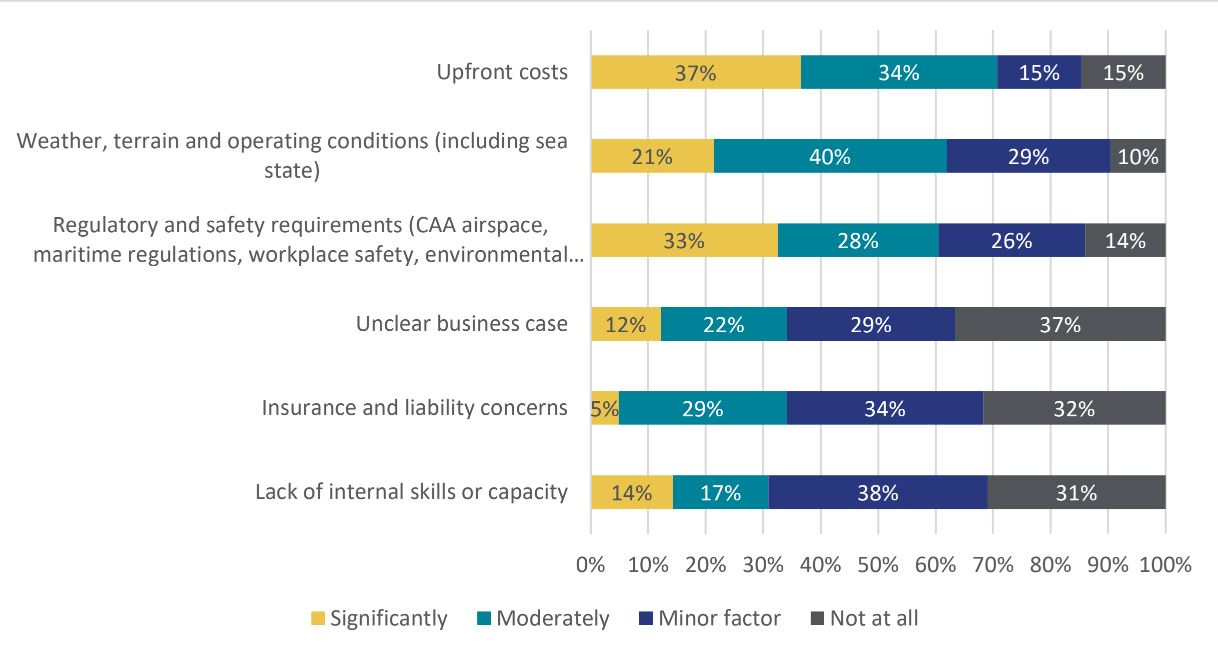
[25] See for instance : https://www.exskallerate.eu/ in which Scottish partners participated.

4.4. Drivers and enablers to future use

4.4.1. Factors limiting current deployment in the H&I

Survey respondents were asked to identify the main factors limiting greater use of unmanned systems, with the option to select more than one factor (Figure 4-7). The findings point to a mix of financial, operational and regulatory constraints, led by upfront cost pressures and followed by weather, terrain and safety-related requirements. Other barriers are present but less consistently reported, suggesting that adoption is shaped by a combination of universal and organisation-specific factors.

Figure 4-7:Key limiting factors to using unmanned systems (Base: 44)



Source: Survey conducted by the authors

Additional open text responses in the survey clustered around a few clear barriers to increased deployment:

- Regulation is the dominant barrier. Respondents repeatedly cited unclear, changing, or overly restrictive rules, especially for BVLOS operations, aerial spraying, and approvals for public-sector or defence use.
- Cost and funding pressure. Several mentioned lack of funding, high equipment and certification costs, poor cash flow, and business models that are not yet commercially viable.
- Skills and capacity gaps matter. Some respondents note shortages of trained operators, the need to maintain pilot currency, and a limited support ecosystem in remote areas.
- Operating conditions in rural and island areas are difficult. Weather, sea conditions, terrain, access, and weak connectivity make deployment harder and more expensive.
- The sector is still immature. Comments refer to fragmentation, lack of standards, limited test sites, low customer buy-in, and uncertainty about the commercial value of the technology.

A smaller number also mention market maturity issues such as customer trust, test-site access, fragmented supply chains, and weak business cases.

A common view is that regulation is slowing adoption more than the technology itself, with some respondents saying that approvals are hard to obtain even for low-risk operations. Another repeated message is that unmanned systems can be technically ready, but organisations cannot justify investment because the economics do not stack up yet. In rural and island settings, people also highlighted that adverse weather, difficult terrain, and poor infrastructure reduce operational windows and raise deployment costs.

In short, the survey suggests that policy uncertainty and regulatory barriers are the biggest blockers, followed closely by cost, skills shortages, and the practical difficulties of working in remote areas. The responses also show that the sector is still at an early stage, with many organisations waiting for clearer rules, stronger demand, and better support infrastructure before scaling up.

From the stakeholder interviews, the most consistently cited barrier is regulation, especially for aerial systems. Interviewees repeatedly described the current UK framework as too slow, too restrictive or too fragmented for commercial-scale drone operations, particularly where beyond visual line of sight, long-range routes or repeatable services are required. Even where the geography of the Highlands and Islands is well suited to low-risk operations, respondents said approvals still depend on complex safety cases, airspace management, local buy-in and coordination with the CAA and infrastructure operators.

The second major barrier is not regulation alone, but the combination of skills, infrastructure, weather and commercial readiness. Respondents described a shortage of qualified pilots, engineers and maintenance staff, especially locally, alongside weak or incomplete supporting infrastructure such as hubs, loading areas, communication systems, charging facilities and appropriate operating spaces. Several interviewees also stressed that weather is a very practical constraint in the region, particularly strong winds, low visibility and difficult terrain, which can reduce operating windows and make standard drone operations less reliable than proponents sometimes assume.

4.4.2. Barriers and drivers to the adoption of autonomous systems

The adoption of autonomous and remotely operated systems across air and maritime domains continues to be shaped by a **common set of regulatory, infrastructure, skills and financing barriers**, although the specific barriers differ between UAVs, UUVs/USVs and UGVs. Across all three domains, regulation remains one of the most persistent constraints because technological development is advancing faster than the institutional mechanisms designed to govern it.

In the UAV sector, the most significant regulatory challenge remains the complexity and fragmentation of national airspace rules. Although a number of jurisdictions have expanded operational permissions for commercial drones, BVLOS approval is still often limited, slow to obtain, and highly conditional, particularly where operations intersect with controlled airspace, populated areas, or critical infrastructure. In parallel, privacy, surveillance and data-capture requirements continue to vary materially across jurisdictions, creating additional compliance burdens for operators seeking scale.

For maritime autonomy, the regulatory picture remains less mature. UUVs continue to operate in an environment where there is no fully unified international framework governing submerged autonomous operations, particularly in relation to liability, navigation rights and interactions with crewed vessels or subsea infrastructure. USVs face a related challenge: while existing maritime law offers partial coverage, the practical application of established navigation rules such as the International Regulations for Preventing Collisions at Sea (COLREGs) to autonomous systems remains subject to interpretation. Questions persist around how vessel responsibility is assigned, how autonomous decisions are audited, and how surface autonomous systems integrate with conventional vessel traffic services. Safety certification pathways also remain inconsistent, with many flag states and port authorities still approaching autonomous vessels on a case-by-case basis rather than through standardised approval routes.

More broadly, across both air and sea domains, international harmonisation remains limited, and regulatory culture often remains cautious, particularly where public safety, cyber resilience and liability exposure are concerned.

Infrastructure constraints are equally significant because many autonomous systems depend not only on vehicles themselves, but on enabling networks around them. In the UAV sector, physical infrastructure such as dedicated launch and recovery sites, drone corridors, safe landing areas and urban integration remains underdeveloped outside demonstrations. Communications infrastructure also continues to be a limiting factor. While 5G and LTE expansion[26] has improved low-altitude connectivity in some regions, coverage gaps remain, particularly in rural, coastal and offshore operating areas where many high-value industrial use cases are located. For USVs and UUVs, port infrastructure has generally not yet been configured to routinely support autonomous operations, whether for docking, maintenance, battery exchange, data upload or secure mission supervision. In addition, autonomous maritime systems often rely on fragmented sensor, navigation and communications architectures, with limited interoperability between operators, platforms and control environments. The absence of standardised data exchange systems means that scaling mixed fleets remains operationally expensive and technically complex.

A related barrier concerns the workforce needed to deploy and sustain these systems safely. Despite growing interest in autonomy, there remains a shortage of trained operators, systems technicians and maintainers who understand both autonomous platform behaviour and the operational environments in which they function. This is particularly in maritime autonomy, where traditional marine engineering pathways have not yet fully adapted to include autonomy, robotics, AI-enabled navigation or remote systems assurance. Similarly, in aviation, pilot certification pathways are evolving, but technical maintenance and mission supervision skills remain unevenly distributed. A further challenge is the lack of cross-domain expertise. Many future operating models increasingly require professionals who understand both aerospace and maritime autonomous systems, particularly where coastal logistics, offshore energy, environmental monitoring and defence applications converge. Safety management capability is also uneven, with incident reporting frameworks, human factors training and operational assurance methodologies still emerging in many parts of industry.

Financing remains another major determinant of adoption pace. Across UAVs, USVs and UUVs, high upfront research, development, testing and certification costs continue to create a barrier for both new entrants and scaling firms. For SMEs in particular, the burden of proving technical reliability while simultaneously navigating compliance requirements often stretches available finances. In several sectors, especially UUV and USV commercial deployment, investors still perceive revenue models as insufficiently mature because long-term market demand is proven only in narrow segments such as offshore inspection, defence, hydrography or environmental survey. Traditional investors also remain cautious where deployment depends on regulatory approvals that are uncertain or delayed. Even where technology readiness is high, early adopters often struggle to justify investment without clear operational benchmarks demonstrating reduced cost, improved resilience, or measurable return on investment.

[26] *LTE (Long-Term Evolution) refers to the 4G mobile network standard. Extending LTE coverage is particularly important in rural and island regions because it underpins the reliable connectivity needed for drone and autonomous operations, helping to overcome geographic isolation and infrastructure constraints.*

Against these barriers, **several enabling conditions** are becoming clearer. On the regulatory side, as mentioned previously, progress is increasingly linked to frameworks that allow gradual scaling rather than full-system approval from the outset. In UAV operations, clearer and more scalable BVLOS frameworks are beginning to emerge (slowly) where regulators adopt phased approvals linked to operating environment, detect-and-avoid capability and operator maturity. Equivalent thinking is beginning to influence maritime autonomy, where international working groups are developing more structured pathways for certifying autonomous functions incrementally rather than certifying entire vessels as fully autonomous from day one.

Regulatory sandboxes are proving particularly valuable across all domains because they allow live operational learning without requiring immediate full compliance, generating evidence that regulators can use to refine future rulemaking. Increasingly, alignment with international standards bodies such as International Civil Aviation Organisation, International Maritime Organisation and International Association of Marine Aids to Navigation and Lighthouse Authorities is also helping to create common reference points across jurisdictions.

Infrastructure enablers are similarly moving toward shared rather than sector-specific models. Rather than building entirely separate ecosystems for each autonomous mode, there is an opportunity for common infrastructure that supports multiple autonomous functions: droneports, coastal launch zones, maritime service hubs, shared charging facilities and common maintenance environments. Reliable connectivity remains central, particularly where autonomous systems require persistent command-and-control, telemetry or remote intervention capability. Satellite broadband, resilient terrestrial networks and maritime digital communications such as VHF Data Exchange Systems (VDES - technology that offers higher bandwidth, increased reliability, and global coverage via satellites) are increasingly viewed as foundational infrastructure rather than optional enhancements.

Workforce enablers are increasingly focused on building formal pathways rather than relying on ad hoc capability development. National curricula in autonomy, robotics and remote systems operation have still to emerge, but there is clear scope for a blended model that combines certificated CPD and short courses with apprenticeships. Industry-academia partnerships are important because they help align technical teaching with industry requirements and the most effective approaches are likely to combine academic robotics capability with apprenticeship-based maintenance and operational exposure.

Financial enablers are also becoming more structured. Innovation grants remain critical in early-stage development, but increasingly there is recognition that grant funding alone does not support transition to deployment. Public–private partnerships, matched funding models and blended finance mechanisms are therefore likely to become prominent because they can distribute risk across public and private actors. The strongest investment cases currently emerge where a clear use case can demonstrate measurable return - for example infrastructure inspection, offshore asset monitoring, emergency response or environmental data collection. In these cases, early public-sector procurement often plays a decisive role because governments act as anchor customers, reducing uncertainty for later private investment.

In practical terms, mitigation increasingly depends on small step development rather than attempting full system transformation immediately. Regulatory mitigation is strongest where sandboxes are linked to incremental certification pathways, allowing operators to move from limited operations to fuller permissions. Adoption of recognised model standards, including those developed through the American Society for Testing and Materials (ASTM), the European Organisation for Civil Aviation Equipment (EUROCAE) and maritime classification frameworks, also allows systems to be designed with future certification in mind rather than retrofitted later.

Infrastructure mitigation similarly benefits from phased rollout. Concentrating first on high-value corridors - such as logistics routes, offshore energy clusters, or selected port zones - may reduce capital exposure while generating operational evidence. Shared asset models can also reduce cost, particularly where charging, storage, maintenance and mission supervision are provided through common hubs rather than duplicated across operators. Digital interoperability is equally important.

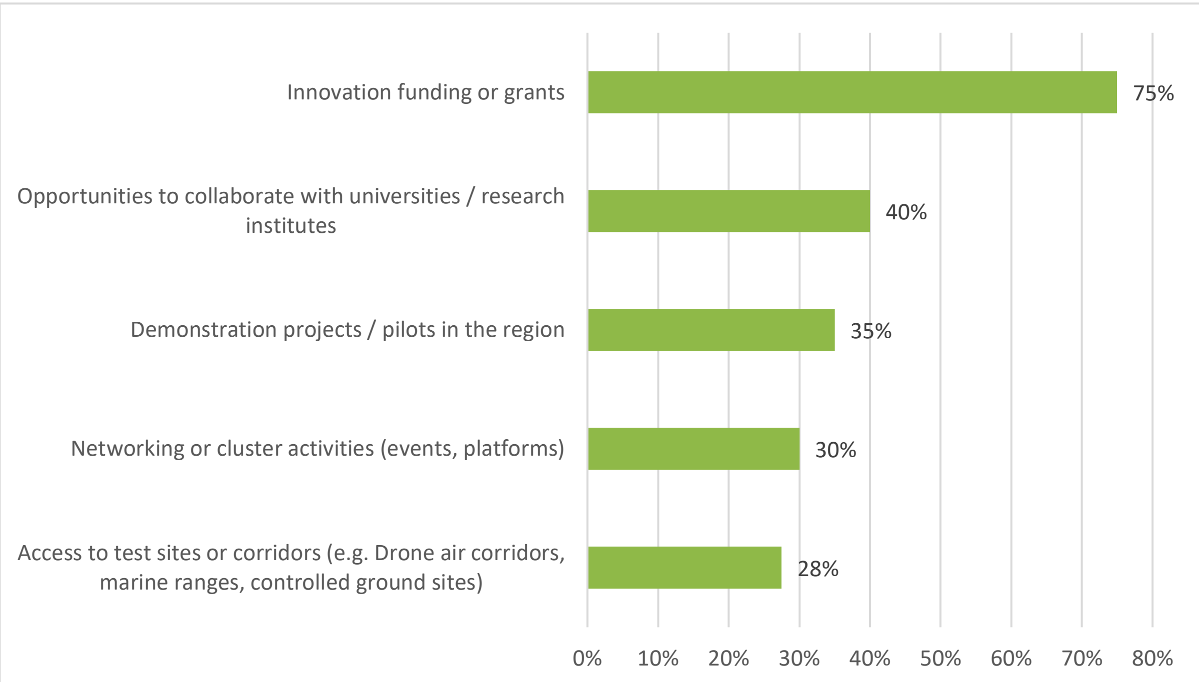
Skills mitigation depends heavily on formal accreditation. National accreditation frameworks help reduce ambiguity for employers and operators, while simulation-based training allows competence to develop faster and at lower cost than relying solely on live operations. Safety culture programmes remain essential because autonomous adoption depends as much on trust and disciplined incident learning as on technical performance.

Finally, financial mitigation increasingly depends on reducing perceived risk for investors. Blended finance structures, milestone-based capital release, loan guarantees and early feasibility support all help bridge the gap between technical promise and commercial confidence. Public-sector demand remains especially influential because where governments adopt autonomous systems early, they create the first stable market conditions from which commercial adoption can develop.

4.4.3. Support needs for the increased use of unmanned systems in the Highlands and Islands

Survey respondents were asked about the areas where they most needed support to enable greater use of unmanned systems (selecting up to three) (Figure 4-8). Support needs are dominated by funding and access to knowledge-sharing or collaborative infrastructure, suggesting that respondents see both financial barriers and ecosystem gaps as key constraints on adoption. Demonstration activity, networking and access to test sites also feature as important enablers, indicating that practical proof-of-concept and connection to the wider innovation system matter alongside direct investment.

Figure 4-8: Key support needed to increase use (Base: 40)



Source: survey, analysis study team

Stakeholder interviewees were clear that the key support needed is coordination, not just technical solutions. They repeatedly called for stronger demand aggregation, clearer customer pipelines and more proactive brokerage between potential users and service providers, so that commercial cases can be built around real service needs rather than around technology push alone. This was especially prominent in the Skyports and NHS interviews, where interviewees argued that public agencies, HIE and other regional actors could help match use cases to operators, convene customers, and create the kind of multi-user model that makes regular operations more viable.

A second set of enablers concerns training, local capability and infrastructure development. Interviewees saw real value in local hubs, training pathways, apprenticeships, links with UHI and other academic institutions, and clearer routes for upskilling pilots, maintenance staff and hub operators. They also emphasised the importance of early engagement with regulators, airfield operators, community stakeholders and end users, because that helps reduce uncertainty, build trust and avoid late-stage delays that can exhaust funding or derail pilots before they become operational.

5. Assets, capabilities and strategic fit (Argyll and Islands / Oban and North Lorn)

Oban and North Lorn sits within a high-value, place-based innovation ecosystem anchored in marine science, rural logistics, and emerging aviation capability. The area combines globally recognised research assets, natural test environments, and targeted public investment, **positioning it as a strong candidate for a robotics and drone hub**. Argyll and the Islands accounts for 15% of the potential £100bn investment in Regional Transformational Opportunities (RTO) in the Highlands and Islands.[27] However, while rooted in Argyll and the Islands, the hub's significance should be viewed as regional rather than purely local, providing a west-coast base from which to support and tap into the wider Highlands and Islands investment pipeline in sectors such as activity spanning offshore wind, marine energy, hydrogen, ports, and aquaculture. The potential synergies associated with the opportunity for Oban and North Lorn, alongside that for Orkney, greatly enhances that regional proposition.

Within this (and without detracting from the Orkney offer), Oban plays a disproportionately strategic role due to:

- Co-location of marine science, robotics, and innovation infrastructure
- A developing aerial drone capability at Oban Airport
- Strong alignment with blue economy, net zero, and rural connectivity priorities

The proposed drone and robotics hub offers dual strategic value:

1. Creation of a new aerial robotics and drone cluster
2. Enhancement of existing marine, environmental, and aquaculture sectors.

5.1. Physical and knowledge assets

Oban's asset base is unusually dense for a rural location, combining research excellence, operational capability, and development infrastructure.

Table 5-1: Core Assets

Asset	Type	Function	Strategic Relevance
Scottish Association for Marine Science (SAMS)	Research	Marine science & biotechnology	Global R&D anchor
Scientific Robotics Academy	Training	Robotics skills development - short courses, hands-on robotics	Workforce pipeline
Scottish Marine Robotics Facility	Operations	Marine robotics deployment AUVs, gliders, seabed systems, drones	Real-world testing

[27] https://www.hie.co.uk/research-and-reports/our-reports/2025/may/08/rtoresearch/

Asset	Type	Function	Strategic Relevance
European Marine Science Park (EMSP)	Innovation	Life sciences & aquaculture	Commercialisation
Oban Airport	Infrastructure	Aviation and UAV operations	Aerial hub foundation
Oban Airport Business Park	Development	Commercial co-location	Cluster growth

Source: authors based on desk research

SAMS provides R&D, education and training functions and support for deployment and operation of marine robotics/automated systems (including data analytics) expertise and services. A number of tenant firms at EMSP and other local businesses are also active in providing services and engineering and data analytics for the marine sector.

Capabilities include:

- Autonomous underwater vehicles (AUVs)
- Ocean gliders (incl. North Atlantic Glider Base),
- Environmental monitoring and data analytics.

Hence, the Oban area already hosts a **mature, if small, marine robotics cluster** aligned with international research and offshore industry needs, which is comparable to the Nordic twin-hub model (see section 6.2) with a combination of R&D/skills capacities and piloting and then operational deployment in industry.

There is a potential to extend and apply this model to the planned aerial drone hub at **Oban Airport**, with the proposed UAV logistics and training hub supporting the operation and testing of aerial drones. Funded by the Rural Growth Deal, the proposed project would develop the UK's first specialised drone innovative research and development hub and training centre, with indoor test facility to trial UAVs and to provide UAV control training, laboratories, and lecture suites - providing direct access between the labs and the airfield. This would include the installation of new state of the art hangars with maintenance facilities for compliance aircraft and UAVs.

Table 5-2 : Aerial Robotics Capability (Emerging)

Feature	Capability	Value
Controlled airspace	Safe UAV testing	Regulatory advantage
Runway infrastructure	Launch & recovery	Operational readiness
Coastal/island geography	Real-world testing	Ideal for logistics trials
BVLOS potential	Long-range operations	High-value applications

Source: authors based on desk research

The proposal to develop **Oban Airport Business Park** would provide enabling infrastructure (roads, utilities, serviced plots) to attract aviation, engineering, and technology firms[28] to locate for both testing and development purposes. For instance, SAMS and Oban airport have already supported the testing of a solar powered drone,[29] SAMS and renewable/aquaculture firms already operate or use aerial drone services (as noted in section 4.2). Moreover, the recent decision to locate seasonal search and rescue operations at Oban airport[30] opens up the possibility of future deployment of drones by the coastguard.[31]

Compared to the marine robotics capacities, the R&D and innovation capacities in aerial drones are less developed in the Oban area. Moreover, as is discussed in the next section, there remains a need, beyond the existing marine robotics capacity, for the development, of additional education and training provision to support drones and robotics deployment. Some relevant examples of remote or shared access models are highlighted in section 6, but this will need to be researched and developed further by key stakeholders.

From a Highlands and Islands perspective, the Oban and North Lorn existing assets and proposed hub sit within a wider network of complementary capability, notably in Orkney (marine renewables and robotics and heavy lift drone trials via project SATE), the National Robotarium and the broader developing Scottish robotics cluster, thereby strengthening the region's collective offer in research, skills, testing, and deployment (see Figure 5.1).

Figure 5-1 : Complementary regional and national assets

Orkney's Research and Innovation Campus (ORIC)[32] provides complementary Highlands and Islands capability by combining research, innovation, and applied testing capacity in a geographically distinct but strategically connected setting. ORIC is an established innovation campus focused on clean energy and low-carbon expertise. ORIC's key assets are its 3.75-acre campus in Stromness, purpose-built to bring together clean energy and low-carbon expertise, and its mix of occupants and facilities that support research, collaboration, and business incubation. It houses organisations such as the European Marine Energy Centre (EMEC)[33], Aquatera, Heriot-Watt University's International Centre for Island Technology (ICIT), and Robert Gordon University, and includes modern office, teaching, co-working, and collaborative spaces designed to strengthen Orkney's renewables ecosystem. ICIT adds further specialist technical and applied research strength, making Orkney a valuable partner in a wider regional network.

The European Marine Energy Centre (EMEC) underpins Orkney's role as a practical testbed for marine, energy, and robotics innovation. EMEC brings internationally recognised marine energy testing infrastructure. The Blue Robotarium[34] extends that offer into robotics, AI, and data-driven solutions for the blue economy, creating a strong complementarity between energy systems and autonomous technologies. The Blue Robotarium is a new robotics testing and development centre being developed in partnership with The National Robotarium, Heriot-Watt University, EMEC, and private sector partners in Orkney.

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[28] *See: https://www.argyll-bute.gov.uk/news/2026/mar/oban-airport-plans-take-another-step-forward*
[29] *See: https://www.sams.ac.uk/news/sams-news-limosaero-drone-testing.html*
[30] *See: https://www.gov.uk/government/news/new-search-and-rescue-base-for-hm-coastguards-rescue-helicopter*
[31] *Drones became part of HM Coastguard's aviation fleet in March 2022 and are currently deployed supporting search and rescue activity in the English Channel. See: https://www.gov.uk/government/news/government-contract-uses-the-latest-technology-for-search-and-rescue*
[32] *https://www.orkneycampus.co.uk/*
[33] *https://www.emec.org.uk/*
[34] *Blue Robotarium*

The National Robotarium[35] provides a national anchor for robotics research and innovation through its dedicated labs, engineering expertise, and direct links between research and industry. Its role in rapidly moving robotics and AI solutions from laboratory development into real-world application makes it a central node in Scotland's robotics ecosystem.

The developing Scottish robotics and autonomous system (RAS) cluster[36] offers a pathway for knowledge exchange, partnership, and commercial scale-up by connecting regional testbeds, academic centres, and industry partners into a more integrated innovation system. Recent cluster activity emphasises the value of a national platform to share knowledge, strengthen adoption, and support productivity gains across the economy, while also positioning Scotland as a destination of choice for robotics development and deployment.

5.2. Business base, skills and workforce

5.2.1. Business base: key sector applications for drones and robotics

The business base around Oban, and across Argyll and the Islands more broadly, is relatively small in absolute terms but highly specialised, with a concentration of activity in sectors where drones and robotics have clear application.[37] The area already brings together marine science, aquaculture, offshore energy, environmental monitoring, engineering and related service provision and operations. Anchored by institutions such as SAMS and EMSP, this ecosystem combines research capability, operational experience, and industry presence in ways that naturally align with the development and deployment of autonomous systems across marine, aerial, and environmental applications. This ecosystem also has the benefit of being able to draw on other regional expertise, such as that centred around Orkney's Blue Robotarium cluster, and/or to set up regional collaborations.

Table 5-3: Business Base Overview

Sector	Strength	Gap
Marine science and aquaculture	Established cluster	Limited automation adoption
Offshore energy	Growing investment	Inspection & O&M capability
Tourism	Strong regional driver	Limited digital integration
Construction & housing	Active pipeline	Productivity challenges
Aviation and drones	Emerging	Early-stage ecosystem

Source: authors based on desk research

Section 3.4 highlighted the alignment of the proposed Oban drones and robotics hub with key regional policies and sectors and, in particular, the potential synergies with other projects in the Argyll and Bute Rural Growth Deal. The Rural Growth Deal projects provide immediate use cases and demand signals, enabling early deployment and validation of drone and robotics applications.

[35] https://thenationalrobotarium.com/

[36] https://thenationalrobotarium.com/industry/scottish-robotics-cluster/

[37] *A report by Stantec report (West Coast Unmanned Aerial Vehicle Logistics and Training Hub. Outline Business Case) October 2024, describes the Oban and North Lorn region as having around 120 businesses in the marine economy within a 20-mile radius of Oban, plus identified demand from public service trials, SAMS, aquaculture, offshore renewables and other users.*

Table 5-4: Applications by Growth Deal project

Project	Drone & Robotics Applications
Rothesay Pavilion	Tourism flyovers and digital content creation; construction site monitoring; health and safety oversight; ongoing structural inspection
Kintyre Sea Sports	Tourism flyovers; immersive visitor experiences; construction monitoring; facilities inspection
STEM Hubs	Direct training in drones and robotics (engineering, computing); indirect skills for renewables, construction, environment, defence
Islay Low Carbon Economy[38]	Site inspection; construction monitoring; energy infrastructure inspection; operations and maintenance support
Housing (Mull and Islay)	Forestry survey and inspection; timber logistics; construction monitoring; health and safety; ongoing building inspection
Colgrain	Construction monitoring; infrastructure inspection; potential integration with energy/logistics systems
Defence (Faslane-related activity)	Surveillance; security; logistics; maritime and aerial autonomous systems
Marine Aquaculture	Environmental monitoring; biomass assessment; automation; feeding systems; biosecurity; skills and training
Ports, Shipping and Logistics	Vessel tracking; port inspection; cargo monitoring; last-mile logistics via UAVs

Source: authors based on desk research

The table below shows where current sector activity creates the clearest use cases, and where capability gaps suggest a hub could add value over time.

Table 5-5: Cross-Sector Value Creation

Sector	Application	Impact
Aquaculture	Monitoring & automation	Productivity, sustainability
Energy	Inspection & maintenance	Reduced cost, improved safety
Construction	Site monitoring	Efficiency, compliance
Tourism	Aerial media	Enhanced visitor experience
Logistics	Drone delivery	Rural connectivity
Defence	Surveillance & autonomy	Strategic capability

Source: authors based on desk research and interviews

[38] *This project is under review and will not be as originally described in Growth Deal.*

These applications would allow the region to act as a living laboratory, demonstrating real-world deployment across multiple sectors.

5.2.2. Skills, Education and Training

Skills, education and training are a central component of assessing and developing a robotics and drone hub. The evidence suggests that this should be approached through two connected lenses:

- first, the capabilities required to develop robotics and drone products and services; and
- second, the capabilities required to adopt, operate and maintain those technologies across end-user sectors such as marine, aquaculture, energy, logistics and public services

Current Skills Development Scotland (SDS) reports,[39] including Regional Skills Assessments (RSAs) for the Highlands and Islands, Rural Scotland, Argyll and Bute, and Inverness and Highland, as well as Sectoral Skills Assessments for Energy, Digital Technologies, and Engineering, make no direct mentions of drones or uncrewed autonomous systems. However, there is consistent evidence, both for Argyll and Bute and across the Highlands and Islands, of demand for the underpinning capabilities on which robotics and drone activity depends, including, engineering (e.g. mechanical/electrical in energy/marine), digital and data skills, electronics, and technical operational capability. This means the case for intervention is less about responding to an already formalised drone/robotics occupation structure, and more about strengthening the enabling skills base from which a regional cluster can grow.

The strongest direct evidence comes from the marine skills research undertaken for Skills Development Scotland in Argyll and Bute.[40] That work highlights an ageing workforce, persistent recruitment difficulties, dependence on in-house training, and shortages in engineering, boat electrics, electronics, machine operation and data-related capability, **alongside a wider expectation that automation, robotics and data use will increase across fishing and aquaculture** as firms seek efficiency gains in response to regulation and cost pressure. Although these findings are not specific to aerial drones or ground robotics, they are highly relevant because they describe the adjacent technical skills environment into which robotics and drone solutions would need to be introduced and scaled.

This challenge is visible both locally and across the wider Highlands and Islands. In Argyll and the Islands, the evidence points to replacement demand, specialist shortages and barriers to attracting and retaining skilled workers, particularly in technical roles. Recruiting skilled staff is a major risk for future planned investments in robotics and autonomous system applications and services both in the Oban/North Lorn area and the wider Highlands and Islands. Shortages in drone pilots, robotics technicians, and trainers were noted by stakeholder interviewees based on experience with past and ongoing projects. Competition from central belt providers, both as service providers and for skilled employees exacerbates this. Low vocational uptake and skills gaps in STEM, UAV, and robotics technology will hinder scaling. Finally, interviewees noted that limited scale of the local workforce means there is often temporary reliance on labour external to the region for short-term projects increases costs and limiting local retention.

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[39] *Available from: https://www.skillsdevelopmentscotland.co.uk/publications-statistics/publications*
[40] *OPTIMAT. Marine Industry Training Research Refresh. Report for Skills Development Scotland. April 2025*

Table 5-6: Skills gaps

Area	Gap	Impact
UAV operations	Limited local training	Slows aerial cluster growth
Engineering	Specialist robotics skills	Limits innovation
Data analytics	Environmental data processing	Underutilised outputs
Workforce scale	Recruitment challenges	Constrains growth of local firms

Source: authors based on desk research and interviews

At the wider Highlands and Islands scale, the regional workforce summit findings[41] highlights a constrained talent pipeline, uneven access to specialist provision, and the importance of combining immediate upskilling responses with longer-term workforce development if emerging sectors are to capture investment opportunities. For the purposes of this assessment, the strongest evidence base should therefore be treated as local to Argyll and the Islands, while wider Highlands and Islands material provides supporting context on the broader labour market pressures affecting delivery.

A further implication is that the skills response should not be framed narrowly in terms of awareness raising about STEM, robotics and autonomous systems. The evidence (from skills and workforce reports and interviews) suggests that the challenge is not simply low visibility of careers, but the need to build an attractive and credible pathway into a sector that can offer high-quality and well-paid technical employment. This requires visible progression routes from school engagement and STEM participation through to apprenticeships, short certificated courses, continuing professional development (CPD), and advanced specialist training. In short, the evidence supports foundational needs for flexible training that could underpin autonomous technology adoption in renewables, marine and other relevant sectors, with forecasts to 2035 showing growth in engineering/digital roles.

The current and planned provision in and around Oban (see Table 5-7) already provides some of the foundations for this approach, particularly in marine science, aquaculture and marine robotics. SAMS has an established role in research and teaching linked to autonomous platforms and, through the Scientific Robotics Academy, has developed a model that combines specialist teaching, early-career skills development and shorter forms of applied training. This is best understood as part of the area's existing advanced capability in marine robotics and environmental monitoring, rather than as a complete response to the wider skills needs of a future robotics and drone hub.

[41] *See: The Highlands and Islands Workforce Summit: Strengthening the Regional Workforce (April 2025). Available at :* https://www.skillsdevelopmentscotland.co.uk/what-we-do/skills-planning/workforce-north

Table 5-7: Current and planned training provision in Oban and North Lorn

Asset	Focus	Contribution
Scientific Robotics Academy[42]	Robotics, including aerial, sea-surface, and underwater platforms	Provides basic to intermediate training in specialised marine robotics, including tailored 1-day CPD courses for industry needs
SAMS[43]	Robotics is embedded within marine science programmes rather than offered separately	Specialised undergraduate and postgraduate studies, programmes and research in marine science.
STEM Hubs (planned)[44]	Broad STEM	Future workforce pipeline

Source: authors based on desk research

At the more applied and vocational end of the system, the evidence points to the need for flexible provision that can be accessed by employers with limited staff capacity and variable training needs. The marine skills evidence[45] shows that many businesses, especially smaller firms, rely heavily on informal and in-house training, while external provision is used mainly where certification is required; there is a strong preference for short, local, hybrid or on-site delivery that reduces time away from work. This is an important finding for the design of any future skills offer linked to robotics and drones because it suggests that provision based solely on long-form classroom delivery would not align well with employer demand.

Taken together, the evidence supports development of an integrated skills ecosystem, that connects entry-level, technical, and advanced capabilities into a coherent pipeline, rather than a single-point intervention. At entry level, planned STEM hubs and school-employer engagement can help strengthen not only awareness of opportunities, but development of the local pool of talent by improving access to technical learning, demonstrating that the sector offers credible and well-paid career opportunities, and connects young people to emerging regional industries. STEM hubs would provide accessible entry points into science, engineering, and digital skills, creating early engagement. At intermediate level, there is a need for targeted technical provision in areas such as UAV operations, maintenance, electronics, data handling and robotics-related engineering, delivered through a mix of short courses, certificated training, apprenticeships and employer-responsive provision.[46]. At the advanced level, institutions such as SAMS and partner institutions can provide specialist research, testing and innovation capability, including shorter certification and academy-style provision where appropriate.

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[42] *See: https://www.sams-enterprise.com/sra/*
[43] *See: https://www.sams.ac.uk/study/ and*
[44] *Within the Argyll and Bute Rural Growth Deal programme, around £2.5 million is allocated to create new Community STEM Hubs that provide modern facilities for learning and engagement in science, technology, engineering and mathematics. The initiative will deliver two physical hubs, one in Dunoon and another located at or near the European Marine Science Park or SAMS in Oban, supported by digital and outreach activities to reach communities across the region. These hubs are intended to provide hands-on training, digital learning spaces, laboratories, and collaborative work areas for schools, colleges, businesses and community groups, helping to improve access to STEM education in a geographically dispersed rural area.*
[45] *Optimat (2025), ibid.*
[46] *The proposal for a Marine Industry Training Centre (MITC), while no longer proceeding, also summarises evidence on the scale of employer need, the value of flexible and open-access facilities, and the importance of combining apprenticeships, formal qualifications, CPD and industry-led training.*

The overall implication is that the skills challenge for a robotics and drone hub in Oban is not the absence of all relevant provision, but the lack of a coherent pathway that connects existing strengths in marine science and robotics to broader workforce needs in operations, maintenance, regulation, adoption and commercial deployment. Strengthening that pathway would reinforce both innovation capacity and technology uptake, and would improve the region’s ability to retain talent, support local firms and capture emerging market opportunities in autonomous systems.

5.3. SWOT of Oban and North Lorn as a drones/robotics hub

The SWOT provides a summary of the evidence collected through the documentary review, interviews and survey activities.

Strengths	Weaknesses
• Unique geography. Relatively clear airspace over land and sea and low population density which is ideal for safe BVLOS drone testing and marine robotics operations. • Established infrastructure including Oban Airport, SAMS and European Marine Science Park supporting business and scientific operations, R&D and training (e.g. SAMS Scientific Robotics Academy). • Proven trials in logistics (school meals, NHS, Royal Mail) boosting resilience for remote islands and use for inspections (offshore wind, aquaculture, ports, powerlines, rail, land use) for key business and public services. • Alignment with net-zero goals via low-emission drone deliveries replacing ferries/roads, drones and UUVs supporting blue economy growth, etc.	• Skills shortages in STEM and UAV/robotics expertise, with aging workforce and competition from renewables for available talent. • Heavy reliance on public funding (e.g. Rural Growth Deal) and delays in phased developments like airport enhancements. • Limited private sector maturity; nascent cluster needs anchor tenants and scaling beyond trials. • Challenging weather in west coast impacting operations, especially offshore robotics.
Opportunities	**Threats**
• Expanding renewables (offshore wind, aquaculture) demand drone/robotics for inspections, monitoring, and logistics via Scotwind/INTOG pipelines. • UK drone strategy level and push for BVLOS by 2027 can position Oban as west coast testbed/training hub • Co-operation / alignment with other hubs/centres of expertise in the Highlands and Islands (especially Orkney) and with National Robotarium to optimise investment in infrastructure and skills. • Job creation (both higher-tech and operational roles) and repopulation via hub, attracting startups/SMEs. • Multi-user drone payloads: NHS (meds/defibs), Royal Mail, police/ambulance could boost viability.	• Slow operational evolution of CAA regulations hindering BVLOS/commercial scaling despite trials. • Competition from other Scottish sites and UK/international hubs eroding first-mover advantage. • Economic pressures like construction inflation, funding gaps, and depopulation worsening skills shortages. • Technical risks (payload limits, failures) and public/general aviation pushback delaying adoption.

6. Comparative insights and benchmarks

6.1. Benchmark cases

A comprehensive desk-based review of leading UK aviation test and innovation facilities has been undertaken to benchmark Oban Airport and identify good practice and potential collaboration opportunities. The facilities that have been considered are:

- National Drone Hub at Predannack Airfield in Cornwall;
- Sustainable Aviation Test and Evaluation (SATE) facility in Orkney;
- Snowdonia Aerospace Centre in North Wales;
- West Wales Airport at Aberporth; and
- Drone Test and Development Centre (DTDC) at Westcott Venture Park in Buckinghamshire.

In addition, two relevant maritime sector-based initiatives have been reviewed:

- Maritime UK South West, the region's strategic maritime cluster; and
- Plymouth and South Devon Freeport

All of these facilities and initiatives provide a diverse set of operational models, governance approaches, funding mechanisms, and infrastructure capabilities that can inform the strategic development of the proposed Oban drone and Robotics. A summary of the key characteristics is set out in the following table.

Table 6-1 : Benchmark sites

Facility	Location	Purpose & Specialism	Governance / Ownership	Funding Sources	Key Capabilities
National Drone Hub	Predannack Airfield, Cornwall	CAA-accredited drone test site; UAV testing and certification	WholeShip Ltd and Royal Navy	WholeShip Ltd, Royal Navy/MoD, Cornwall Space Cluster	4 runways, 8,000 sq km airspace, BVLOS, hangars and office space
SATE – Orkney[47]	Kirkwall Airport, Orkney	Low-carbon aviation testbed	Consortium with lead partner: HITRANS	Future Flight, regional funds	Zero-emission aircraft tests, renewable integration
Snowdonia Aerospace Centre	Llanbedr, North Wales	Aerospace/space R&D, STTC	Snowdonia Aerospace Centre + Newton Launch Systems	UK Space Agency, private investment	Space Technology Test Centre, launch infrastructure, lab facilities

[47] See: https://sate.scot/about/

Facility	Location	Purpose & Specialism	Governance / Ownership	Funding Sources	Key Capabilities
West Wales Airport	Aberporth, Ceredigion	UAV development/ testing	Tekever UK	Welsh Gov., ERDF, UK programmes, MoD	Segregated airspace, BVLOS, certification, training
Drone Test & Development Centre, Westcott	Westcott Venture Park, Buckinghamshire	Secure drone testing & prototyping	Satellite Applications Catapult	Getting Building Fund	Runway, drone cage, sensor ranges, workshops
Maritime UK South West	South West England	Regional maritime innovation cluster	M(UK)SW Ltd not for profit	Cluster Development Fund, strategic partners, sponsorship, government project funding	Clean maritime, autonomy, offshore renewables
Plymouth & South Devon Freeport	Plymouth and South Devon	Manufacturing and innovation hub	Private company limited by guarantee	Government seed capital, Levelling Up Fund, business rates	Tax sites, land, employment space, innovation support, upgraded port facilities

Source: authors based on desk research

In the Highlands and Islands and north-east Scotland, there are also proposals for developing other drone-ports and marine robotics facilities. For instance, there is potential for future synergies between Oban and SAMS' marine robotics capabilities, EMEC in Orkney, and the planned International Blue Economy Robotarium.[48] The emerging opportunity is to create a more joined-up Scottish offer spanning test facilities, research, training, and commercial deployment across marine, surface, and underwater systems. At this stage, this should be seen as a developing collaboration rather than a formalised network, but it could help strengthen Scotland's wider blue robotics ecosystem. Potential synergies may also arise with Mercury Drone Ports in Montrose, funded by the Tay Cities Regional Growth Deal, which is intended to provide a trials airspace for BVLOS drone operations and support commercial drone development. Together with Oban's emerging facilities, this could contribute to a more connected Scottish ecosystem for testing, regulation, and deployment of uncrewed systems.

[48] Blue Robotarium

6.2. European and Nordic Comparators

To complement the development of the Scientific Robotics Academy and the Scottish Marine Robotics Facility by SAMS at Dunstaffnage and to illustrate best practices for the Oban Airport Drone Hub and Business Park, we undertook a desk-based review of robotic and drone clusters across Europe.

This work focused primarily on the Nordics model (described below) due to the alignment of contextual factors with those in Argyll and the Islands and the wider Highlands and Islands, namely:

Sparse populations	Long distances	Limited specialist workforce locally
Weather complexity	Diverse Applications	Need to justify infrastructure investment

A key lesson is that instead of waiting for industry first, the Nordic clusters built **capability ecosystems**. The logic aligns to the development of both a maritime and aerial hub.

The Nordic Twin-Hub Drone Model

A core idea in the Nordic case is that instead of concentrating everything in one location, Nordic regions deliberately split drone development into **two complementary hubs with different purposes**:

Hub Type	Primary Function	Typical Location
Innovation / Knowledge Hub	R&D, education, testing concepts	University or research town
Operations / Deployment Hub	Real-world services and industry adoption	Rural, coastal, or industrial region

The logic can be summarised as: **knowledge flows digitally. Practice happens physically.** This model is ubiquitous across the Nordic region (see annex G), with both aerial and maritime hubs adopting specialisations, which helps differentiate them from each other.

Further research was undertaken to identify aerial and maritime drone hubs across mainland Europe, which tended to focus predominantly on operations and market development, as illustrated in annex G: Nordic and EU Drone Hubs.

Within these results, there are some stand-out models that would warrant further review and discussion by the key stakeholders involved in developing the Oban Drones and Robotics Hub:

1. Rozas Airborne Research Centre (Galicia Drone Hub)

Galicia represents a **place-based, public infrastructure model**, where drones are deployed to solve regional challenges rather than developed as standalone technologies. The hub combines controlled airspace testing with real-world operations across forestry, healthcare logistics, and coastal monitoring. Its defining feature is the integration of drones into **public services and territorial management systems**, creating sustained demand and operational maturity.

2. ICAERUS (Rural Drone Innovation Network)

ICAERUS demonstrates a **distributed, multi-region ecosystem model**, where drone applications are developed and tested across different European geographies rather than within a single hub. It coordinates use cases such as agriculture, forestry, and rural logistics through a network of partners, aligning technology development with local needs in each region. The key innovation is shifting from a centralised hub to a **networked system of 'living laboratories'**, enabling, remote access to skills, education and training, faster validation and broader applicability.

3. Ifremer (Deep-Sea Subsea Robotics and Ocean Intelligence Platform)

Ifremer represents a **deep-ocean robotics and scientific autonomy model**, focused on subsea environments where human access is impossible or prohibitively expensive. It operates advanced autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs), and integrated sensing systems for deep-sea mapping, environmental monitoring, and infrastructure inspection. The key novelty of Ifremer is its role as a **science-led autonomy ecosystem for extreme environments**, where robotics is not primarily commercial or logistical but is used to extend human capability into the deep ocean.

4. ECDI (European Cluster for Drone Innovation)

ECDI represents a **distributed innovation and adoption model**, where drones and robotics are advanced through a network of regional hubs rather than a single test centre or cluster. It connects SMEs, public sector users, and research organisations across multiple European regions, providing access to testing, technical expertise, funding support, and market validation services.

6.3. Lessons for the Highlands and Islands

The key insights gained from the comparative analysis are as follows:

Governance Lessons

- Governance models among benchmarked sites show strong multi-stakeholder structures integrating government, industry, and academia. This is critical for strategic alignment and operational credibility.
- Clear ownership structures accelerate delivery, and the benchmark sites use single accountable entities for operational oversight.
- Specialist advisory groups (skills, innovation, regulation) strengthen ecosystem coordination and collaboration across the region.

Capability Development Lessons

- Most of these facilities prioritise segregated airspace, specialist laboratories, propulsion testing, and simulation environments. Segregated airspace has been a particular enabler for BVLOS and large-UAS operations.
- There is an emerging focus on green propulsion and low-carbon technologies which position regions for future regulatory and commercial shifts.
- Integrated multi-domain test environments (air, sea, land) attract national level R&D programmes.
- Specialist test facilities (LVC simulation, propulsion labs, EW testing) provide strategic differentiation.
- Close alignment with regulators (CAA, MCA) enables accelerated certification pathways.

Cluster & Ecosystem Lessons

- The best-established robotics and drones hubs across Europe align well with pre-established expertise, (e.g. maritime, space, etc.) or regional priorities, (e.g. agriculture, forestry, place-based healthcare, net-zero, etc.)
- Strong cluster leadership builds regional identity and attracts national investment.
- Skills pipelines (STEM programmes, apprenticeships) underpin long-term innovation ecosystem growth.
- Successful zones align innovation strategy with regional assets and industry strengths.
- Benchmark sites demonstrate measurable economic impacts, including SME growth, skills development, and attraction of investment.

Funding Lessons

- Blended funding models (public, private, regional) ensure long-term resilience and capability development.
- Fiscal incentives, such as Freeport business rate retention, unlock infrastructure investment at scale.
- Innovation grants and cluster funds attract SMEs and accelerate technology adoption.

The comparative analysis shows that successful drone and robotics test sites are built on strong governance, differentiated technical capability, aligned regional clusters, and blended funding models. High-performing sites typically operate through clear, accountable leadership structures supported by collaboration between government, industry, and academia. This ensures both strategic direction and operational efficiency.

From a capability perspective, leading sites invest in specialised infrastructure - particularly dedicated airspace, advanced testing facilities, and simulation environments - which enables more complex operations such as beyond visual line of sight (BVLOS). Increasingly, they are also positioning around future-facing technologies, including low-carbon propulsion and integrated multi-domain testing (air, land, and maritime), which strengthens their attractiveness for large-scale R&D programmes.

The Highlands and Islands do not need to replicate existing drone hubs as they already possess many of the natural, operational, and sectoral advantages those sites are trying to build. The priority is to coordinate, specialise, and scale these assets through strong governance, targeted capability investment, and a clear regional proposition.

7. Strategic opportunities, options and roadmap

7.1. Priority opportunities for the Highlands and Islands

The Highlands and Islands region, including Oban and North Lorn, represents one of the UK's most compelling environments for the deployment and testing of uncrewed systems and robotics. Its combination of remote communities, complex coastal geography, low-density airspace, and strong marine and energy sectors creates both a clear operational need and a natural testbed for innovation.

Our research has identified that the key strategic opportunity for Oban and North Lorn lies in establishing the area as a multi-domain robotics hub, capitalising on the unique co-location of marine science expertise, accessible aviation infrastructure, and complex rural and coastal environments. Unlike many test sites that focus on a single domain, the region has the potential to support integrated operations across air, sea, and land. This creates a distinctive proposition for industry and research organisations seeking to trial and deploy systems in realistic, challenging conditions, particularly for applications that require coordination between different autonomous platforms.

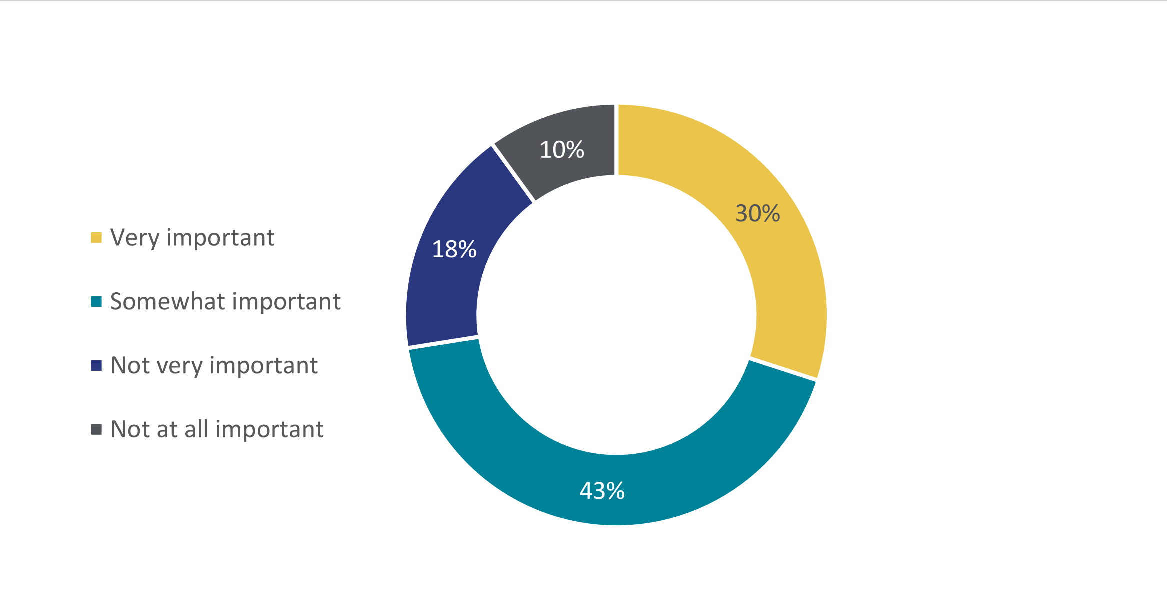
A defining feature of the area is the ability to support multi-domain robotics (air, sea, and land) within a single geography. For example, SAMS operates the Scottish Marine Robotics Facility in Oban, deploying aerial drones, autonomous underwater vehicles (AUVs), and ocean gliders for environmental monitoring and scientific research across challenging marine environments. This positions the area as a rare integrated test environment spanning atmosphere, ocean, and seabed. This is a very distinct proposition from Orkney, which is focusing more on the marine opportunity, although aerial testing was core to the SATE project.

7.1.1. Role of a regional hub

Oban and North Lorn already demonstrates real-world adoption of drones and uncrewed systems, particularly in logistics and marine science. The next phase is scaling this into a coordinated regional testbed and innovation cluster, with a distinctive strength in multi-domain (air, sea, land) autonomy and remote operations. Rather than competing with large urban test centres, the Highlands and Islands can establish a unique position as the UK's leading environment for testing and deploying robotics in remote, coastal, and island contexts, drawing on its Oban and North Lorn, and Orkney clusters of expertise (as well as others under development in the region).

Survey respondents placed strong value on locally accessible expertise and services related to drones and unmanned systems. Three in four (73%) said these were at least 'somewhat important', of which 30% said they were 'very important' (Figure 7-1).

Figure 7-1:Importance of a regional hub/cluster (Base: 40)



Source: survey, analysis by authors

Interviewees were strongly supportive of the idea of a hub or cluster in the Oban area, seeing it as a practical way to bring together testing, training, research, operations and commercialisation in one place. Across the consultations, the recurring message was that Oban already has unusual advantages for unmanned systems because of its coastal setting, relatively clear airspace, low population density, nearby academic and research capacity, and existing trial activity with partners such as SAMS, Argyll and Bute Council, Skyports and HITRANS.

Interviewees envisaged the hub less as a single building and more as a cluster effect: a place where operators, researchers, public bodies and training providers could co-locate and create a pipeline from trials to routine use. They repeatedly linked that idea to the wider Oban Airport Business Park, the EMSP, SAMS' Robotics Academy, and the planned UAV Logistics and Training Hub, arguing that proximity would make collaboration easier and increase the chances of building a real regional capability (for Argyll and the Islands and the wider Highlands and Islands) rather than isolated projects.

A central theme was that a hub would help move beyond one-off demonstrations into a more durable operating model. Interviewees said the biggest value would come from shared infrastructure for testing, maintenance, training, approvals support and customer engagement, which would reduce the friction that currently comes with developing new drone and robotics services from scratch. This was especially important in their view for BVLOS work, logistics, healthcare delivery, marine monitoring and other applications that need regular access to compliant operating space and technical support.

They also stressed that the Oban area could become a living lab for the Highlands and Islands. Several interviewees said the region's geography makes it a strong test environment for services that need to work over sea corridors, in remote rural areas and in challenging weather conditions, and that a local hub would make it easier to trial, refine and scale those services in partnership with users. Some interviewees were careful to note that the hub should remain open and networked rather than closed or overly place-specific, but the overall judgement was that Oban is well placed to act as the focal point for a wider regional cluster.

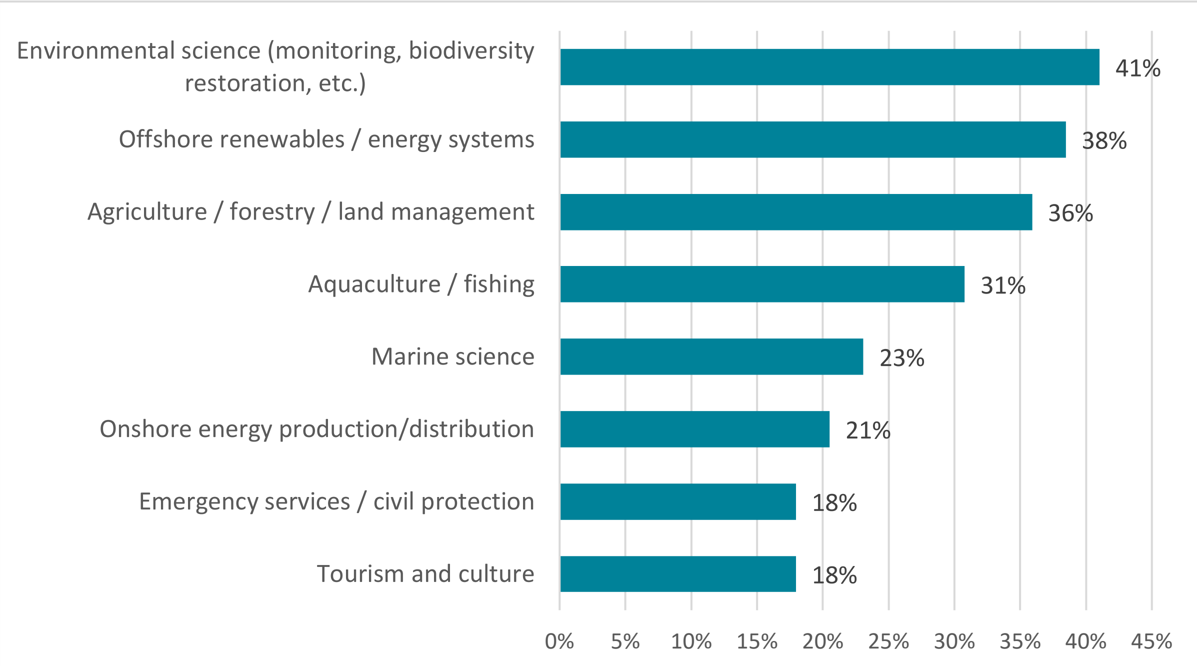
The interviews also suggest that the cluster's credibility would depend on its ability to support real users, not just technology providers. Respondents repeatedly pointed to the importance of anchor tenants, repeat customers and partnerships with sectors such as aquaculture, offshore renewables, healthcare, Royal Mail, local authorities and transport bodies. In that sense, the hub was seen as both an innovation asset and an economic development tool: a way to attract external firms while also helping local organisations adopt and normalise unmanned systems.

At the same time, interviewees were clear that the hub would need careful design and coordination to succeed. They highlighted the need for strong local leadership, clear governance, active market engagement and alignment with regulation, training and infrastructure development, so that the site becomes a functioning ecosystem rather than an underused facility. Their overall message was positive: Oban has the ingredients to become a regional centre of gravity for drones and robotics, but only if the hub is built around practical service delivery, collaboration and long-term demand.

7.1.2. Sectors with the greatest opportunities

Survey respondents saw the greatest opportunity for drones and unmanned systems in sectors where the geography, remoteness, or operational demands make conventional approaches more difficult. Environmental monitoring and resource-based sectors stood out most clearly, with offshore renewables, agriculture, forestry and land management, and aquaculture all emerging as strong areas of perceived potential. There was also a secondary set of opportunities in marine science, onshore energy, emergency response, and tourism and culture, suggesting that respondents saw drones as relevant not just to core economic sectors but also to public services and place-based activity (Figure 7-2).

Figure 7-2: Sectors with the greatest potential to benefit (Base: 39)



Source: survey, analysis authors

Survey and interview responses cluster around a clear set of priorities: regulatory reform, funded testbeds/hubs, infrastructure, skills, and targeted adoption support. Respondents repeatedly noted that the region needs practical enablers—especially BVLOS approvals, a coordinated interface with regulators, and places to test and prove use cases in real conditions.

- Regulation and approvals. The strongest and most repeated message is that current rules, especially around BVLOS and other commercial approvals, are holding the sector back. Respondents want clearer pathways, earlier engagement with the CAA, and a more pragmatic, regionally informed regulatory approach.
- Testbeds and anchor infrastructure. Many responses call for dedicated facilities such as a drone hub, innovation zone, or testing space, linked to Oban Airport or similar assets. These are seen as anchor investments that can attract firms, enable trials, and support wider cluster growth.
- Funding and commercial support. Several comments emphasise grants, loans, and pilot funding, including support for equipment, compliance, and early-stage projects. The idea is to reduce the upfront cost and risk of adoption for both operators and customers.
- Skills and training. Respondents called for training centres, courses, apprenticeships, and stronger links with colleges and universities. A recurring point is that the region needs local capability to operate, maintain, and regulate systems, not just host trials.
- Real-world demand and market building. A number of responses focus on identifying high-value use cases in sectors like marine, energy, logistics, health, agriculture, and utilities, and on public-sector procurement to create dependable demand. Several also stress awareness-building to improve acceptance and correct misconceptions about costs and capabilities.

In terms of sector opportunities respondents most often point to marine, renewable energy, utilities, logistics, and remote public services as the best early markets. The logic is that drones and unmanned systems are most valuable where terrain, distance, weather, or safety make conventional methods slow or expensive. Overall respondents were broadly supportive of drones and robotics, but they want less hype and more delivery: clearer regulation, visible infrastructure, trusted service providers, and evidence that the technology works at regional scale.

7.2. Recommended priority actions

Based on the findings, this section sets out the strategic choices for addressing barriers to the deployment and uptake of uncrewed systems and robotics, while maximising their contribution to Argyll and the Islands' (Argyll and Bute in terms of the local authority) and the wider Highland and Islands economic and social development and to realisation of HIE's regional transformation opportunities objectives.

The evidence suggests that an Oban–North Lorn Robotics and Drone Hub should not be treated as a stand-alone infrastructure or technology asset, but rather as part of a wider delivery ecosystem linking physical infrastructure, service demand, skills provision, research capability and Growth Deal investment within Argyll and the Islands, and the Highlands and Islands more broadly.

Consultation findings also indicate that the strongest near-term opportunities are practical, service-led and place-based, particularly where uncrewed systems can improve resilience, reduce travel times and support hard-to-reach rural and island communities. The central strategic question is therefore not whether the region should invest in drones and robotics, but how best to sequence that investment so that it is demand-led, financially credible and capable of scaling over time.

Taken together, the evidence points to **four recommended priority actions**.

Priority action 1: Establish Oban as an integrated test, training and deployment hub

The first priority should be to progress the Oban hub from outline business case to a fully specified proposition that supports multiple forms of uncrewed systems, including UAVs, UUVs, USVs and, where viable, land-based robotics. This reflects both the wider HIE brief, which explicitly considers drones and robotics across domains, and the emerging evidence that Oban's comparative advantage lies in combining aviation, marine science and applied testing capability rather than focusing narrowly on aerial logistics alone.

This should involve refining the hub concept so that it functions as a shared enabling platform for research, testing, operator training and early-stage service deployment. It should also be co-designed with the CAA, the Maritime and Coastguard Agency, Argyll and Bute Council (owners of Oban Airport) and relevant operators (e.g. HIAL which operates other regional airports) so that Oban is positioned as a recognised low-complexity test environment with clearer and more predictable approval pathways.

Priority action 2: Build demand through a focused portfolio of flagship deployments

The second priority should be to concentrate effort on a small number of high-value, multi-stakeholder deployments that can demonstrate operational value and generate a stronger evidence base for wider roll-out. Across the consultation, the most credible near-term applications were NHS logistics corridors, energy network and wind farm inspection, aquaculture and blue economy monitoring, and emergency, flood and wildfire response.

These deployments should be deliberately designed as long-running programmes rather than short proof-of-concept trials. A focused portfolio of visible use cases, linked wherever possible to Oban Airport and associated marine facilities, would help justify capital investment, support regulatory learning, and demonstrate the practical value of uncrewed systems in the Highlands and Islands context.

Priority action 3: Secure anchor customers and strengthen skills pathways

The third priority should be to turn latent interest into a durable pipeline of demand and capability. This means securing anchor users and industrial sponsors through multi-year programmes with organisations such as the NHS Highland, Royal Mail, utilities, renewables developers, aquaculture firms and emergency services (e.g. search and rescue services at Oban Airport), with clearly defined service volumes, operational requirements and opportunities for co-investment.

In parallel, partners should develop a clearer skills offer linking SAMS, UHI, the National Robotarium and industry provision into structured pathways for technicians, operators and data specialists. Consultation evidence suggests that the main gap is not advanced technical/R&D capability, but the local ability to operate, maintain and embed these systems in routine service environments; this makes technician and operator training especially important.

There is also value in linking the region more systematically to comparable international clusters, particularly in Norway and the wider Nordic region, where similar geographies are supporting practical deployment of autonomous systems. Such collaboration could support curriculum design, applied learning and commercial positioning.

Priority action 4: Improve coordination, positioning and public communication

The fourth priority should be to improve coordination across the regional ecosystem and to communicate the proposition more clearly to users, investors and communities. Several interviewees pointed to the need for stronger strategic coordination so that activity becomes more requirement-led, less fragmented and easier for external partners to understand.

The Highlands and Islands uncrewed systems offer would benefit from more deliberate coordination across the ecosystem so that activity becomes more requirement-led, less fragmented and easier for users, investors and communities to navigate. A Highlands and Islands uncrewed systems forum or working group could help align public services, academia, regulators, local authorities and industry around shared priorities, test opportunities and a clearer regional narrative.

That narrative should present the Highlands and Islands as a distinctive but distributed offer, built around geography, test conditions, airport assets, marine science capability and public-service use cases. It should also make clear that the region's strength lies in complementarity rather than internal competition. For example, the Orkney and Oban hubs should be positioned as complementary assets that strengthens the wider regional proposition by providing distinctive operating environments with collaborative potential, rather than as competing hubs or clusters.

Community engagement should form part of this action from the outset. Public support cannot be assumed, and clear communication will be needed to explain benefits, manage expectations and address possible concerns around safety, privacy, noise and job displacement. A more systematic external communications approach would help ensure that the regional offer is understood not just as a technical innovation agenda, but as an integrated proposition with economic, social and service-delivery value for communities across the Highlands and Islands.

7.3. Outline roadmap

A phased roadmap is needed to move from enabling conditions to routine deployment. The sequencing below reflects the consultation evidence and the practical need to align governance, infrastructure, demand, skills and regulation over time.

Table 7-1: Outline roadmap

Phase	Timeframe	Key Focus	Core Activities	Outcomes
Phase 1: Foundation	0–12 months	Establish leadership and vision	Create single accountable governance structure Align with regulators (e.g. Civil Aviation Authority, Maritime and Coastguard Agency) Define priority use cases (healthcare, energy, aquaculture) Map regional assets and gaps Launch early pilot projects	Clear regional proposition Coordinated stakeholder ecosystem Initial pilots demonstrating value
Phase 2: Capability Build-Out	1–3 years	Develop infrastructure and technical capability	Establish managed test zones (air and marine) Deploy infrastructure (landing sites, charging, data platforms) Attract R&D programmes and industry partners Develop skills and training pathways	Operational test environment Increased industry engagement Strengthened local workforce capability
Phase 3: Integration & Scaling	3–5 years	Transition to routine operations	Scale pilots into commercial services Integrate multi-domain systems (air–sea–land) Expand use cases (logistics, energy, environment) Mature regulatory frameworks (e.g. BVLOS)	Routine autonomous operations Recognition as a national testbed Multi-sector adoption at scale

8. Annexes

Annex A: Main reference materials

Other sources are provided in footnotes;

Regional strategy and investment context

- Highlands and Islands Enterprise (2025) Regional Transformational Opportunities in the Highlands and Islands.
- Argyll and Bute Council (2024) Argyll and Bute Council's Economic Strategy Refresh 2024–2034.

Growth Deal and business case material

- Argyll and Bute Council / project partners (2024) West Coast UAV Logistics and Training Hub Outline Business Case.
- Argyll and Bute Council / project partners (2025) Argyll and Bute RSAP Outline Business Case.
- UHI Argyll / project partners (2025) Marine Industry Training Centre Outline Business Case.
- SAMS / project partners (2024) C-SSIDe Outline Business Case for Rural Growth Deal.
- Highlands and Islands Enterprise (2024) Marine Aquaculture Programme Strategic Outline Case.
- European Marine Science Park Phase 2 Proposed Masterplan.

Regulation, market and ecosystem references cited in the report

- Civil Aviation Authority, CAP 3105: Review of UK UAS Regulations.
- Civil Aviation Authority, CAP 3182: UK BVLOS / Future of Flight roadmap material.
- Civil Aviation Authority, CAP 3145: UAS Operations at Test Sites.
- Drone Industry Insights, market data on the commercial drone market and service share.
- MarketsandMarkets, Fortune Business Insights, Grand View Research, TechSci Research and related market outlooks
- PwC (2022; 2024) Skies Without Limits reports on the UK drone economy.
- Project CAELUS programme materials
- HITRANS / Sustainable Aviation Test Environment (SATE) project materials.
- Argyll and Bute Council / Skyports demonstration materials.

Skills and sector evidence

- Optimat Ltd for Skills Development Scotland (2025) Marine Industry Training Research Refresh Report.
- Highlands and Islands regional partners (2025) Workforce North: A Shared Mission to Grow and Expand Our Workforce. [file:13]
- Highlands and Islands regional partners (2025) The Highlands and Islands Workforce Summit: Strengthening the Regional Workforce
- Skills Development Scotland (2025) Scotland Energy Sector Skills Assessment 2025.

- Skills Development Scotland (2025) Scotland Digital Technologies Sectoral Skills Assessment 2025.
- Skills Development Scotland (2025) Rural Scotland Regional Skills Assessment 2025.
- Skills Development Scotland (2024) Argyll and Bute Growth Deal Regional Skills Assessment.

Annex B: Methodological framework

A PESTLE framework (Political, Economic, Social, Technological, Legal and Environmental) was used as the overarching analytical structure for the study.

B.1. Political

Strategic Alignment & Policy Leverage

- How do priorities of the Scottish Government and UK Government align with an unmanned systems cluster in Oban (e.g. net zero, rural innovation, defence resilience, blue economy, Scottish Robotics and Autonomous Systems Cluster)?
- How does the cluster concept support regional development objectives of HIE and Argyll and Bute Council?
- How can the cluster contribute to delivery of the Argyll and Bute Rural Growth Deal (projects) and other relevant priorities (EMSP, etc.)?

Regulatory & Institutional Context

- What is the policy of the Civil Aviation Authority in enabling BVLOS corridors in rural airspace?
- How do marine and subsea regulatory regimes (e.g. via Maritime and Coastguard Agency) affect UUV deployment?
- Are there opportunities for regulatory sandboxes or innovation testbeds in the Oban area?

Geopolitical & Security Factors

- How exposed are UAV/UUV supply chains to sanctions or defence export controls?
- Does defence interest (e.g. proximity to naval infrastructure in western Scotland) create opportunity or political sensitivity?
- Is there growing UK policy emphasis on developing domestic ('sovereign') drone and marine robotics capability, and could this create opportunities for cluster development in the Highlands and Islands?

B.2. Economic

Market Opportunity (HI-Specific)

- What is the addressable market within Highlands and Islands for (examples):
    - Offshore wind (ScotWind maintenance, inspections)
    - Aquaculture and fisheries
    - Marine science
    - Remote logistics and medical delivery
    - Forestry and peatland monitoring?
- What realistic market size proxies can be derived for H&I-specific demand?

Cluster Economics

- What scale of investment (£0.5m / £5m / £25m pathways) would be required to anchor a viable cluster in Oban?
- What economic multipliers (employment, supply chain, induced effects) could be expected relative to comparable UK clusters?
- How does Oban compare competitively to established UK drone hubs?

Finance & Scale-Up

- What are the main barriers to firm growth in the region (capital, defence/public procurement cycles, research funding, certification costs)?
- Are there anchor firms or institutions that could crowd-in private investment?
- How dependent would the cluster be on public funding versus commercial revenue?

Regional transformation links

- Could the cluster help diversify Argyll and Bute's economy ?
- Could it strengthen year-round, higher-value employment opportunities?
- How would the cluster support broader H&I level transformation priorities ?

B.3. Social

Workforce & Skills

- What skills gaps exist in:
  - Drone (UAV) piloting / operations
  - Marine autonomous systems
  - Robotics engineering and ground-based systems
  - Data analytics and AI
  - Related services and maintenance of equipment.
- Can regional providers (e.g. University of the Highlands and Islands, SAMS) develop/scale relevant training pathways?
- Would the cluster help attract or retain young professionals in Argyll and Bute?

Demographics & Service Need

- How does sparse population and ageing demographics increase demand for drone-enabled healthcare/logistics?
- Could unmanned systems improve resilience of island communities?

Public Perception & Acceptance

- What are local concerns regarding:
  - Privacy
  - Noise
  - Airspace safety

    - Environmental disturbance?
- What engagement mechanisms are needed to secure community licence to operate?

Inclusion & Regional Equity

- Would benefits concentrate in Oban, or spill over to islands and remote mainland areas?
- How inclusive are career pathways for local residents?

B.4 Technological

Regional Assets & Specialisation

- How can Oban's marine science ecosystem (SAMS) support marine robotics specialisation?
- What is the potential for mobilisation of tenants / attraction of new tenants to EMSP?
- Does Oban Airport provide a viable testbed for rural BVLOS operations?

Infrastructure Requirements

- What physical and digital infrastructure is required:
    - BVLOS corridors
    - Charging and maintenance facilities
    - Data processing capacity
    - 5G/6G or satellite connectivity?
- Are there gaps in hangar space, wet labs, fabrication facilities?

Technology Maturity

- What is the TRL of relevant technologies for offshore wind inspection, aquaculture monitoring, and emergency logistics?
- How ready are AI navigation and detect-and-avoid systems for harsh coastal weather?
- How resilient are systems to Highlands and Islands wind and precipitation conditions?

Integration Potential

- How well can UAV/UUV platforms integrate with IoT networks, marine sensors, and renewable infrastructure?

B.5. Legal

Aviation & Marine Regulation

- What are the specific CAA pathways for routine BVLOS operations in rural airspace?
- Are there airspace conflicts with military or commercial aviation?
- What marine licensing requirements apply to autonomous subsea systems?

Data & Liability

- How do UK GDPR requirements affect data-heavy applications (inspection, mapping)?

- What liability frameworks apply to autonomous offshore operations?
- Are insurance markets mature for marine BVLOS/UUV applications?

Employment & Contracting

- How do IR35 and contractor rules affect the viability of freelance operators?
- Are there any import/export control constraints for possible dual-use technologies?

B.6. Environmental

Net Zero & Nature Restoration Contribution

- What emissions reductions are achievable when replacing helicopters, crewed vessels, or road logistics with UAV/UUV systems for inspection and monitoring?
- Can drones reduce the carbon intensity and cost of offshore wind, aquaculture, forestry and infrastructure maintenance?
- Could UAVs accelerate monitoring of peatland restoration, biodiversity, coastal erosion and habitat condition across remote areas?
- How can drones support large-scale tree planting and native woodland regeneration (e.g. aerial seed dispersal, precision reforestation)?
- What role could autonomous systems play in wildfire detection, flood resilience monitoring and climate adaptation?
- Can drone-based LiDAR and multispectral imaging improve soil quality assessment, erosion monitoring and sustainable land management?
- How can UAVs support detection and protection of archaeological and cultural heritage sites in remote areas?
- Could high-resolution aerial and geospatial data strengthen natural capital accounting and carbon market verification?
- Can high-resolution aerial data improve compliance reporting for carbon markets and natural capital accounting?
- Are there opportunities to link drone services to Scotland's just transition and community-led climate action initiatives?

Marine Environmental Remediation

- How can UUVs (uncrewed underwater vehicles) support detection, mapping and recovery of marine litter, including discarded fishing gear ("ghost gear")?
- Can marine robotics reduce the cost and risk of seabed surveys in sensitive habitats?
- What partnerships (fisheries, environmental NGOs, marine science institutes) would be required to operationalise such services?
- Could Oban area position itself as a centre for marine environmental robotics linked to blue economy transition?

Environmental Constraints

- What are operational risks in protected marine areas?

- How do seabird migration routes or marine mammals constrain operations?
- What safeguards are required to avoid environmental disturbance (wildlife, nesting birds, protected sites)?
- What lifecycle impacts (battery disposal, materials) need mitigation?

Resilience

- How do extreme weather and saltwater corrosion affect reliability and maintenance costs?
- Can autonomous systems increase climate resilience of offshore energy assets?

Policy Alignment

- How does a would an unmanned systems/robotics cluster support HIE's net-zero and blue economy ambitions?

8.1. Cross-Cutting: Cluster as Regional Transformation Engine

Across all PESTLE dimensions, consultations should explore:

- Can Oban specialise in marine and remote-environment autonomy, differentiating from other UK drone hubs?
- What "anchor project" (e.g. offshore wind inspection corridor, medical drone route, aquaculture monitoring programme) could demonstrate early impact?
- How does the cluster align with:
    - Blue economy growth
    - Offshore wind expansion
    - Rural population retention
    - Skills transition from oil & gas / maritime sectors?

Annex C: Stakeholder interviewee list

Organisation	Location
HITRANS	Regional
SAMS Enterprise	Local (Oban area)
Scottish Association for Marine Science (SAMS)	Local (Oban area)
Skyports Drone Services	UK (active in H&I)
Argyll and Bute Council	Local (Oban area)
HIAL	Regional
National Robotarium	Scotland
Tritonia (DNV Group)	Local (Oban area)
NHS Highland	Regional
NHS Grampian	Regional
DRAX	Regional/UK
Scottish Power	Regional/UK
Windracers	UK (active in H&I)
MOWI	Regional
TSL	Regional

Annex D: Survey tables - drones and Robotics in the Highlands and Islands: Market Assessment Stakeholder Survey - tables

Q1. What type of organisation do you represent?

Answer Choices	Response Percent	Responses
Public sector body (NHS, etc.)	6%	3
Business	71%	35
University / research institute	10%	5
Third sector / social enterprise	4%	2
Other (please specify)	8%	4
	Answered	49
	Skipped	0

Q2. Including yourself, how many employees does your organisation have?

Answer Choices	Response Percent	Responses
Micro (0-9 employees)	60%	24
Small (10-49 employees)	23%	9
Medium (50-249 employees)	13%	5
Large (250+ employees)	5%	2
	Answered	40
	Skipped	9

Q3. Which best describes your main sector of activity? (Select all that apply.)

Answer Choices	Response Percent	Responses
Agriculture / forestry / land management	23%	9
Aquaculture / fishing	20%	8
Manufacturing	5%	2
Business and professional services	15%	6
Onshore energy production/distribution	18%	7
Offshore renewables / energy systems	13%	5
Transport / logistics / ports and airports	0%	0
Health and social care	3%	1
Education and training	10%	4
Environmental science (monitoring, biodiversity restoration, etc.)	15%	6
Marine science	15%	6
Other scientific services	3%	1
Tourism and culture	10%	4
Emergency services / civil protection	0%	0
Other (please specify)	40%	16
	Answered	40
	Skipped	9

Q4. Where is your organisation based? Please select the location of its main premises.

Answer Choices	Response Percent	Responses
Oban, Lorn and the Argyll Islands	26%	10
Helensburgh and Lomond	0%	0
Other areas of Argyll and Bute	0%	0
Arran and Cumbrae	3%	1
Highland – Inverness, Nairn, Dingwall and the Black Isle	13%	5
Highland – Caithness and Sutherland	10%	4
Highland – Badenoch and Strathspey	0%	0
Highland – Lochaber	8%	3
Highland – Easter Ross	0%	0
Highland – Skye, Raasay and Wester Ross	5%	2
Moray	0%	0
Na h-Eileanan Siar	0%	0
Orkney	0%	0
Shetland	3%	1
Outside the Highlands and Islands but in Scotland	23%	9
Outside Scotland but in the rest of the UK	10%	4
Outside of the UK	0%	0
	Answered	39
	Skipped	10

Q5. In which of the following markets does your organisation operate? (Select all that apply.)

Answer Choices	Response Percent	Responses
Highlands and Islands	88%	35
Outside of the Highlands and Islands but in Scotland	65%	26
Outside Scotland but in the rest of the UK	48%	19
Outside of the UK	35%	14
	Answered	40
	Skipped	9

Q6. What is your role in the organisation?

Answer Choices	Response Percent	Responses
Senior leadership / director / owner	58%	28
Manager	10%	5
Professional / technical	21%	10
Operations / delivery	2%	1
Other (please specify)	8%	4
	Answered	48
	Skipped	1

Q7. Before today, how familiar were you with the use of unmanned systems (UAVs, UUVs and land-based robotics/UGVs)?

Answer Choices	Very familiar	Somewhat familiar	Heard of but not familiar	Not at all familiar	Total
UAVs	29	16	3	0	48
UUVs	13	16	11	5	45
UGVs/Ground robots	9	15	19	4	47
				Answered	48
				Skipped	1

Q8. Does your organisation currently use any of the following unmanned systems? (Select all that apply.)

Answer Choices	Response Percent	Responses
No, we do not currently use any unmanned systems	23%	11
Unmanned aerial vehicles (UAVs, “drones”)	65%	31
Unmanned underwater/undersea vehicles (UUVs, ROVs, AUVs)	31%	15
Land-based robots / unmanned ground vehicles (UGVs, autonomous machinery, warehouse/port robots)	21%	10
Not sure	2%	1
	Answered	48
	Skipped	1

Q9. For what purposes do you currently use unmanned systems? (Select all that apply.)

Answer Choices	Response Percent	Responses
Asset inspection (e.g. buildings, infrastructure, turbines, pipelines)	47%	16
Environmental or marine monitoring / surveying (including subsea)	62%	21
Agriculture / forestry / land management applications	35%	12
Logistics / delivery of goods or medical supplies	9%	3
Port, terminal or yard operations (e.g. automated vehicles, yard robots)	6%	2
Emergency response / search and rescue	9%	3
Media / marketing / tourism	21%	7
Training, R&D or testing (e.g. at research or test facilities)	29%	10
Other (please specify)	32%	11
	Answered	34
	Skipped	15

Q10. How frequently are unmanned systems used in your organisation?

Answer Choices	At least weekly	At least monthly	A few times per year	Once per year	Less than once per year	Not sure	Not applicable	Total
UAVs	11	12	6	0	1	1	2	33
UUVs	6	2	0	1	4	3	9	25
UGVs/Ground robots	3	4	3	0	1	3	10	24
							Answered	34
							Skipped	15

Q11. How are these services provided?

Answer Choices	Response Percent	Responses
We own and operate our own unmanned systems	76%	26
We use external service providers	3%	1
We use a mix of in-house and external systems	21%	7
Not sure	0%	0
	Answered	34
	Skipped	15

Q12. Where are your external systems sourced? Please select all that apply.

Answer Choices	Response Percent	Responses
Within Argyll and the Islands	0%	0
Elsewhere in the Highlands & Islands	13%	1
Elsewhere in Scotland	38%	3
Rest of the UK	75%	6
Internationally	63%	5
	Answered	8
	Skipped	41

Q13. Would you be interested in sourcing these services locally (from Highlands & Islands suppliers) if they were available?

Answer Choices	Response Percent	Responses
Yes	50%	4
No	0%	0
Not sure	50%	4
	Answered	8
	Skipped	41

Q14. Where do you provide services for others with the unmanned systems you own and operate, if any? Please select all that apply.

Answer Choices	Response Percent	Responses
We do not provide services for others	18%	6
Within the local (Argyll & Islands) area	61%	20
Elsewhere in the Highlands & Islands	64%	21
Elsewhere in Scotland	64%	21
Elsewhere in the UK	61%	20
Internationally	42%	14
	Answered	33
	Skipped	16

Q15. How likely is it that your organisation will use any of the following types of unmanned systems within the next 2-3 years?

Answer Choices	Very likely	Somewhat likely	Not very likely	Not at all likely	Not sure	Total
UAVs	1	2	4	3	0	10
UUVs	1	2	2	4	1	10
UGVs/Ground robots	1	1	2	5	1	10
					Answered	10
					Skipped	39

Q16. If you were to use unmanned systems in future, what would be the most relevant applications? (Select all that apply)

Answer Choices	Response Percent	Responses
Asset inspection (e.g. buildings, infrastructure, turbines, pipelines)	30%	3
Environmental or marine monitoring / surveying (including subsea)	50%	5
Agriculture / forestry / land management applications	20%	2
Logistics / delivery of goods or medical supplies	20%	2
Port, terminal or yard operations (e.g. automated vehicles, yard robots)	20%	2
Emergency response / search and rescue	20%	2
Media / marketing / tourism	30%	3
Training, R&D or testing (e.g. at research or test facilities)	30%	3
Other (please specify)	30%	3
	Answered	10
	Skipped	39

Q17. In your view, what are the main benefits (either realised or potential) of unmanned systems/ robotics in your sector? (Select up to three.)

Answer Choices	Response Percent	Responses
Not sure	7%	3
Reducing costs	31%	14
Improving safety	40%	18
Improving quality or speed of services	18%	8
Improved services for remote communities / sites	24%	11
Reduced environmental impacts / emissions	33%	15
Improving data collection and monitoring functions (including environmental of air, land, sea and subsea monitoring)	64%	29
Automating operations (e.g. agriculture, forestry, warehousing, ports) to improve operational efficiencies	13%	6
Supporting innovation and new business opportunities	38%	17
Other (please specify)	7%	3
	Answered	45
	Skipped	4

Q18. To what extent, if at all, do the following factors limit your organisation's use of unmanned systems / robotics today?

Answer Choices	Significantly	Moderately	Minor factor	Not at all	Total
Unaware of, or have not considered, the options and benefits of using unmanned systems / robotics	4	6	7	24	41.0
Upfront costs	15	14	6	6	41.0
Unclear business case	5	9	12	15	41.0
Lack of internal skills or capacity	6	7	16	13	42.0
Difficulty accessing reliable service providers	1	9	12	18	40.0
Regulatory and safety requirements (CAA airspace, maritime regulations, workplace safety, environmental regulations)	14	12	11	6	43.0
Insurance and liability concerns	2	12	14	13	41.0
Public or community acceptance	3	6	19	14	42.0
Weather, terrain and operating conditions (including sea state)	9	17	12	4	42.0
Access to suitable infrastructure (airfields, ports, marine test sites, indoor or controlled test facilities)	3	9	16	13	41.0
Data management, cyber security or privacy concerns	3	7	17	13	40.0
				Answered	44
				Skipped	5

Q19. Please use the space below to provide more detail on any significant barriers your organisation experiences regarding the use of unmanned systems/robotics.

Answered	18
Skipped	31

Q20. What forms of support would be most helpful for your organisation to increase its use of unmanned systems/robotics? (Select up to three.)

Answer Choices	Response Percent	Responses
Information on the use of unmanned systems and robotics	13%	5
Information and advice on regulations and safety across air, sea and land	10%	4
Demonstration projects / pilots in the region	35%	14
Access to test sites or corridors (e.g. Drone air corridors, marine ranges, controlled ground sites)	28%	11
Training for staff (piloting, operating, data analysis, safety/compliance)	23%	9
Access to trusted service providers or procurement frameworks	5%	2
Innovation funding or grants	75%	30
Opportunities to collaborate with universities / research institutes	40%	16
Networking or cluster activities (events, platforms)	30%	12
Other (please specify)	18%	7
	Answered	40
	Skipped	9

Q21. How important would it be to have expertise and services on drone and unmanned systems located in proximity to your operations for your organisation to begin or increase its use of these technologies?

Answer Choices	Response Percent	Responses
Very important	30%	12
Somewhat important	43%	17
Not very important	18%	7
Not at all important	10%	4
	Answered	40
	Skipped	9

Q22. How aware are you of the emerging 'cluster' of activity on drones or other unmanned systems in Argyll and the Islands (notably around Oban)?

Answer Choices	Response Percent	Responses
Very aware	25%	10
Somewhat aware	23%	9
Not very aware	33%	13
Not at all aware	20%	8
	Answered	40
	Skipped	9

Q23. How, if at all, has this cluster of activity in Argyll and the Islands influenced your organisation's thinking about using drones and other uncrewed systems?

Answer Choices	Response Percent	Responses
Positively - it makes us more likely to consider using them	68%	13
No real effect	21%	4
Negatively - it makes us less likely to consider using them	5%	1
Not sure	5%	1
	Answered	19
	Skipped	30

Q24. Which sectors or combinations of sectors in the Highlands and Islands do you think have the greatest potential to benefit from drones and unmanned systems ? (Select up to three).

Answer Choices	Response Percent	Responses
Agriculture / forestry / land management	36%	14
Aquaculture / fishing	31%	12
Manufacturing	3%	1
Business and professional services	8%	3
Onshore energy production/distribution	21%	8
Offshore renewables / energy systems	38%	15
Transport / logistics / ports and airports	15%	6
Health and social care	3%	1
Education and training	5%	2
Environmental science (monitoring, biodiversity restoration, etc.)	41%	16
Marine science	23%	9
Other scientific services	3%	1
Tourism and culture	18%	7
Emergency services / civil protection	18%	7
Other (please specify)	15%	6
	Answered	39
	Skipped	10

Q25. Thinking about opportunities that link these sectors (for example, drones supporting both offshore wind and marine science), please briefly describe any cross-sector or cluster opportunities you see in the Highlands and Islands.

Answered	17
Skipped	32

Q26. Thinking about the next 3–5 years, how strong do you think the opportunity is for the Highlands and Islands to position itself as a leading region for the deployment and use of drones and unmanned systems?

Answer Choices	Response Percent	Responses
Very strong	44%	17
Strong	28%	11
Moderate	8%	3
Limited	10%	4
Very limited	3%	1
Not sure	8%	3
	Answered	39
	Skipped	10

Q27. In your view, what actions (by the public and/or private sectors) should be given the highest priority to support the development of drones and unmanned systems in the region?

Answered	29
Skipped	20

Q28. Is there anything else you would like to add about drones and unmanned systems (air, sea, land) deployment and use in the Highlands and Islands?

Answered	18
Skipped	31

Q29. Would you be willing to be contacted to participate in a short follow-up interview? Your contact information will only be used for these purposes and will be destroyed 3 months after the completion of this project. Please see our privacy notice, which was emailed to you with this survey, or contact research@diffleypartnership for more details on how your information will be used. If you are willing, please provide your name and email below. If you are not, you may skip this question.

Answer Choices	Response Percent	Responses
Name (first and last)	100.0%	33
Email address	100.0%	33
	Answered	33
	Skipped	16

Annex E: Robotics and Drone Hubs in Scotland

Hub / Facility	Location	Type / Focus	Key Organisations / Partners
National Robotarium	Edinburgh (Heriot-Watt campus)	National robotics & AI innovation centre	Heriot-Watt University, University of Edinburgh
Edinburgh Robotics / SuperLab	Edinburgh	Advanced robotics R&D and prototyping	University of Edinburgh
Scottish Marine Robotics Facility	Oban	Marine robotics, underwater vehicles, environmental monitoring	Scottish Association for Marine Science (SAMS), UHI
Scientific Robotics Academy	Oban	Training and applied robotics research	SAMS / UHI
Oban Airport Drone Hub	Oban	UAV logistics testbed and operations	Argyll & Bute Council, Skyports
Borderlands Deep Tech Hub	Hawick	Robotics, AI and deep tech SME accelerator	South of Scotland Enterprise, Borders College
Launchpad Robotics Hub	Edinburgh	Industrial robotics and automation R&D	Launchpad Build, Scottish Enterprise
Mercury Drone Port / Mercury Programme	Montrose, Angus	Drone testing, logistics trials, BVLOS airspace	Angus Council, DTLX, Skyports, NHS Tayside
Windracers Cargo Drone Service (Orkney logistics route)	Kirkwall, Orkney	Autonomous cargo drone operations and testing	

Annex F: Robotics and Drone Hubs in Rest of the United Kingdom

Hub / Facility	Location	Type / Focus	Key Organisations / Partners
National Drone Hub	Predannack Airfield, Cornwall	Large-scale UAV testing, BVLOS operations, defence & commercial drone evaluation	WholeShip, Royal Navy, Cornwall Space Cluster
Spaceport Cornwall / Autonomous Systems Test Environment	Newquay, Cornwall	Integrated testing for autonomous systems including drones, satellites and aerospace systems	Spaceport Cornwall, UK Space Agency, Satellite Applications Catapult
ORCA Hub (Offshore Robotics for Certification of Assets)	Multi-site (London, Edinburgh, Oxford etc.)	Robotics for offshore energy inspection and maintenance	Imperial College London, Heriot-Watt, Oxford Robotics Institute
Oxford Robotics Institute	Oxford	Autonomous vehicles, robotics, machine learning and sensing	University of Oxford
Bristol Robotics Laboratory (BRL)	Bristol	One of Europe's largest robotics labs; service robotics, swarm robotics, drone systems	University of Bristol, UWE
Drone Major Group / Defence UAS Cluster	Cranfield	Defence and advanced autonomous aviation systems	Cranfield University, defence industry partners
Midlands Robotics Cluster	Birmingham/ Coventry	Manufacturing robotics, autonomous vehicles, industrial automation	University of Birmingham, Warwick Manufacturing Group
National Centre for Nuclear Robotics	Cumbria / Manchester	Robotics for nuclear inspection, decommissioning and hazardous environments	UKRI, University of Manchester
Llanelli NHS Drone Logistics Hub (Dragon's Heart project)	Llanelli, Wales	Medical drone delivery network and vertiport testing	NHS Wales, Welsh Blood Service
Snowdonia Aerospace Centre (UAS test range)	Llanbedr, North Wales	UAV testing, aerospace and autonomous flight	Snowdonia Aerospace LLP

Hub / Facility	Location	Type / Focus	Key Organisations / Partners
ParcAberporth / West Wales UAS Test Centre	Aberporth, Ceredigion	UAV testing, certification and evaluation in segregated airspace over Cardigan Bay	Welsh Government, QinetiQ, West Wales Airport, Defence & Industry Partners
Thales UAS & Autonomous Systems Cluster	Belfast	Defence drones, autonomy, aerospace systems	Thales, Queen's University Belfast
Titanic Quarter / Advanced Autonomous Systems research	Belfast	Robotics, AI and autonomous maritime systems	Queen's University Belfast, NI technology firms

Annex G: Nordic and EU Drone Hubs

Table 9-1: Nordic Aerial Drone Ecosystem Model

Country	Knowledge & Experimentation (Research Engine)	Operations & Markets (Deployment Engine)
Norway	Norwegian University of Science and Technology – autonomy, control systems, cybernetics SINTEF – AI, sensing, applied autonomy	Andøya Space – BVLOS, Arctic ops, long-range testing Avinor – airspace integration, UTM Energy & maritime sectors – offshore inspection, surveillance demand
Sweden	Linköping University – AI, autonomy, human–machine interaction RISE Research Institutes of Sweden – systems integration, validation methods	Västervik Drone Science Park – multi-domain trials Defence & infrastructure sectors – applied deployment Public sector pilots – integrated mobility & infrastructure use cases
Finland	VTT Technical Research Centre of Finland – UTM, AI, digital systems Aalto University – autonomy, systems engineering	Fintraffic ANS – UTM deployment, drone corridors National airspace programmes – integration at scale Platform providers – operational infrastructure
Denmark	University of Southern Denmark – robotics, UAV systems Technical University of Denmark – sensing, autonomy	UAS Denmark Test Center – testing & validation Odense Robotics – commercialisation, SME scaling Industrial inspection & logistics markets
Iceland	University of Iceland – environmental monitoring, remote sensing	Flytrex – live delivery operations Fisheries & environmental monitoring users – real-world deployment Decentralised operators – field-based testing

Table 9-2: Nordic Maritime Drone Ecosystem Model

Country	Knowledge & Experimentation (Research Engine)	Operations & Markets (Deployment Engine)
Norway	NTNU – autonomy, marine cybernetics, AUV/USV systems SINTEF Ocean – ocean tech, digital twins, autonomous vessels	Kongsberg Maritime – autonomous ships, control systems Ocean Autonomy Cluster – commercialization ecosystem Norwegian Maritime Authority – autonomous vessel regulation
Sweden	KTH Royal Institute of Technology – marine systems, AI, navigation Chalmers University of Technology – shipping, autonomy, safety systems	RISE Research Institutes of Sweden – testbeds, prototyping, validation Port of Gothenburg – real-world deployment, smart port integration Volvo Group – autonomous transport integration (port ↔ land ↔ sea)
Finland	VTT Technical Research Centre of Finland – remote operations, digital navigation, AI Aalto University – ship design, autonomy, ice navigation	ABB Marine & Ports – autonomous shipping systems (e.g., Azipod, remote ops) One Sea – industry collaboration platform Port of Helsinki – smart port and autonomy trials
Denmark	Technical University of Denmark – marine robotics, sensing, autonomy University of Southern Denmark – robotics applied to maritime systems	Mærsk – digital shipping, automation demand driver Danish Maritime Authority – regulatory sandboxing Odense Maritime Technology – shipbuilding + robotics integration
Iceland	University of Iceland – ocean monitoring, fisheries tech Marine and Freshwater Research Institute – fisheries data, ocean systems	Decentralised, industry-led: Brim – data-driven fisheries operations Iceland Ocean Cluster – startups, applied marine innovation

Sweden

Aerial Drone Hub Specialisation

Sweden's aerial drone ecosystem is best characterised by its strength in **systems integration and advanced autonomy**, rather than a single dominant application niche. Research led by Linköping University and applied work through RISE Research Institutes of Sweden emphasise AI-enabled decision-making, human–machine interaction, and the integration of drones into wider socio-technical systems. Test environments such as Västervik Drone Science Park support multi-sector trials, often linking aerial platforms with ground and maritime systems.

This results in a **cross-domain autonomy specialisation**, where drones are developed as part of broader digital and industrial ecosystems, including defence, mobility, and infrastructure. Rather than focusing narrowly on one application (e.g. delivery or inspection), Sweden's comparative advantage lies in **combining platforms, data, and control systems across domains**, making it a systems integrator within the Nordic drone landscape.

Maritime Robotics Hub Specialisation

Sweden's maritime robotics ecosystem similarly emphasises **integration within complex operational environments**, particularly through collaboration between academia and industry. Institutions such as Chalmers University of Technology and KTH Royal Institute of Technology focus on vessel autonomy, navigation safety, and digital maritime systems, often linked to sustainability and energy efficiency goals.

Deployment is closely tied to industrial and port environments, notably through actors like Port of Gothenburg and Volvo Group. This creates a **"smart port and logistics integration" specialisation**, where maritime robotics is embedded into end-to-end transport systems, connecting sea, land, and digital infrastructure rather than existing as a standalone technology domain.

Norway

Aerial Drone Hub Specialisation

Norway's aerial drone ecosystem is distinguished by its focus on **long-range operations, Arctic conditions, and airspace integration at scale**. Facilities such as Andøya Space provide unique capabilities for testing in remote, harsh environments, enabling development of high-endurance and beyond visual line of sight (BVLOS) operations. This is reinforced by the active role of Avinor in integrating drones into controlled airspace and developing national unmanned traffic management systems.

As a result, Norway has developed a clear niche in **operationalising drones in complex, real-world environments**, particularly where distance, weather, and airspace constraints are significant. This positions the country as a leader in **scaling drone operations beyond pilot projects**, especially for energy, maritime surveillance, and remote logistics applications.

Maritime Robotics Hub Specialisation

Norway represents the most advanced and vertically integrated maritime robotics ecosystem in the Nordics, with strong alignment between research, industry, and regulation. Core research institutions such as Norwegian University of Science and Technology and SINTEF Ocean underpin developments in autonomous vessels, marine cybernetics, and ocean systems.

These capabilities are translated into commercial solutions by global leaders such as Kongsberg Maritime, supported by coordinated cluster activity and regulatory engagement from the Norwegian Maritime Authority. Norway's specialisation is therefore **full-stack maritime autonomy**, encompassing everything from sensing and control systems to vessel deployment and regulatory frameworks.

Finland

Aerial Drone Hub Specialisation

Finland's aerial drone ecosystem is centred on **digital infrastructure, data integration, and unmanned traffic management (UTM)**. Research led by VTT Technical Research Centre of Finland is closely aligned with operational deployment through Fintraffic ANS, enabling the development of integrated airspace management solutions and drone corridors.

This creates a distinct specialisation in the **"back-end" architecture of drone ecosystems**, including communication systems, data platforms, and interoperability. Finland's role is less about high-profile test environments and more about enabling **scalable, system-wide coordination of drone operations**, making it a critical enabler for wider adoption across the region.

Maritime Robotics Hub Specialisation

Finland has developed a strong position in **remote vessel operations, digital navigation, and autonomous shipping in challenging conditions**, particularly ice-covered waters. Research from Aalto University and VTT Technical Research Centre of Finland feeds directly into industrial applications through companies such as ABB Marine & Ports.

The collaborative platform One Sea further aligns stakeholders across the ecosystem, supporting a coordinated national approach. Finland's specialisation can therefore be defined as **remote and digital maritime operations**, with a particular emphasis on navigation intelligence, control systems, and operating in extreme environmental conditions.

Denmark

Aerial Drone Hub Specialisation

Denmark's aerial drone ecosystem is notable for its **strong commercialisation focus and cluster-driven development model**. Anchored by UAS Denmark Test Centre and supported by Odense Robotics, the ecosystem prioritises attracting companies, supporting SMEs, and accelerating the transition from prototype to market-ready solutions.

This results in a specialisation in **industrialisation and business development**, rather than purely technical differentiation. Denmark acts as a **scaling hub**, where companies validate use cases, access test infrastructure, and connect to global markets, making it one of the most commercially oriented drone ecosystems in the Nordics.

Maritime Robotics Hub Specialisation

Denmark's maritime robotics ecosystem is shaped by its position as a global shipping hub, with innovation driven by industry demand rather than research alone. Major actors such as Mærsk create strong pull for digitalisation and automation, supported by research at the Technical University of Denmark.

Cluster organisations such as Odense Maritime Technology further support integration between shipbuilding, robotics, and digital systems. Denmark's specialisation is therefore **demand-led maritime innovation**, where robotics and autonomy are developed in response to real operational and commercial needs within global shipping.

Iceland

Aerial Drone Hub Specialisation

Iceland's aerial drone ecosystem differs from other Nordic countries in its **decentralised, deployment-led structure**, with less emphasis on formal test hubs. Research at the University of Iceland supports applications in environmental monitoring and remote sensing, while companies such as Flytrex have pioneered real-world drone delivery services.

This creates a specialisation in **early adoption and real-world deployment in challenging environments**, including sparsely populated and geographically complex areas. Iceland effectively acts as a **living laboratory**, where drone applications are tested directly in operational settings rather than through large, centralised test facilities.

Maritime Robotics Hub Specialisation

Iceland's maritime robotics ecosystem is closely tied to its fisheries and ocean economy, with a focus on **data-driven resource management and environmental monitoring**. Research institutions such as Marine and Freshwater Research Institute provide critical data and scientific insight, while industry players integrate digital tools into fishing operations.

The Iceland Ocean Cluster supports innovation across startups and established firms, but the ecosystem remains less centralised than in other Nordic countries. Iceland's specialisation is therefore **applied marine innovation embedded in industry**, particularly in fisheries, rather than large-scale autonomous vessel development.

Table 9-3 :Mainland European Aerial Drone Hubs

Hub	What it does (concise description)	Key sectors served
Rozas Airborne Research Centre (Galicia Drone Hub)	A real-world operational drone laboratory embedded in a rural region, combining controlled airspace testing with live public-service deployment. Strong focus on certification and scaling services, not just trials.	Environmental management, public safety, rural logistics, maritime monitoring, agriculture, infrastructure inspection
ICAERUS (Rural Drone Innovation Network)	A pan-European rural deployment network positioning drones as territorial infrastructure, coordinating multi-country demonstrations across agriculture, forestry, and logistics.	Agriculture, forestry, biodiversity, rural logistics, livestock monitoring, skills & adoption
Exercise REP(MUS) (Portuguese Maritime & Coastal Cluster)	A large-scale, multi-domain (air–sea–subsea) experimentation environment focused on interoperability, defence, and ocean monitoring in real maritime conditions.	Maritime surveillance, defence, offshore energy, oceanography, environmental monitoring
European Cluster for Drone Innovation (ECDI Meta-Cluster)	A European-level meta-cluster linking regional ecosystems to scale SMEs, foster collaboration, and build cross-border capability rather than acting as a physical test site.	Aerospace, SME growth, training, cross-border innovation, industrial collaboration
Aerospace Valley (France)	A major aerospace-led drone ecosystem integrating UAVs into certified aviation supply chains, with strong links to defence and airworthiness certification.	Aerospace, defence, certification, advanced manufacturing
Andalucía Aerospace Cluster (Andalusia)	A southern Europe aerospace cluster expanding into UAVs, with emphasis on industrial drone manufacturing and integration into aviation systems.	Aerospace manufacturing, defence, industrial UAVs
BCB Navarra Aerospace Cluster (Navarra)	A regionally embedded cluster linking UAV development to advanced manufacturing SMEs and supply chains, with a strong industrial production focus.	Advanced manufacturing, UAV components, industrial supply chains

Hub	What it does (concise description)	Key sectors served
Skywin (Belgium)	A collaborative innovation cluster integrating drones into wider mobility and industrial systems, with emphasis on cross-sector technology transfer.	Aerospace, mobility systems, industrial innovation
NLR (Netherlands)	A research-driven aviation integration hub specialising in UTM, airspace integration, and certification frameworks for drones within civil aviation.	Airspace integration, UTM, aviation safety, certification
DNW Wind Tunnels (Germany/Netherlands)	A high-end testing infrastructure used for aerodynamic validation of UAVs and advanced aerial systems, supporting certification and design optimisation.	Aerospace engineering, UAV design, defence, R&D
CATEC (Spain)	A dedicated UAV R&D centre focused on robotics, AI, and autonomous flight systems, bridging research and industrial deployment.	Robotics, AI, autonomous systems, aerospace R&D
Drones4Safety (EU Programme)	A large-scale European demonstration programme focused on integrating drones into critical infrastructure inspection and airspace operations under SESAR.	Energy infrastructure, transport, airspace management, safety systems
EuroUSC Italia (Italy)	A specialist certification and regulatory advisory hub supporting UAV airworthiness, compliance, and operational approvals across Europe.	Certification, regulation, aviation safety, compliance
AESA (Spain – Regulatory Sandbox Role)	A national aviation authority actively enabling drone integration through regulatory sandboxes and certification pathways, supporting transition to operations.	Regulation, certification, public safety, aviation and airspace integration and UAS operations enablement

Table 9-4: European Maritime Drone Hubs

Hub	What it does (concise description)	Key sectors served
Exercise REP(MUS) (Portuguese Maritime & Coastal Cluster)	A large-scale, multi-domain experimentation environment integrating aerial, surface, and subsea systems in real maritime conditions. Focused on interoperability, defence exercises, and operational validation rather than isolated testing.	Maritime surveillance, defence, offshore energy, oceanography, environmental monitoring
Pôle Mer Bretagne Atlantique (France)	A major maritime innovation cluster coordinating industry, research, and government to develop advanced ocean technologies, including autonomous and robotic systems. Strong emphasis on translating R&D into commercial and industrial applications.	Blue economy, defence, marine robotics, offshore energy, shipbuilding
Hamburg Port Authority (Smart Port & Automation Hub)	A real-world smart port testbed deploying autonomous surface vessels, robotics, and digital systems within live port operations. Focuses on integrating automation into logistics and port management.	Ports & logistics, shipping, infrastructure monitoring, digital maritime systems
Port of Rotterdam (Autonomous Shipping & Digital Port Hub)	One of the world's most advanced digital and autonomous port ecosystems, using uncrewed vessels, digital twins, and AI to optimise maritime traffic and logistics. Emphasis on system integration at scale.	Global shipping, logistics, energy, smart infrastructure
Ifremer (France)	A world-leading ocean research institute specialising in deep-sea robotics, autonomous underwater vehicles (AUVs), and marine data systems. Focused on scientific exploration and environmental monitoring.	Oceanography, subsea robotics, climate science, marine resources
Fraunhofer CML (Germany)	A logistics and maritime research centre developing autonomous shipping concepts, digital supply chains, and port automation technologies. Bridges research and industry deployment.	Maritime logistics, autonomous shipping, supply chains, digitalisation
MARIN (Netherlands)	A high-end simulation and testing institute specialising in vessel hydrodynamics, autonomous navigation, and digital modelling. Provides validation environments for next-generation ships.	Ship design, autonomy, offshore engineering, simulation
CETMAR (Galicia, Spain)	A regional marine innovation centre linking fisheries, environmental monitoring, and emerging maritime robotics. Focuses on applied	Fisheries, marine environment, coastal monitoring, blue economy

Hub	What it does (concise description)	Key sectors served
	innovation in coastal and resource management.	
CMRE (Italy)	A defence-focused maritime robotics and experimentation centre specialising in autonomous underwater and surface systems for naval operations. Emphasises real-world mission testing.	Defence, underwater robotics, surveillance, naval systems
ECA Group (Industrial Robotics Hub)	A commercial leader in maritime robotics, developing autonomous underwater and surface systems for defence and offshore industries. Focus on deployable, operational technologies.	Defence, offshore energy, subsea inspection, robotics manufacturing
Saab Seaeye (European Subsea Robotics Leader)	A leading developer of remotely operated and autonomous underwater vehicles, widely used in offshore energy and defence. Represents strong industrial capability in subsea systems.	Offshore energy, defence, subsea inspection, marine engineering
Subsea Tech (France)	An SME-driven applied subsea robotics provider, focusing on compact ROVs and inspection tools for industry. Demonstrates how smaller firms commercialise niche marine robotics solutions.	Subsea inspection, offshore energy, infrastructure monitoring
OceanScan-MST (Portugal)	A specialist in autonomous underwater systems and ocean data services, linking robotics with environmental monitoring and survey applications.	Ocean data, environmental monitoring, subsea robotics, offshore surveys
Blue Cluster (Belgium)	A national blue economy cluster supporting innovation in offshore energy, marine robotics, and coastal technologies through industry–research collaboration.	Offshore wind, marine robotics, coastal systems, blue economy

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