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# Beyond the buzzwords: Charting the course to fully autonomous combat aircraft

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Warfare is undergoing a fundamental shift. From the skies over Ukraine to the strategic planning rooms of Canberra, the role of uncrewed systems is expanding at a breakneck pace. We are witnessing a transition from the era of the Predator and Reaper—remotely piloted hunter-killers—to a new age of Autonomous Collaborative Platforms (ACP). For the Royal Australian Air Force (RAAF), this is not just a technological upgrade; it is a critical journey toward 'affordable mass' and sovereign capability.

However, there is a dangerous fog hanging over this battlefield, and it isn't made of smoke. It is made of language. As we chart the course for the RAAF's future, we must stop using 'automation' and 'autonomy' as if they are interchangeable synonyms. They are not. If we want to build a force that is effective, legal, and trusted, we must start by agreeing on what we are actually building.

## Words count: Defining the machines

To navigate this journey, we must adopt the definitions recommended by the Australian Association for Uncrewed Systems (AAUS, 2023). In their technical paper, the AAUS highlighted a critical problem: inconsistent terminology confuses regulators, industry, and the public, especially regarding the risks of lethal systems.

We need to be precise:

- **Remotely Controlled:** This applies to systems actively controlled, piloted or overseen by a human from a distance.
- **Automation:** This describes a system's ability to perform actions based on pre-defined criteria without human intervention. It is deterministic. An automated system follows a script. If Condition X is met, do Action Y. Most of what we see in the sky today, even impressive systems, is highly automated, not autonomous.
- **Autonomy:** This is a much higher bar. Autonomy describes a system's independence and self-governance. An autonomous aircraft can operate independently of direct human involvement to plan and execute actions to achieve a goal. It doesn't just follow a rule; it decides how to solve a problem within a complex environment.

Why does this distinction matter for the RAAF? Because the MQ-9A Reaper, the backbone of Western drone operations for years, is a *remotely controlled* aircraft. It relies on a pilot making decisions via satellite link. As we look toward the future, specifically toward the Loyal Wingman and Autonomous Collaborative Platform concepts, we are moving now into the realm of *Collaborative Combat Aircraft* (CCA). These are not yet fully autonomous; they are semi-autonomous systems designed to team with humans, not replace them.

## The current state: Automation, not Terminator

The history of Uncrewed Combat Aerial Vehicles (UCAV) shows a clear trajectory, but perhaps a slower one than the hype suggests. We began with the MQ-1 Predator and MQ-9 Reaper, which revolutionised warfare by removing the pilot from the cockpit but keeping them firmly in the remotely controlled loop.

We then moved to demonstrators like the Northrop Grumman X-47B and the BAE Systems Taranis. These were blended-wing, stealthy aircraft that proved automated machines could take off from carriers or fly intercontinental missions with minimal intervention. Yet, these were technology demonstrators, not production aircraft.

Today, the RAAF is at the forefront of the next evolution with the **MQ-28A Ghost Bat**. Designed and manufactured in Australia, the Ghost Bat is a semi-autonomous Loyal Wingman. It is designed to fly alongside crewed assets like the F-35A or E-7A Wedgetail, providing sensor mass and protection.

Crucially, the Ghost Bat, its American counterparts (like the General Atomics Gambit or Anduril Fury) and other global development efforts like the Turkish Baykar Kızılelma, which just conducted an air-to-air BVLOS engagement last month, are currently "human-on-the-loop" systems. A human mission commander orchestrates the team (Dougherty, 2025). The drone uses high levels of *automation* to fly and sense, but it does not yet possess the *autonomy* to make lethal decisions independently.

## The hard road to full autonomy

The destination of this journey is **Level 5 Full Autonomy**, where a system independently determines its flight path, target selection, and engagement without human intervention (Joint Authorities for Rulemaking of Unmanned Systems, 2023). Achieving this will require overcoming hurdles that are not just technological, but ethical, legal, and industrial. Some of these hurdles include:

1. **The ‘Digital Triad’ gap.** To excel at autonomy, a military must master the ‘digital triad’: software, data, and artificial intelligence (AI) / Machine Learning models. This is an area where the commercial sector (like self-driving cars) is vastly outpacing the military. For the RAAF to reach full autonomy, we must understand the Autonomy Government Reference Architecture (A-GRA) that prescribes the systems engineering of these systems, and leverage commercial innovations in edge computing and AI to do it, rather than relying solely on traditional, slow-moving military acquisition cycles.
2. **The cost of attritable mass.** The promise of CCAs is that they are ‘attritable’: low-cost enough that we can afford to lose them in combat. However, the reality is that the sub-systems in current prototypes are still expensive. A jet engine like the FJ-44 costs in the order of US$1 million. Ghost Bat, Gambit and Fury have all selected this engine. Exquisite sensors and missiles like the AIM-9X or AIM-120X cost hundreds of thousands, if not millions, of dollars each. Until we can drive these costs down through new manufacturing philosophies, true mass generation will remain difficult to achieve (Castrejon, 2024).
3. **The ‘Out-of-the-Loop’ ethical dilemma.** Moving from Level 4 (Semi-Autonomy) to Level 5 (Full-Autonomy) involves removing the human from the decision-making loop entirely. This raises profound ethical and legal questions, particularly regarding Lethal Autonomous Weapons Systems (LAWS). The tension between the military efficiency of a machine that can react faster than a human and the moral accountability of lethal force is acute. Without clear, internationally agreed frameworks, this remains a significant barrier to deployment.

## Prediction: The long game

So, when will the RAAF field a fully autonomous collaborative platform combat aircraft? History suggests we will need long game patience: It took 43 years for autonomous cars to move from a Japanese laboratory in 1977 to Waymo taxis in Arizona in 2020.

While the foundations for Autonomous Collaborative Platforms are maturing, the leap to full autonomy is significant. It requires a convergence of agile software, trust, regulatory reform, and cost reduction that simply isn't there yet. Recent research suggests that while we will see highly capable *automated* and *semi-autonomous* teams in the near future, the realisation of fully autonomous combat aircraft, with the cost structures to make them viable, is likely a challenge for the 2040s: it's a journey towards full-autonomy.

The RAAF is on the right path. Programs like the Ghost Bat demonstrate a commitment to sovereign capability and the Loyal Wingman concept. But to reach the destination, we must clear the fog of war, the fog of autonomy. We must be disciplined in our language, distinguishing strictly between the *automation* we have and the *autonomy* we seek: autonomy literacy is important. And we must acknowledge that this is a multi-decade journey. By understanding the technology readiness accurately, we can make better investment decisions, avoid the 'trough of disillusionment' of the hype cycle, and ensure that when the technology finally matures, we have the doctrine and social license to use it effectively.

The era of the pilot is not over, but the era of the pilot as a crewed-uncrewed team mission commander has just begun. Let's make sure we know exactly what we are commanding.

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