Royal Air Force

Autonomous Collaborative Platform Strategy

ROYAL AIR FORCE

Foreword

The RAF has been on the frontline of remotely piloted operations and uncrewed air systems (UAS)[1] for nearly two decades, and has developed a deep understanding of the conceptual, tactical, legal and ethical considerations associated with such operations. In doing so, the RAF has executed missions in congested, unilateral and coalition-led areas of operations spanning three continents. With the graduation of machine learning and autonomy into practical application, the uncrewed systems world is rapidly and inexorably advancing towards the use of Autonomous Collaborative Platforms (ACP). The Defence Drone Strategy[2] provides the core reference baseline for the RAF ACP Portfolio ensuring coherence for the introduction of new developments in capability, supported by lessons learnt in our recent past and in current conflicts; we must keep pace if we are to remain competitive in the modern world.

The Remotely Piloted Aircraft System (RPAS) Force has now achieved over 145,000 operational hours providing overwatch and weapon employment delivering national and coalition operational advantage. Protector forms the next generation of the RPAS Force and will continue to deliver the RAF's requirements for ISR and Attack. However, these platforms are more vulnerable in warfighting conflicts involving a peer or near-peer adversary. Therefore, as a priority, the RAF needs to go beyond RPAS to develop ACP capabilities alongside sister Services that will provide the Freedom of Access and Manoeuvre needed for the most contested or degraded battlespace environments.

The modern operating environment will require us to undertake activity in areas that are demanding, difficult or overtly hostile. It is of national importance that we plan and prepare to conduct and succeed in these High-Risk Operations. This will entail doing things differently from how we have done them in the past, in some cases, significantly. ACP offer us a unique opportunity – a result of lower cost, adaptability and the evolving nature of technology – to drastically increase the pace at which we can bring emerging capabilities to bear. It must therefore also be a Joint endeavour to rapidly harness lessons and developments across the Services and the wider enterprise.

Our geopolitical climate demands that we move beyond the caution of the post-cold cold-war world; Integrated Operating Concept 25 directs us to adopt a spirit of daring that was previously reserved for wartime – we have this opportunity with ACP. The processes we have established over the past 100 years have been developed to ensure we operate safely and professionally. But these must not become a limitation to our warfighting effectiveness. The war in Ukraine shows we **must** be able to sprint when needed. History also shows us that we will be going to war with the equipment we have today; we need to ensure that we can, when called to do so, innovate rapidly, balancing both safety and operational risks.

To do this we must also enable our industrial and commercial sector to keep pace. The professional employment of drones has developed at a rate unimaginable 5 years ago. Many of these systems have developed dynamically, catalysed by Russia's illegal invasion of Ukraine and have provided a significant contribution to Ukrainian efforts to defend their homeland. There is a clear intent to further develop autonomy, blending Human-Machine Teaming and Artificial Intelligence (AI) to further catalyse the rate of change and capability. We must assist the UK sector to keep pace and remain a world leader. In doing so, we support UK prosperity, onshore industry and therefore operational resilience – taking a strategic approach in this offers significant opportunity to incentivise investment and export to our Allies and Partners. Fundamentally, our experiments show that these technologies are not something for consideration in epochs or decades – they are ready now and set the conditions for future development!

It is not possible though, to rely solely on the commercial sector to lead in the development of higher-value ACP. The integration of advanced sensors, stand-off weapons, and functions of survivability, such as low observability, are also a military endeavour. Operational analysis has shown that areas of autonomy, certification, cost, and integration with our crewed force mix are fundamental to how we should employ these technologies. Consequently, in line with the Defence Drone Strategy the RAF will focus its research and experimentation efforts to become expert in the military application of autonomy within the Air domain, sharing information across the Joint Force and those of our Allies and Partners where we operate alongside them. We are already working hand-in-hand with the Royal Navy to exploit our

[1] Different terminologies used as drones and capabilities have evolved.

[2] Defence Drone Strategy - The UK's Approach to Defence Uncrewed Systems

combined knowledge and experiences, identify opportunities, complement each other's work, find efficiencies and drive development. In doing so, we will seek to resolve outstanding questions on intended tactical use cases; how to resolve debate on ethical and legal employment; and add a precision to value curves to better inform where resource will provide the maximum benefit.

We are also now a signatory to an agreement across the Five Eyes (FVEY) community. This agreement will help keep us in lockstep with our closest Allies and Partners. Communication and agreement across NATO should also increasingly bear fruit, catalysed by the events in Ukraine. This collective development, combined with the lessons hard won in Eastern Europe, will ensure that we will all benefit from this technology.

Together, this bold strategy recognises a new way of doing things; our partnerships and the innovation we are seeking to harness and will provide us with a force multiplier. It will augment and enhance our existing capability and provide us with the opportunity and means to learn, develop and fight faster than our adversaries.

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Executive summary

The RAF will build on the Defence Drone Strategy through continued close collaboration with both the Royal Navy and Army. To realise the Autonomous Collaborative Platform (ACP) vision and mission of generating ACP capability, we must achieve three distinct outcomes. These outcomes will give us the technological capability to achieve advantage, the cultural and procedural backbone to ensure it is done rapidly and professionally, and the impetus to maintain the pace of change and remain ahead of our adversaries. The infographic below details these Strategic Outcomes. Associated enabling objectives (EOs), with Air Cap Strat operational analysis (OA) linked considerations and use cases, are discussed in para 16-18. A projected implementation timeline of these Strategic outcomes, linking their respective EOs against short, mid and long-term time periods is available at figure 5.

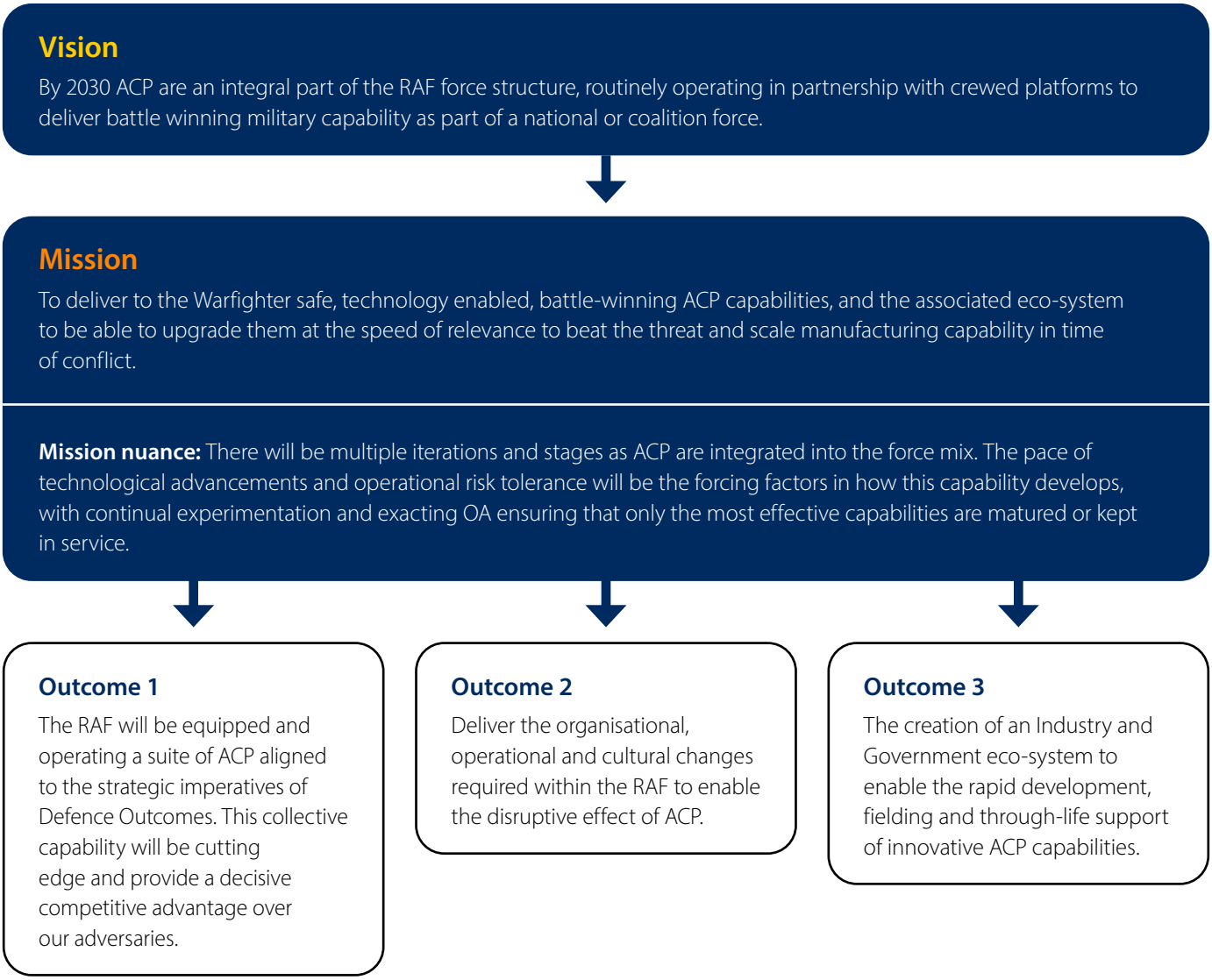


Figure 1: Vision, mission and strategic outcomes associated with the Air ACP Strategy.

Introduction

Strategic context

'The world is becoming ever more complex and volatile. The only certainty about the future is its inherent uncertainty, yet we must prepare. We need to encourage curiosity, be comfortable with ambiguity and open to the world of possibility not probability. The central challenge to prosperity and security is the re-emergence of long-term, strategic competition by what the National Security Strategy classifies as revisionist powers. Our adversaries are countering our airpower strength with greater mass of forces and a complicated operational environment that limits the ability to sense and project credible combat power in contested areas of operation.'[3]

DCDC Global Strategic Trends: The Future Starts Today

In Global Strategic Trends, the Development, Concepts and Doctrine Centre (DCDC) assess that there are 16 focus areas where the potential for profound change to humanity is high[4]. Many of these contain potential threats, opportunities and challenges to the future operating environment that must be addressed. This list includes but is not limited to harnessing artificial intelligence; an expanding competitive space; increasing proliferation of weapons of mass effect; increasing competitions in the global commons; greater automation; an increasingly diverse workforce; and managing technological change.

The threat

The modern operating environment is increasingly multipolar, with new and emerging actors forcing change and conflict on regional and international communities. With many powers now increasingly invested in global geopolitics, it is growing more likely that small, local flashpoints will draw in competing global actors on opposing sides.

This is exacerbated by the proliferation of advanced capabilities. Russia's illegal invasion of Ukraine, the Nagorno-Karabakh conflict and the fight against Daesh in the Levant have proven to be catalysts for the spread of UAS, asymmetric capabilities and anti-access, area denial (A2AD) effectiveness. It is likely that the proliferation of AI technology enabling ACP activity will spread just as fast, supported by malign or apathetic actors, which could itself drive increasing regional competition.

[3] DCDC Global Strategic Trends: The Future Starts Today, 6th Ed, P15.

[4] DCDC Global Strategic Trends: The Future Starts Today, 6th Ed, P4.

Diagnosis

Existential change is approaching exponentially quickly. Digitisation and data science form one of the most catalytic areas of development in modern times. This is evident in the ACP environment; UK Defence must be at the vanguard of this development. The current RAF inventory has been designed with aggregated sensor and weapon packages often slaved to traditional and expensive platforms. This situation mandates an elevated, and at times, unacceptable risk of loss in highly contested environments and on High-Risk Operations (HRO).[5]

The problem

HRO mandate it is essential that we have the ability to adapt and escalate our capabilities rapidly. We must accept that we may not always be able to generate extant capabilities to meet the threat in the usual manner. When engaged on these HRO, or when it is obvious we will be, we must be positioned to adapt our capability as needed. Where appropriate, we may be required to modify, adjust, or dispense with levels of regulatory process normally applied to military capability acquisition, in order to rapidly meet and overcome threats. HRO will also dictate how the RAF will train to fight. The certification level of the ACP may result in all training being completed in the synthetic environment. The RAF must look to accommodate all Force Elements' (FEs) synthetic training facilities within Gladiator and other associated systems to enable multi-domain integration of ACP.

Analysis of Ukraine's use of low-cost, high volume platforms, such as first-person view (FPV) drones, alongside Air's comprehensive experimentation programme must be used to inform future plans. Our focus on overwhelming an adversary's Air Defences remains key, however, we are likely to operate these platforms at significantly greater range than in current operations against significantly more sophisticated air and ground targets in a complex environment. Manufacturing technologies will evolve, autonomy will improve, and costs associated with high-end systems (which currently compare to more capable crewed platforms) will continue to fall. Transition towards more multifaceted and capable systems will be more achievable. Numbers still matter and Air will continue to work alongside international and industrial partners to develop the critical technologies necessary to support increasingly capable and cost effective ACPs becoming a major part of Future Force Design.

The current platforms in RAF service require extensive infrastructure to sustain and support, paired with a significant support overhead requirement. The RAF lacks uncrewed capability to augment existing airborne platforms across a variety of contested and highly contested mission areas. Problem sets and areas for consideration include:

a. Lengthy development-delivery pathways can diminish the strategic relevance of Air Vehicles (AV) and air-delivered effects before their introduction, often exacerbated by continuous modernisation costs once in service. ACP must be affordable and of regenerative mass to present a credible force capable of continued operations despite attrition.
b. Capacity, pre-conflict and during it, to train air and mission crews for significant increases in required sorties of crewed and remotely-piloted aircraft.
c. Current major programmes are unable to adapt rapidly throughout the procurement cycle and require extensive production time and resources. The RAF must be able to access industrial infrastructure and commercial agility as described in the Defence Drone Strategy to manufacture AVs and air-delivered effects in sufficient quantities to present a credible force capable of reconstitution.
d. The need to evolve high-end "traditional" capabilities to maintain relevance against the pace of development in the information age is costly.
e. Resolution of the paradox that the RAF continually seeks ways to make its high-end traditional systems more lethal and survivable through onboard improvements, thus increasing each platform's level of acquisitional drag and reducing its risk tolerance.
f. A lack of resilient basing options, especially when balanced against the nature of potential strategic dispersal imperatives.

Fixing the problem

Part of how the RAF must answer these issues will involve ACP, as described in the Defence Drone Strategy which sets four objectives:

[5] High-Risk Operations: Delivery of capabilities that are specifically designed to a level of risk commensurate to the threat and desired warfighting outcomes. HRO are not factored for operations outside of threat-facing activity.

Objectives

1. Expedite the adoption of Acquisition Reform
2. Build a resilient industrial base
3. Define digital architectures for seamless operational integration
4. Foster a culture of innovation – exploit technology at the leading edge

The RAF will support these objectives, building on existing relationships and activity and seeking new opportunities across UK Defence, the British industrial base and with our Allies and Partners. Indeed, many of the challenges, risks and opportunities identified by the RAF are closely shared by the Royal Navy; collaboration across the Services must therefore be a central tenet of ACP development. This strategy outlines a concept for ACP that is:

a. A system of uncrewed AVs, across a wide range of capabilities, complexities, and roles, as part of a warfighting system.[6]
b. Able to deter or defeat an adversary's attempt at fast and decisive action.
c. Designed with modular open system architectures, digital engineering, rapid software development, and new manufacturing techniques.
d. Able to offer the potential for a new genus of smart, teamed AV with trusted autonomous behaviours, which can throw our adversaries off balance, while countering their A2AD strategies.

RAF ACP categorisation

Initial assessment of the potential types of ACP led to the identification of three main tiers that could be used dependant on requirements. Figure 2 outlines this delineation and is endorsed by both the Royal Navy and RAF as a framework for categorisation (AVs displayed are examples and not funded programmes). The graph is intended to show where the three main tiers are assessed to fit, relative to their individual value to Defence.

a. **Tier 1** disposable. ACP with a life-cycle of one or very few missions.
b. **Tier 2** attritable. ACP that are expected to survive the mission, but losses are acceptable.
c. **Tier 3** survivable. ACP of high or strategic value; their loss would significantly affect how the RAF will fight.

[6] Through increasing use of autonomy, remote mission operators (commanders/supervisors) will be able to command and control an increasing number of AV within each ACP system (autonomy has not yet been developed and integrated to be fully uncrewed across the warfighting system).

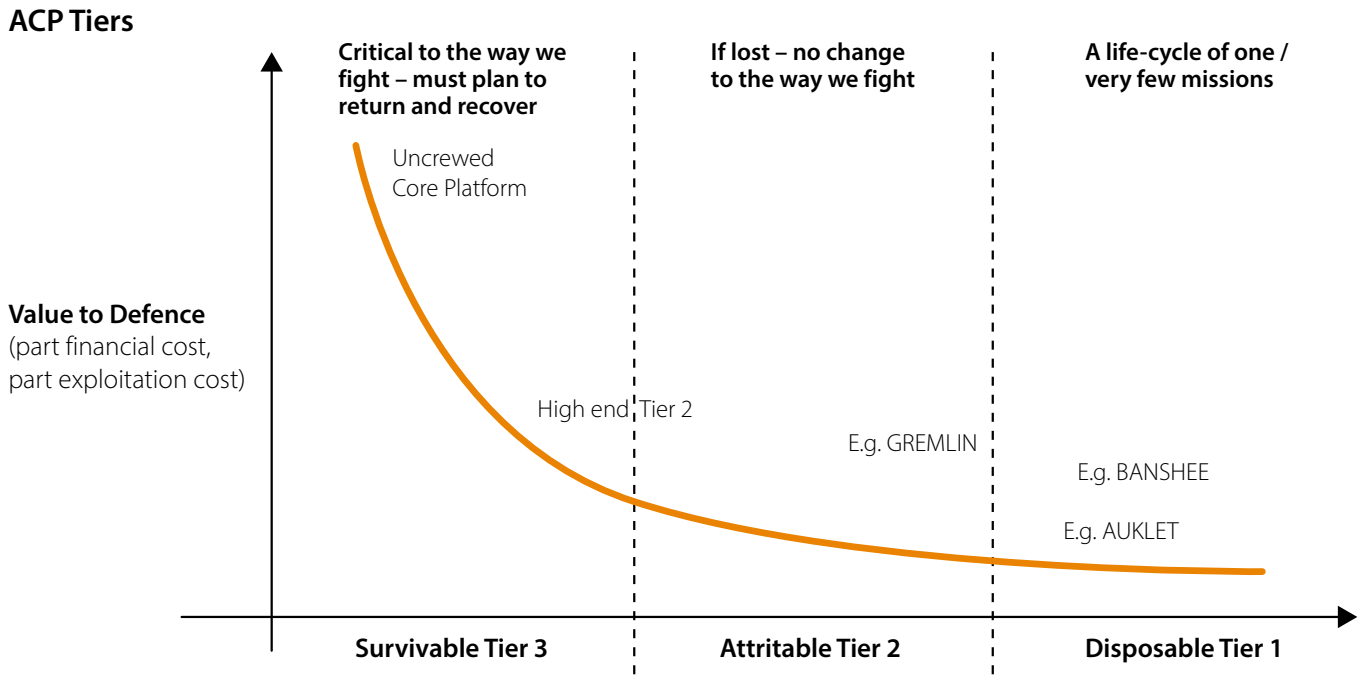


Figure 2: ACP Tiers

Contribution to the Air Operating Concept

Where appropriate, these platforms will team with other crewed and uncrewed AV across domains, add additional capacity to our current capability, and contribute to many key elements of the Air Operating Concept. By leveraging systems engineering advancements, new uncrewed aircraft can be dynamically developed, designed and produced in a manner that that will make combat loss, whilst undesirable, acceptable.

Risk Tolerance

The following aspects inherent in the envisaged ACP make their loss more tolerable and hence could be used in higher risk environments:

a. Their ability to deliver desired effects in 'dangerous, dull and dirty' environments.[7]
b. Their order of magnitude lower cost per vehicle compared to traditional crewed platforms.
c. Their collaborative and disaggregated design enables optimal adaptation to maintain mission performance in the face of attrition.

This collection of attributes offers a reduced personnel recovery burden; reduced acquisition drag and cost; increased chance of mission success; and increased flexibility in tasking, including operating in high threat environments; thus offering a range of options to the Operational Commander. ACP will be able to co-operate with crewed and uncrewed platforms to supplement or off load tasks such as High-Value Air Asset (HVAA) protection, sense and detect, communication nodes, weapons carriage, intra and inter theatre lift and deception. Variants of ACP will be able to operate away from traditional infrastructure and runways to increase the number of basing sites to generate threat-relevant combat effects and impose a targeting problem set on our adversaries.

[7] Dangerous: Risk to life is less acceptable. Dull: Better use should be made of the work force. Dirty: Chemical, Biological, Radiological and Nuclear (CBRN) environment.

Ends

In order to realise this vision, and the mission of generating this ACP capability, we must achieve three distinct outcomes. These outcomes will give us the technological capability to achieve advantage, the cultural and procedural backbone to ensure it is done rapidly and professionally, and the impetus to maintain the pace of change and remain ahead of our adversaries. These are summarised in figure 3 below.

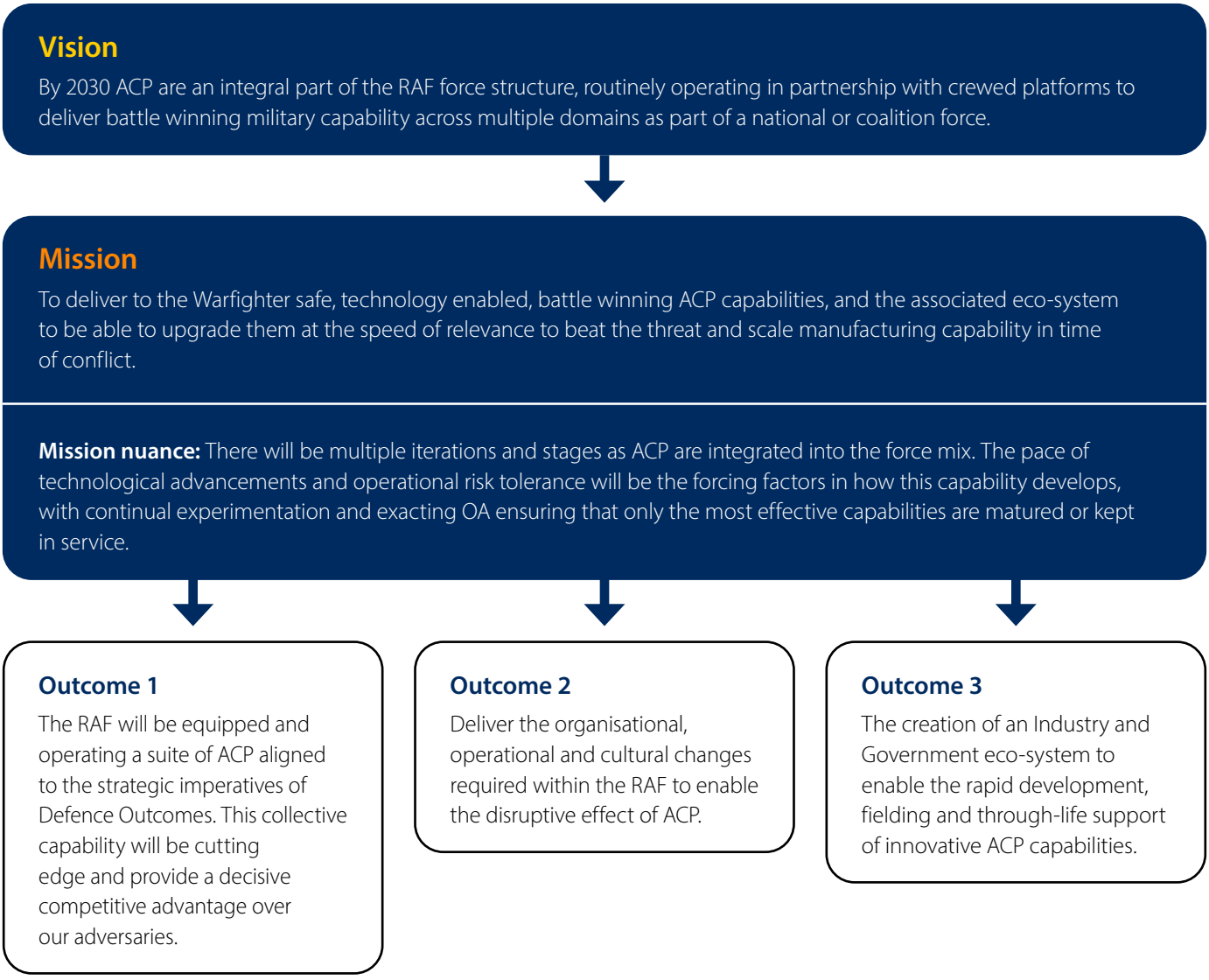


Figure 3: Vision, mission and strategic outcomes associated with the RAF ACP Strategy.

Ways

Work to deliver Outcomes 1-3 will be conducted concurrently. Communication between key organisations is essential as this strategy is implemented. This will prevent work developing in isolation that could fracture efforts and/or drive inefficiencies that damage optimised effort. Furthermore, continued cooperation with the Royal Navy, Army, other government departments and the UK industrial base, will promote collaboration in pursuit of support to the Defence Drone Strategy.

Achieving these outcomes will require multiple differing lines of effort. Some of these lines of effort will build upon previous work and will need to be carried out in sequence, whilst others will be conducted in parallel. These enabling objectives are broken out for each outcome below:

Outcome 1

With the required OA, industrial support (Outcome 3: Industry-Govt ecosystem for technology, scaling, support and costs) and funding, by 2030 the RAF will be equipped and operating a suite of ACP aligned to the strategic imperatives of Defence. This collective capability will be cutting-edge, refreshed at the pace of relevance, to provide a decisive competitive advantage over our adversaries.

a. **Enabling Objective (EO)1.1:** By the end of 2024, the RAF will be equipped and operating disposable ACP, enhancing Force Mass and leveraging competitive advantage.
b. **EO1.2:** By 2030, Tier 2 attritable ACP will form a critical component of the RAF's Combat Air Force mix.
c. **EO1.3:** By 2035, deliver seamless interaction with the Global Combat Air Programme (GCAP) and associated adjunct programme.
d. **EO1.4:** Integration of disposable, attritable and survivable ACP within the four pillars of air power[8], tailorable across different mission sets and environments.
e. **EO1.5:** Operate as a seamless 'system of systems' with the ability to function across multiple domains, within a Joint and multi-nation force mix.[9]
f. **EO1.6:** Able to operate in an agile combat environment, launching from well-found, remote or austere locations as the task demands.
g. **EO1.7:** Use autonomy to execute assigned or commanded tasks without continuous human control, including reconstitution of capabilities within their network.
h. **EO1.8:** To conduct onboard sensing and data processing, including automatic target recognition.
i. **EO1.9:** To enter, operate, and maintain mission effectiveness, within acceptable levels of attrition, when faced with A2AD environments.

Outcome 2

Deliver the organisational, operational and cultural changes required within the RAF to enable the disruptive effect of ACP.

a. **EO2.1:** A new ACP force development capability transformation and acquisition system.
b. **EO2.2:** A new ACP Force, incorporating whole force personnel, able to transform, develop, train, force generate and operate the capability.
c. **EO2.3:** Develop a new planning and operating model for cross-domain ACP operations that outcompetes our adversaries.
d. **EO2.4:** Enable the supporting arms and branches of the RAF to keep pace with ACP by encouraging and facilitating the technical, procedural and cultural shifts required.[10]

Outcome 3

The creation of an Industry and Government ecosystem to enable the rapid development, fielding and through-life support of innovative ACP capabilities.

a. **EO3.1:** Ensure the strategy-develop-deliver pipeline is agile and aligned to technological advancement.
b. **EO3.2:** A resilient ACP development and production capability that ensures operational advantage, attrition replacement and multiple lines of development.
c. **EO3.3:** Able to operate from land and sea, and in support of all components.
    i. **EO3.3.1:** Resilient characteristics to operate in disaggregated, disconnected and degraded environments.

[8] Control of the Air, Attack, ISR and Air Mobility. It is essential that this includes integration with UK Space Command and UK StratCom (Special User, Med etc).

[9] AUKUS / FVEY / NATO / Joint.

[10] This includes use of the synthetic environment, essential in response to HRO.

d. **EO3.4:** To be interconnected using a common architecture, mission-tailored through hardware and software, and employing a human-machine interface appropriate to the level of autonomy and task required.
   i. **EO3.4.1:** Accept and utilise distinct systems today – ensure rapid progress now and not limit the adoption of critical capabilities for the want of perfect software solutions.
   ii. **EO3.4.2:** Integrate common architectures when tested and ready, in order to ensure enhanced operational effectiveness.
e. **EO3.5:** Operate risk-tolerant AVs capable of homeland and expeditionary launch and recovery operations to complement the major weapons, Aircraft Platform Protection (APP) and combat systems already in acquisition.

Use, storage and sustainability

All ACP, and particularly Tier 1 and 2, are intended to be operated in hostile environments where their loss may be intended or tolerated. They should be acquired with an expectation that stocks may need to be rapidly replenished and capabilities re-evaluated once use begins. As a planning principle, there should be an assumption that existing stocks will be kept in the inventory for as long as reasonably practicable (diverging from how we have managed life-expired weapon stockpiles) and systems should be 'upcycled' wherever possible; providing the best capability at a sustainable expense to Defence. Where possible, a common data management system should be incorporated into ACP designs, in order to ensure mission data can be updated in a simple and timely manner whilst the system is still in storage.g

Commercial enablement

MOD has already adopted Category Management (CatMan) for complex procurement areas. This process aims to avoid duplication, and identify and enable fast, compliant routes to delivery where applicable. Early CatMan efforts including the Human Machine Teaming and Heavy Lift Challenge UAS frameworks, are proving to be of utility. This is consistent with the objectives of the Defence Drone Strategy. As default, the MOD should aim to own the core intellectual properties.

Industrial Landscape

The industry landscape in ACP, Robotics and Autonomous Systems (RAS) is still new, though the Science and Technology base is already well developed within the UK. This needs to be nurtured and brought on; to date the larger UK UAS acquisition projects have been awarded to foreign companies. Coherent with the Defence Drone Strategy and working collaboratively with the Royal Navy and Army, where possible and appropriate we should look to invest in UK SMEs and companies to ensure the growth of the UK's industrial capacity and innovation.

a. To maintain operational advantage and the ability to respond rapidly to crisis and conflict, the RAF should require the lead systems integrator to be "on-shore" and capable of securely handling and safeguarding classified UK information. This should extend to the ability to manufacture and scale capacity within the UK.
b. This will require acquisition to work differently, learning the lessons from the COVID-19 vaccine roll-out. There should be greater parallelism and co-ordinated development, using competition where appropriate, aspiring to have multiple solutions to single requirements from different suppliers. We should mandate open system requirements and only transition to a "traditional" acquisition approach when opportunity/requirement and solution options are clear.

Means

Resourcing

Resource Schedule

The ACP Strategy will deliver its outputs over the short (2024-2025), medium (2026-2030) and long term (2031+). The exact level of resource to be allocated is yet to be defined. However, where and when timelines allow this will be progressively developed using the existing Defence Annual Budget Cycle (ABC) process alongside full alignment with the Integrated Review. It will be validated and assessed through the annual Defence Capability Audits. Iterative Operational Analysis being undertaken by Air Capability staffs, in consultation with other Services and alongside DSTL studies, will aim to give this resourcing clear priorities and opportunities to exploit within the ACP ecosystem.

Short-term resources

The initial personnel for ACP development will be established from across the existing ACP-related projects, to enable best use of Sufficiently Qualified and Experienced Personnel (SQEP). This includes personnel within Air Capability Strategy (Air Cap Strat), Air Capability Delivery (Air Cap Del) and the Rapid Capabilities Office (RCO). Importantly, working closely with sister Services (including Navy Develop, Maritime Aviation and Army Combat Aviation) to ensure a compelling Joint case for resource is made through Defence investment cycles. Air Cap Strat will focus on the development of initial use cases and establishing OA constructs to inform future development. Air Cap Del and the RCO will use the OA developed alongside this strategy to inform current projects and balance of investment decisions to provide an initial operating capability, and experimentation capacity. Frontline workforce and resource should be established to enable continual test and development of capabilities. The ACP workforce should be intentionally designed to grow and contract, subject to operational demand, in order to best support the deployable capability. A small permanent core would be provided by regular personnel and, when activated, supplemented with surge capacity through rapid augmentation and reserve activation.

Medium-term resources

Medium-term resources will focus on generating the force mix recommended in the OA, continually developing it in line with emerging technologies identified through DSTL and Air Cap analysis. This process will be supported and approved through dedicated cross-cutting Capability Planning Groups (CPG). Experimentation and OA methods are expected to mature in this timeframe and will be developed to ensure continued relevance and accuracy. Resources and personnel for dedicated operational units will need to be increased during this epoch. It is also expected that the ABC and Capability Audit processes will begin to identify initial ACP capabilities to retire and replace during this time frame.

Long-term resources

Long-term resources will involve allocation of funding and personnel for long-term operational test and evaluation, operational conversion unit and front-line unit personnel. It is likely that successor projects will be identified and initiated around this time. The resources for this epoch will be defined more precisely in future Integrated Reviews.

Initial Findings

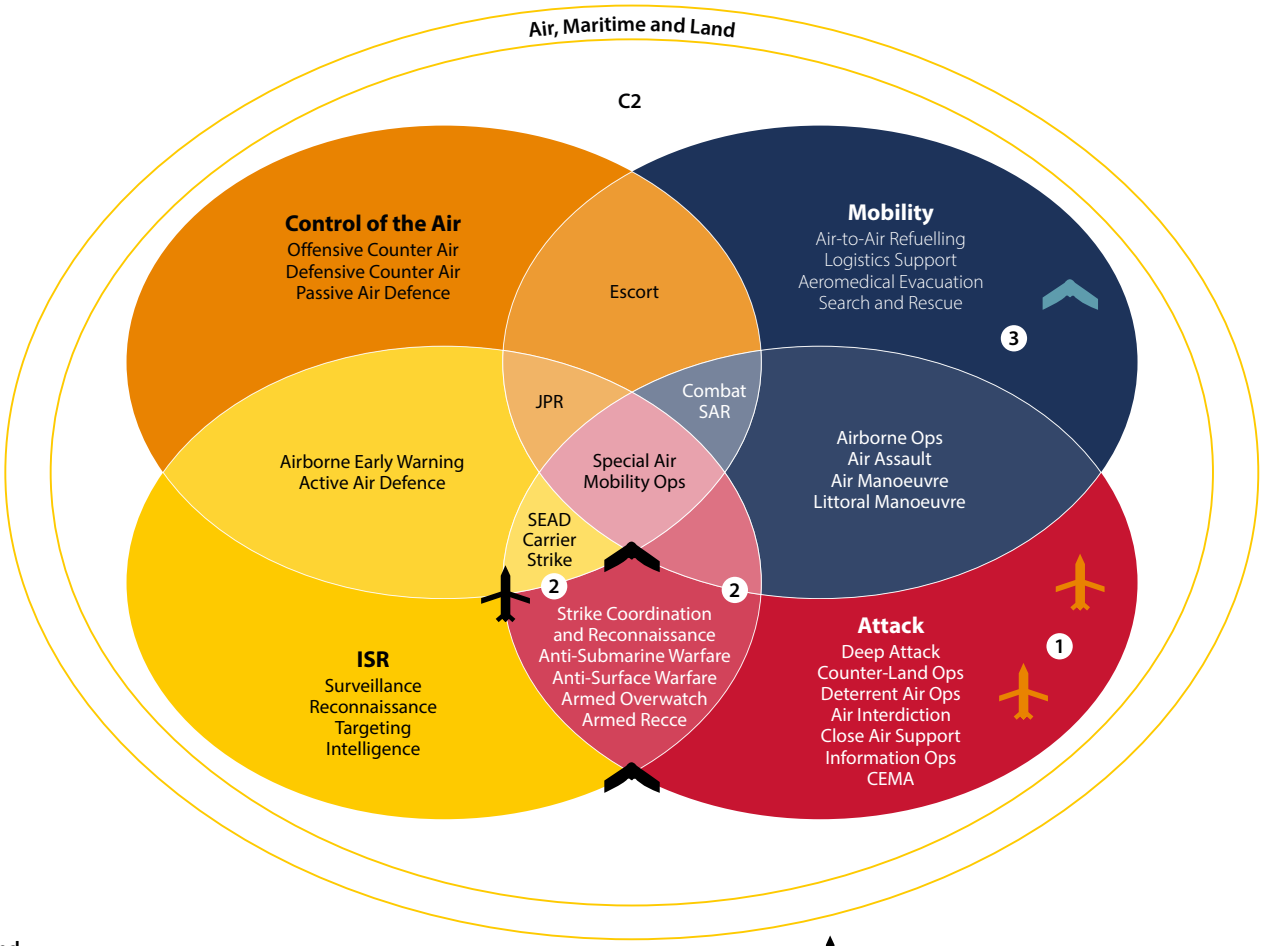
Use Cases

Evolving from the software and systems engineering world, the term 'use case' describes a methodology used in system analysis to identify, clarify, and organise system requirements. ACP use cases describe the effects and functions that ACP may perform, providing aiming marks for Concept Development, Capability Development and the RCO to target. OA has identified a significant number of use cases across the pillars of Air Power and outline ACP classifications.

Recognising the current operational context is key to understanding where ACP can deliver effect in the short-term. This approach has allowed the RAF to develop niche solutions in the Tier 1 category which are capable of delivering bespoke effects in operational theatres now. The lessons being identified from these systems are forming a foundation from which the RAF will rapidly spiral develop new and innovative solutions.

Figure 4 below uses the Air Power Model to identify where OA suggests ACP will best support air power roles in the future. It is evident that some ACP types, particularly at Tier 1, will likely have use across multiple roles. This is especially evident between the Control of the Air, Intelligence Surveillance and

Reconnaissance (ISR), and Attack roles, where similar mission sets have been identified, and modular Tier 1 AVs could be readily adapted to the prevailing mission requirements. It is likely however, that some critical tasks in these roles will still require a specialist, niche capability, potentially across both Tier 1 and Tier 2. Alongside these, multi-purpose mission-configurable Tier 2 AVs will be critical to the RAF's ACP fleet. They will have the ability to conduct roles which are dangerous, dull and dirty, reducing the risk to, and making better use of, our workforce. They will span the pillars of Air Power and in due course, will become ubiquitous in the RAF's operational force mix.



Legend

1. Multiple distinct use cases, most of which require a bespoke ACP type to accomplish.
2. A significant cross-over of roles and capabilities affecting most roles of air power. These effects are likely to be best provided by Tier 2 ACP capable of multi-role employment.
3. Distinct use cases designed to better utilise our workforce, though the nature of these tasks requires a larger Tier 2 ACP.

Tier 1: Small, single use ACP capable of various tasks

Tier 2: Larger attritable ACP capable of multi-role employment

Distinct Tier 1: Small single use ACP designed for one bespoke role

Distinct Tier 2: Larger attritable ACP designed for one primary role

Figure 4: ACP Mission Role Visualisation

ACP Use Cases

ACP OA has been ongoing for several years, drawing upon data from previous and ongoing research and development projects. It considered multiple example mission sets and was baselined against the funded capability programme over 5-year epochs. It indicates requirements for:

a. Self-healing mass sensor network (SIGINT, including COMINT and ELINT).
b. Data & communications rebroadcast networks moving information into and out of threat envelopes.
c. Up-threat targeting & attack.
d. Suppression of Enemy Air Defences (SEAD) – Electronic Warfare (EW), Stand-in-Jamming (SIJ), decoys
e. Interoperability – Multi-Domain Integrated Systems.
f. Multi-use configurable common platforms executing >1 use cases.
g. Early OA indicates potential use cases for higher end Tier 2. Associated OA & Decision Support may centre on enhanced Combat Air mass vice specific autonomous capabilities.

Implementing the strategy

Governance

a. **Overall strategy owner:** Director Capability & Programmes, RAF.
b. **Defence Uncrewed Systems Strategic approach.** The Defence Drone Strategy Objectives (page 5) and Defence strategic approach will deliver Financial Military Capability direction and guidance for the Front Line Commands (FLCs) on methods of improving coherence; enhancing R&D to FL capability pull through; increased pan-Defence capability knowledge; and recommendations for effective acquisition methods. The Strategy, released in February 2024, incorporates key portfolios such as Multi Domain Integrated System (MDIS). Pan-Defence, it covers Airborne, Land, Maritime Surface and Sub Surface systems. It is essential that the three Services and Strategic Command continue to work closely to develop an iterative strategy that is coherent with individual Service uncrewed strategies.
c. **Maintenance of strategy: Air Cap Strat.** Air Cap Strat will revise the strategy no later than 1 Nov 24, to enable alignment with complementary single Service strategies currently under development. Outside of periodic revision the RAF will revise the strategy in response to changes to the operating or operational environment, or on direction from the MOD.

Tasks and Outcomes

There are 3 RAF ACP strategic objective Outcomes, each with associated enabling objectives. A synchronisation matrix projecting outcomes and enabling objectives against short, mid and long-term time periods is available in Figure 5 below.

Communication

This Strategy will be communicated to the relevant stakeholders, organisations and departments. A communications plan that informs stakeholders (internal and external audience) of the existence of this Strategy, and that its implementation is underway will be led by the Air Cap Strat ACP team.

Test & Evaluation (T&E)

T&E is an entirely SQEP reliant activity ideally placed to support the user, assure the risk Duty Holder chains, and enhance a competitive edge. Currently the Air and Space Warfare Centre has the lead for Air T&E and is closely linked to Air Cap Strat, Cap Del, RCO, Military Aviation Authority and Defence Equipment & Support. However, this must also be a Joint endeavour to ensure developments and learning is available across the enterprise.

ACP Strategy Timeline

As set out in Figure 5 below.

Glossary/Lexicon

See Annex A.

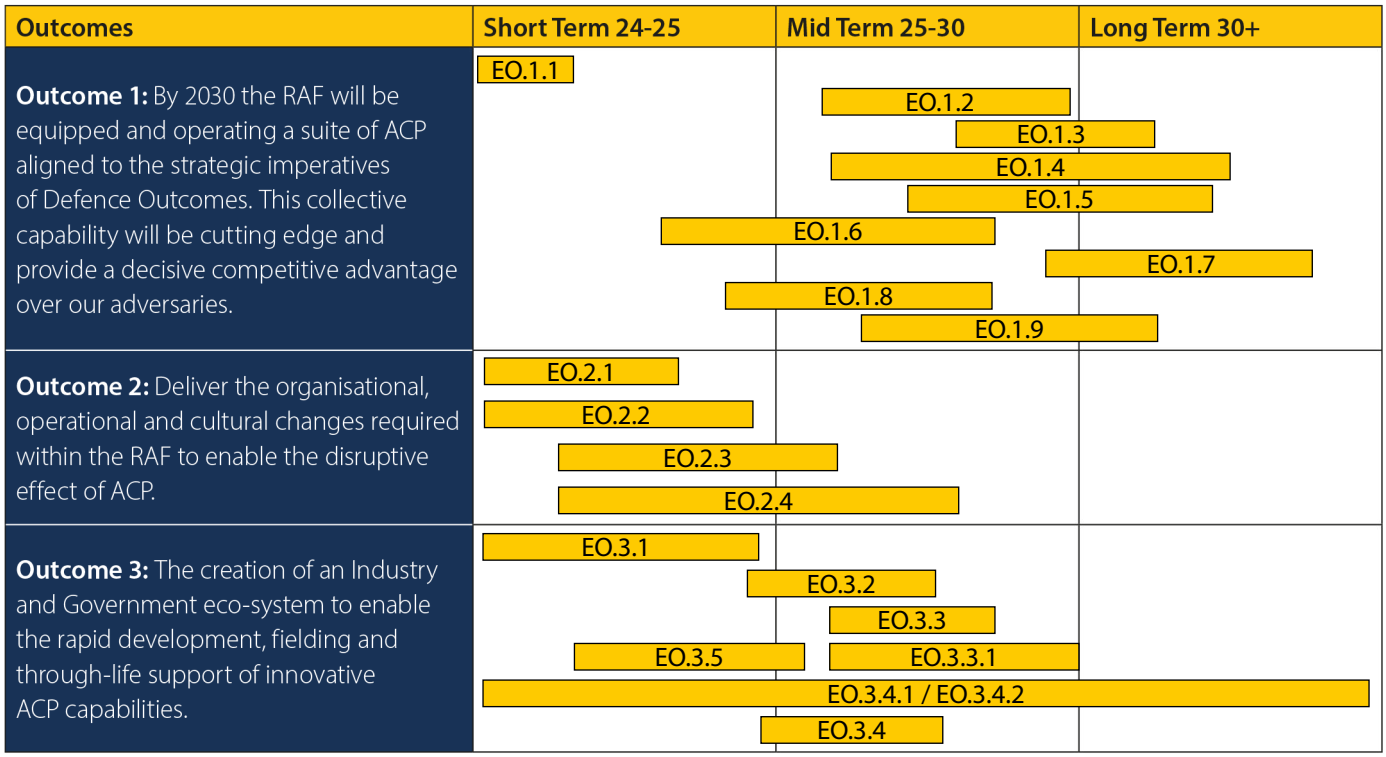


Figure 5: Implementation projection. Outputs synchronised to enabling objectives in short-, mid- and long-term ranges.

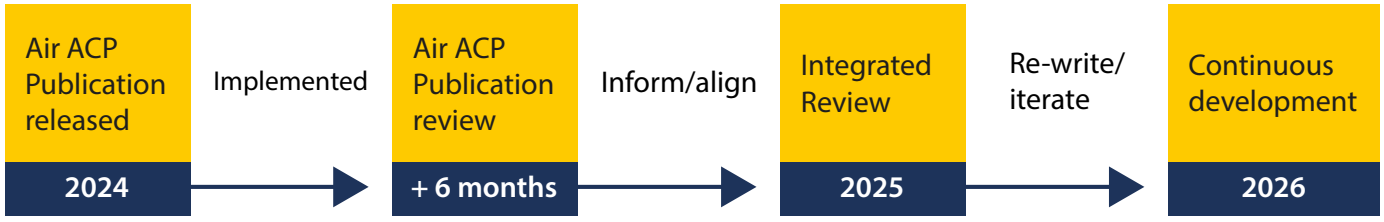


Figure 6: ACP Strategy Timeline

Annexes

A. Lexicon for Autonomous Collaborative Platforms (ACP) and Human-Machine Teaming (HMT)

Background

The technologies surrounding the development of ACP and HMT have advanced significantly over the past few years. In order for this development to continue unhindered, a common lexicon is required to ease understanding and awareness across Air, the Joint enterprise and our Allies and Partners. The following are suggested as accepted definitions in the concept of ACP and HMT development and operations.

Lexicon

#	Item / Concept	Definition	Provenance
1	**autonomous collaborative platforms (ACP)**	A series of uncrewed vehicles which demonstrate autonomous behaviour and are able to operate in a collaborative manner with other assets.	Air Capability Strategy
2	**additive capability**	An uncrewed aircraft system or similar uncrewed capability that adds to the effectiveness of the force mix.	UK Rapid Capabilities Office
3	**adjunct**	Additive capabilities specifically designed to work in conjunction with other aircraft or effects.	UK Rapid Capabilities Office
4	**artificial intelligence**	The capacity of computers or other machines to exhibit or simulate intelligent behaviour. ***Notes: Such technologies can be intended to operate fully autonomously, or with a degree of human monitoring. They can be produced by leveraging data which is representative of the problem(s) at hand, statistical assumptions about the problem, programmed rules, or a combination of these.***	Oxford English Dictionary
5	**attritable system**	A system that is intended to operate and be recovered over several missions, but where mission requirements dictate its loss or attrition is acceptable. (See tier 2)	UK MOD
6	**automatic**	(Of a device or process) working by itself with little or no direct human control.	Oxford English Dictionary
7	**automated**	Pertaining to a system that, in response to inputs, follows a predetermined set of rules to provide a predictable outcome.	NATO Term
8	**automation pact**	The spectrum of cooperation and separation between human pilots and computer autonomy in carrying out tasks.	UK MOD Cognitive Cockpit Programme, 2001
9	**autonomous**	Pertaining to a system that decides and acts to accomplish desired goals, within defined parameters, based on acquired knowledge and an evolving situational awareness, following an optimal but potentially unpredictable course of action.	NATO Term

#	Item / Concept	Definition	Provenance
10	**autonomy**	A system's ability to function, within parameters established by programming and without outside intervention, in accordance with desired goals, based on acquired knowledge and an evolving situational awareness.	NATO Term
11	**conditional autonomy**	A level of autonomy where a human operator selects action/s to be carried out by a system that is operating under human supervision in specified conditions.	UK MOD – Understanding AI and Autonomy in Defence, Taxonomy October 2019
12	**control of the air (CotA)**	Freedom, over a given period of time, to use a volume of airspace for our own purposes while, if necessary, denying or constraining its use by an opponent.	JDP 0-01.1, UK Terminology Supplement to NATO Term.
13	**destruction of enemy air defences (DEAD)**	The subset of the suppression of enemy air defences that encompasses activities to physically destroy the opponent's electronic systems or their key components, as well as his radar and launch system and any other component that enables operations.	NATO Term. RAF uses Suppression of Enemy Air Defences (SEAD), SEAD(Destruction) or SEAD(D).
14	**digital backbone**	A secure, singular, modern digital means to connect sensors, effectors and decision making across domains and with partners, driving integration and interoperability.	Air Capability Strategy
15	**digitalisation**	Converting (pictures or sound) into a digital form that can be processed by a computer.	Oxford English Dictionary
16	**disposable system**	A sacrificial system designed and intended to be used once and not recovered. (See tier 1)	UK MOD
17	**drones**	A remote-controlled pilotless aircraft	Oxford English Dictionary
18	**expendable system**	A system that is intended for a single use and is designed accordingly. (See disposable.)	Air Capability Strategy
19	**exquisite system**	A system for which the cost or capability is considered of such value to the force that loss would likely cause mission failure. (See survivable)	Air Capability Strategy
20	**family of systems**	Two or more systems capable of operating collaboratively to perform certain tasks or missions, using similar capabilities through different approaches, to create similar or complementary effects.	Air Capability Strategy
21	**fully autonomous**	A level of autonomy where a system operates and makes decisions autonomously, in all conditions, without human supervision.	UK MOD – Understanding AI and Autonomy in Defence, Taxonomy October 2019

#	Item / Concept	Definition	Provenance
22	**ground-based air defence (GBAD)**	The employment of surface-to-air weapons, including all-arms air defence.	The Staff Officers' Handbook
23	**general artificial intelligence**	A level of artificial intelligence development where a system which can perform many tasks concurrently, understand/predict how their decisions affect their environment, and be able to learn and adapt accordingly. (Does not currently exist as a capability.)	UK MOD – Understanding AI and Autonomy in Defence, Taxonomy October 2019
24	**highly autonomous**	A level of autonomy where a system can operate and make decisions autonomously, in conditions specified by a human operator.	UK MOD – Understanding AI and Autonomy in Defence, Taxonomy October 2019
25	**information environment**	An environment comprised of the information itself, the individuals, organizations and systems that receive, process and convey the information, and the cognitive, virtual and physical space in which this occurs.	NATO Term
26	**interoperability**	The ability to act together coherently, effectively and efficiently to achieve Allied tactical, operational and strategic outcomes.	NATO Term
27	**loyal wingman**	Outdated term. Describing an autonomous unmanned aircraft to be paired with and commanded by a crewed aircraft – particularly combat air. Similar capabilities now covered under tier 2 or 3 Autonomous Collaborative Platforms.	Air Capability Strategy
28	**machine learning**	The process by which a functional unit improves its performance by acquiring new knowledge or skills, or by reorganizing existing knowledge or skills.	NATO Term
29	**narrow artificial intelligence**	A level of artificial intelligence development where the system performs one main task without input from a human operator.	UK MOD – Understanding AI and Autonomy in Defence, Taxonomy October 2019
30	**operator assistance**	A system which assists the operator in the carrying out the task, with the Operator remaining in full control of the system.	UK MOD – Understanding AI and Autonomy in Defence, Taxonomy October 2019
31	**relative mass**	The effective mass of the force mix relative to a task, mission, or threat.	UK Rapid Capabilities Office
32	**remotely piloted aircraft**	An unmanned aircraft that is controlled from a remote pilot station by a pilot who has been trained and certified to the same standards as a pilot of a manned aircraft.	NATO Term

#	Item / Concept	Definition	Provenance
33	**risk tolerant system**	A system which has been assessed on a risk-to-benefits framework and found to not impose excessive replacement cost, or critical risk of degradation/loss within its family of systems. *Notes: The loss of risk-tolerant aircraft may be considered acceptable if it contributes sufficiently to a tactical or strategic objective. Not intended to be used synonymously with 'expendable'. Previously described by the term attritable.*	Air Capability Strategy
34	**suppression of enemy air defences (SEAD)**	Set of activities that neutralize, temporarily degrade, or destroy enemy surface-based air defences by a destructive and/or disruptive means and contribute to freedom of manoeuvre for friendly forces in the battlespace.	NATO Term
35	**survivable system**	An exquisite system that is designed to operate and be recovered on a similar level to crewed assets. Attrition would not normally be expected or acceptable except in the prosecution of the highest value mission sets (See tier 3).	UK MOD
36	**swarm (behaviour/ intelligence)**	The collective behaviour of multiple units of the same (homogeneous) or different (heterogeneous) system types, working together to achieve a combined objective and employing an element of shared intelligence.	Air Capability Strategy
37	**system of systems**	An organised collection of interacting systems.	Knowledge in Defence (SOSA)
38	**system of systems approach**	An approach to doing systems of systems analysis, systems design and systems and equipment acquisition based on proven (field-tested and found to be successful) systems of systems and related methods and disciplines that is tailored to the UK Defence Enterprise.	Knowledge in Defence (SOSA)
39	**tier 1 ACP**	ACP with a life cycle of one or very few missions. (See disposable)	Air Capability Strategy
40	**tier 2 ACP**	ACP that are expected to survive the mission, but losses are acceptable. (See attritable)	Air Capability Strategy
41	**tier 3 ACP**	ACP of strategic value and their loss would be unacceptable. (See survivable)	Air Capability Strategy
42	**trust**	Firm belief in someone or something.	Oxford English Dictionary
43	**uncrewed aircraft system (UAS)**	A system whose components include the uncrewed aircraft, the supporting network and all equipment and personnel necessary to control the uncrewed aircraft.	JDP 0-01.1, UK Terminology Supplement to NATO Term
44	**uncrewed system**	A system that does not carry a human operator and is operated remotely using varying levels of automated functions. *Notes: 1. Uncrewed systems can be expendable and recoverable.* *2. Uncrewed systems may carry a lethal or non-lethal payload.* *3. Cruise missiles are not considered uncrewed systems.*	Extrapolated from "uncrewed aircraft"; JDP 0-01.1