

Air Power

Building an Air Force for a Long, Big War

Peter Layton^{1,2} 

¹ Australian Defence Force, ² Griffith University

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Australia's 2024 National Defence Strategy warns of protracted major regional conflicts. Fighting such long, big wars requires modern air forces to have three important attributes that they do not currently possess. There are some alternatives to addressing the identified shortfalls but the preferred approach is adopting the heterogeneous air power model. This uses crewed aircraft, rockets, missiles and drones in coordinated, synchronised and collaborative ways to efficiently achieve operational objectives. To build such a new model air force will require changes in the Fundamental Inputs to Capability.

1. Introduction

Australia's 2024 National Defence Strategy (NDS) warns of the dangers of a protracted major regional conflict (Department of Defence, 2024). In such a conflict, the NDS envisages air warfare would be important. The Royal Australian Air Force's (RAAF) air elements could have a significant role but combat attrition could mean only for a disturbingly short time.

Modern air forces like the RAAF are designed and built around highly sophisticated, technically impressive, crewed combat aircraft. It is this homogeneity, where most of the important constituent parts are of a similar kind, that is these air forces' Achilles heel. Such aircraft take years to build and if lost cannot quickly be replaced. In a major war, crewed aircraft losses are more likely than not. The result is a peacetime air force that enters a major conflict would probably progressively decline in size and effectiveness. This well-known shortcoming now has a solution albeit with major implications for the building of air forces.

The aim of this article is to set out a new model for middle power air forces like the RAAF that is appropriate to fighting a protracted, major conflict. First, I outline the characteristics of long, big wars and three important attributes air forces need to have to fight them but which they do not presently possess. Second, I consider alternatives to addressing these shortfalls before settling on a plausible new model. Third, I explain how this new model addresses the shortcomings initially noted. Finally, I briefly sketch out how to build such an air force using the Australian Defence Force's (ADF) Fundamental Inputs to Capability framework.

Drawing on recent international law statements, the article defines air warfare as: military operations in armed conflict involving the use of aircraft or missiles of all types;

whether in offence or defence; and whether or not over the territory of one of the belligerent parties. (HPCR, 2013, pp. 8–11, 34).¹ Importantly, the article does not address possible concepts of operations for the new model air force. While some insights may be gleaned in the discussion following, this sizeable topic remains for another article to explore.

2. Fighting a long, big war

Peter Wallensteen, a leading researcher in peace and conflict studies, considers major wars have five distinct attributes. Major wars are waged by: (1) authoritarian governments that use highly disciplined, centralised armies to secure their survival; (2) they are fought by major powers; (3) involve developed countries; (4) are regional; and (5) have a global impact (Wallensteen, 2006, pp. 82–87). Such wars are accordingly large scale, intense and in arousing national passions involve, as Clausewitz noted, violence, hatred and enmity (Cole, 2020, p. 43). Implicit is that the militaries fighting such wars will use the more advanced technology of their era, and the states involved will be able to fully mobilise their populations and be able to extract substantial resources from their societies.

On the other hand, in preparing their armed forces, states can choose the length of a war they would prefer to fight depending on their resources relative to an adversary. While the desired length is a major pre-war strategic decision, it may be invalidated as the war progresses. In both World Wars, Germany sought to fight short, sharp wars believing the country lacked the depth and breadth of resources to fight a long war. Britain, considering its global empire gave it great mobilisation potential, based its strategies on the reverse.

¹ In the commentary referenced, 'Air or missile operations' is used as a generic phrase referring to any military airborne activities, whether by crewed or uncrewed aircraft (fixed or rotary wing), missiles, balloons, blimps or dirigibles.

Today, researchers in China's People's Liberation Army have noticed shortcomings in the United States (US) defence industrial base's ability to meet the demands of Ukraine in the Russia-Ukraine War. Consequently, they consider a protracted war with the US would favour China, the manufacturing powerhouse of the world. Moreover, it is argued that the margin of US technological superiority over China at the start of the war would steadily diminish as the war continued, as American combat losses would be unable to be readily replaced (Wang & Zakheim, 2025).

The last protracted major war that Australia and most nations fought was World War II (1939–1945). A future major war in the Indo-Pacific might again feature highly industrialised warfare similar to the European theatre of World War II while being fought mainly in a maritime environment as in the Pacific theatre during 1941–1945.

World War II's war in the air was mainly won through a process of attrition (Murray, 1983). The large, highly competent German air force and Japanese air arms at the start of the war were steadily worn down in combat and continued to be worn down even as their nation's aircraft production rates sharply escalated. It did not initially appear that way as the aircraft losses that Germany and Japan suffered in the first part of each of their air wars looked 'acceptable' given the results. However, aircraft losses also meant aircrew losses and their national training systems were unable to quickly replace them. Aircrew training was fast-tracked producing inexperienced personnel that meant ever increasing losses in both aircraft accidents and combat. For the German air force and the Japanese air arms, World War II was a long war of steadily accelerating decline (Overy, 1987, pp. 78–84). Attrition bit harshly, even when their forces were seemingly winning.

On the Allied side, air power proved central to victory across the many operational theatres, recognised at the time by their air forces generally receiving the largest share of their armed forces' funding (O'Brien, 2015, pp. 17–66). These were air forces built on a grand scale. Many tens of thousands of aircraft were built and lost, air forces expanded hugely in size and air battles often involved thousands of aircraft. Such large numbers of aircraft being built, used in combat and even lost are today not just unimaginable, but also arguably unattainable.

Modern crewed combat aircraft have remarkably long production times and low production rates. The highest production rate is America's F-35 production line that completes 13 new aircraft a month, almost 160 each year; however, a single F-35 takes 18 months to build (Waldron, 2024). Elsewhere, Europe's highest production rate is the Dassault Rafale with about three aircraft a month; building a single Rafale takes about 24 months (France 24, 2025; Meddah, 2012). The Typhoon rate is less at just over one aircraft each month, achieving 14 aircraft a year. A single Typhoon takes 36 months to build with an extra 12 months if the parts supply chain needs restarting (Martin, 2025; Osborne, 2020).

Ramping up these production rates in times of war seems to be solvable simply by creating many more production lines when needed but this in itself would take years.

In World War II, the average time between starting to build an airframe plant and full rate production was 31 months; for aeroengines it was 23 months (Overy, 1987, pp. 90–96). Modern aircraft and engines are much more complicated suggesting even longer times today. Any new aircraft and engine factories set up during a major war would be unlikely to be making useful quantities until well after the war's outcome was decided.

All this means that attrition losses would be hard to quickly make up. However, accurately estimating attrition before a conflict is inherently problematic given the large number of variables. During World War II, the US Army Air Force alone lost dozens of aircraft a day, more than a 1,000 a month (Peck, 2020). More optimistically, in a modern major air war an attrition rate of say only 2% per day might be experienced; that is, 98% of a force would survive each day. Some are more pessimistic albeit using a different basis. A recent Taiwan contingency study assumed an attrition rate of 5% per encounter between Chinese and American crewed combat aircraft (Cancian et al., 2025).

Attrition adds up. Even using the lower 2% daily rate, a nominal 100 aircraft-size combat group would be reduced to half its size in just over a month. This rate would need four of today's F-35 production lines to indefinitely sustain the nominal numbers; the higher World War II average attrition rate would require more than 75 production lines.

Crewed aircraft attrition rates in a major war when set against low production rates implies an air force's crewed aircraft fleets might not recover until post-war. Changes need to be made to ensure modern air forces can stay in the fight in a long, major war. For this, air forces would need to be as they were in World War II: able to quickly recover from losses, able to be rapidly expanded on demand, and of a significant size. In three words: **resilient, scalable and large**.

3. What can be done?

There are some ways to address today's air forces being ill-suited for fighting long, big wars. Countries could attempt to avoid big wars, however such wars are generally forced on them by aggressive authoritarian states. Ukraine did not choose war but had it imposed on it by Russia's expansionism.

More subject to agency is avoiding long wars. During the Cold War, there was a belief that Soviet armies in a war could rapidly overrun Western Europe. War plans assumed there would be a short opening phase involving conventional forces, quickly moving on to a large scale thermo-nuclear exchange. Air forces were accordingly designed for intense short-duration operations with no provision made for expanded production in wartime as the war would be over very quickly. The nuclear weapon solution has obvious shortcomings. Fighting a long war may be a poor choice for air forces but is arguably much better than a war drastically shortened by nuclear warfighting.

On the other hand, concerns can be ignored by simply assuming zero attrition, as the Israeli Air Force almost achieved in its 12-day war in June 2025 with Iran; only eight drones were reportedly apparently lost (Malyasov, 2025; Saab & White, 2025). This replicated the air force's success

in June 1982 over Lebanon (Grant, 2002). However, these two short air wars between ill-matched opponents may not be a good guide to long, big wars between major powers. Moreover, Israel in choosing when to start the war was able to fight to its schedule and strategy; this allowed considerable optimised preparation to be undertaken to maximise avoiding crewed aircraft attrition.

An air war involving an aggressive major power may be considerably more difficult. US think tanks studying Taiwan contingencies instigated by China have determined losses of US crewed combat aircraft in their hundreds (Cancian et al., 2025). Military preparedness for a future major war should include the likelihood of aircraft attrition. Not to do so appears militarily unwise and most imprudent, given the nation's survival may depend on not losing the conflict.

If the possibility of a long, major war exists, an option is to double down on crewed combat aircraft, accept attrition will occur and instead build very large air forces in peacetime. These would be sized to last the several years a protracted major war might last given quick recovery from losses is unlikely. Problems with this approach include very high acquisition costs, large infrastructure requirements, substantial continuing skilled workforce demands and high ongoing operating costs.

Unexpectedly, a more viable solution to the crewed combat aircraft problem is being developed and demonstrated in multiple current conflicts involving non-Western forces. The poster child is Russia's long major war against Ukraine. In the war's early months, both the Russian and Ukrainian air forces suffered high attrition rates that were unsustainable. Both air forces needed to quickly change to remain not just useful but also to avoid extinction. Consequently, the two air forces hurriedly moved to carefully husbanding their remaining crewed aircraft while embracing the heterogeneous air power model where rockets, missiles and drones take on significant roles.

If traditional air forces were homogenous, the heterogeneous air power model is instead characterised by most of the important constituent parts being of a dissimilar kind. The heterogeneous model makes tangible an observation made by the recent Vice Chief of Staff of the US Air Force. General James C. Slife discerned that there was a growing realisation that 'We must not allow ourselves to be "affixed by our prefix", only seeing the future fight through the lens of our past platforms. If it operates in the air domain, it is airpower' (Slife, 2024).

Heterogeneous air power continues trends established early last century. In earlier wars, military forces were arranged in a linear, barrier fashion and directly engaged the front of the other fighting force and vice versa using weapons such as swords, crossbows, pikes and, later, muskets. World War I however saw technological developments that allowed firepower to be applied indirectly, well into armies' rear zones behind the front, initially with artillery but then extending into airpower. Warfare shifted from a two- to a three-dimensional fight, and the battlefield bifurcated into notions of the close and the deep battle (Bailey, 2001, pp. 132–153).

This deep battle has now grown to be certainly regional and potentially global but it is a deep battle with different connotations to land forces' combined arms concept. Traditionally, combined arms involves the use of different elements of land combat power to support ground manoeuvre and closing with the enemy (Jensen & Strohmeier, 2022). Implicit in this are command and control arrangements where the local land force commander prefers to 'own' all the various arms, whether artillery, tanks, infantry, helicopters or crewed close air support aircraft (House, 1984).

In contrast, heterogeneous air power applies power across the tactical, operational and strategic levels of war. It is firepower warfare rather than manoeuvre where battlespace mobility dominates thinking. Firepower warfare is instead characterised by extensive synchronisation and planning, centralised command, risk minimisation, focus on the enemy's main strength and destruction by fires (Raymond, 1992, p. 17). Moreover, and arguably a historically new development, is that much of heterogeneous air power is uncrewed. These are not similar to say artillery shells of earlier times as these uncrewed systems generally each incorporate precision and can often locate targets independently.

The shift towards the new heterogeneous air power model is now arguably dominating contemporary air warfare. Over the past few years, an extraordinary diversity of air systems has been used in conflicts involving Ukraine, Russia, India, Pakistan, Israel, Iran, Hezbollah, the Houthis and Hamas (Borsari, 2025; Clary, 2025; Layton, 2025b).

The new model was well illustrated in the six-week period from early May to mid-June 2025. Across this period, the Houthis continued periodically launching ballistic missiles and drones at Israel some 1,600 km distant, even while Israel undertook significant retaliatory crewed aircraft strikes in response. The Houthis' attacks – amongst the longest-range ballistic missile attacks in history – were mostly defeated by Israel's integrated air and missile defence (IAMD) systems (Al Jazeera, 2025b; Mizokami, 2023).

Early in May 2025, a brief air war erupted between India and Pakistan. This involved subsonic and supersonic cruise missiles, glide bombs, a variety of drones, surface-to-air missile (SAM) systems, ballistic missiles and long-range air-to-air missiles. Crewed aircraft were also used but remained in their own national airspace. Around the same time, two Russian Su-30 fighter jets were shot down in Russian territory by a Ukrainian uncrewed surface vessel off the coast that fired modified air-to-air missiles (Newton, 2025).

By late May, Russia was regularly launching hundreds of drones and comparatively smaller numbers of ballistic and cruise missiles in night-time attacks on Ukrainian cities (Hunder & Mason, 2025). Many were defeated by Ukrainian hard and soft-kill air defence systems. Reversing this, in the last week of May, Russia claimed to have intercepted more than 2,300 Ukrainian drones (Al Jazeera, 2025a).

By then, Ukraine was creating a so-called 'drone wall' to defend against Russian ground forces and prevent their advance. The wall includes counter-drone systems, drone interceptors, drone mining systems, radars and electronic

warfare, and is supported using robotic logistics delivery systems (Velhan, 2025). In early June, Ukraine used 117 drones in a covert attack on airbases deep in Russian territory destroying or seriously damaging some 20 strategic bombers and other aircraft (Strategic Studies Department, 2025).

Finally, in mid-June 2025, Israel launched large-scale air operations against Iran using crewed combat aircraft, air-launched ballistic missiles, cruise missiles, short-range drones, long range/high endurance drones and glide bombs. Iran responded by firing more than a thousand ballistic missiles and drones against Israel; most were defeated by the IAMD and crewed fighter aircraft. This 12-day war, and the Houthis conflict, were most unusual in being almost totally fought in the air. The protagonists did not share a border, making long range air warfare the primary method of waging war.

In considering this busy six weeks in mid-2025, it is evident that heterogenous air power can employ very large numbers, certainly hundreds of elements at a time and sometimes thousands. These are numbers unimaginable with present day crewed combat aircraft and, as the earlier discussion of production rates and times revealed, now unachievable. Relying on crewed combat aircraft alone is no longer enough.

4. Resilient, scalable and large

The heterogenous air power model can address the problems inherent in the long manufacturing times and slow production rates of modern crewed combat aircraft. An air force with its capabilities distributed across crewed aircraft, rocket, cruise and ballistic missiles, and drone systems can be resilient, scalable and large. This model could allow air forces to fight long, big wars.

Resilience involves the speed of recovery from attacks and reducing their impact (Minister of Civil Defence, 2019). Major war attrition rates when combined with low crewed aircraft production rates means an air force's air combat force would steadily decline. Today's air force model built around hard-to-build crewed aircraft is inherently not resilient.

In contrast, the production rate of rockets, missiles and drones is considerably higher than for crewed aircraft. As an example of the relative rates, Russia each month makes about 2 crewed combat aircraft, some 50 Iskander ballistic missiles, 100 cruise missiles, 500 Shahed drones and more than 300,000 First Person View (FPV) drones (Bint & Hinz, 2025; Kovalenko, 2025; Nikolov, 2024; Watling & Reynolds, 2025).

The counter argument is that crewed aircraft are reusable. Rockets, missiles and drones are generally one-use items. In a major war, however, production rates make up this difference. Crewed aircraft, rockets, missiles and drones will all be consumed in a war but only rockets, missiles and drones can have production rates able to keep up with usage rates. A force structure of rockets, missiles and drones is resilient in being able to recover losses; a force structure solely composed of modern crewed aircraft is not.

Furthermore, resilience also includes reducing the impact of attacks. Crewed aircraft and their airbases are difficult to protect as the adoption of agile concepts that aim to widely disperse crewed aircraft recognise (U.S. Air Force, 2022). By comparison, attacks on rocket, missile and drone elements are likely to have less impact as there can be much greater numbers of them to engage, they can be mobile, they are easier to conceal and widespread dispersal is easier.

The heterogenous model also offers scalability. The higher production rates of rockets, missiles and drones allow a much quicker force expansion than is possible with crewed aircraft. An extreme example is FPV drones; one Ukrainian manufacturer is producing 4,000 a day with the country overall making 5 million annually (Fornusek, 2025). Such extraordinary rates are possible using digital technology, fourth industrial revolution techniques and production being distributed across some 150 companies.

Moreover, combat aircrew typically take years to train so that even if large numbers of appropriate aircraft were suddenly available they might be unusable. Learning to operate and maintain rockets, missiles and drones is shorter with FPVs again an extreme example: courses run by accredited commercial operators train Ukrainians to use combat FPVs in 35-37 days (WeTrueGun, 2025).

More broadly, the considerable variation in the production rates of crewed aircraft, rockets, missiles and drones has impacts when an air force rescales. A heterogeneous force structure will have highly differential velocities of expansion with the balance across the force varying almost daily. Such a force gains scalability although at the cost of constant change in what that force materially comprises.

This constant change in force structure could become even more intense given heterogeneous air forces can readily undertake continual innovation. Innovations in uncrewed systems are inherently simpler to achieve and generally more affordable than for crewed aircraft because, with no risk to crews, there are far fewer safety requirements. Innovations in uncrewed systems can be frequent and ongoing. In the Russia-Ukraine War, there is now a three-month innovation cycle of prototyping, experimenting, testing, mass producing and then fielding drones (Molloy, 2024, pp. 57-60). In contrast, it takes several years to introduce innovations into modern aircraft; an exemplar is the many years being taken for the Block 4 upgrade to the F-35 (Decker, 2024).

Lastly, using a heterogeneous force structure air forces can employ mass, that is, large numbers of elements. Just in the first two weeks of February 2025 alone, Russia deployed over 7,500 FPV drones to the frontline and on one day used over 1,000 (Espresso, 2025). Away from the battlefield, Russia's strategic air campaign against Ukraine also reveals the possibilities. On the night of 8/9 July 2025, Russia used some 740 attack drones, decoy drones, cruise missiles and ballistic missiles. Remarkably, it is expected Russia will shortly be able to routinely launch some 1,000 drones per strike package (Harvey et al., 2025).

These numbers would be inconceivable using only crewed aircraft. Moreover, such large heterogeneous air at-

tacks use relatively little infrastructure compared to what an all-crewed aircraft attack would need. Modern air combat aircraft require airbases and airfields of varying sizes. In contrast, drones and ballistic missiles require much smaller launch systems and these can be dispersed widely. A heterogeneous force structure imposes much less demand for specialised infrastructure than the traditional crewed aircraft air power.

Significantly, the mass employed is not necessarily all of one kind or type of element. A heterogeneous air force can include multiple diverse constituent elements, each optimised for specific tasks.

Most future air wars are now likely to involve well-coordinated, large-scale heterogeneous air operations behind and at the frontline, during air interdiction missions and in deep air attacks. Such operations would be designed to combine the defensive and offensive capabilities of multiple crewed aircraft, rockets, missiles and drones to most effectively overcome hostile air forces and inflict the necessary damage. An important concern would be managing the crewed aircraft loss rate given their replacement may be both difficult and time-consuming. This management would involve prudently weighing up the likelihood of attrition against operational needs, and a desire to continue operating them as long as practical.

The combination of crewed aircraft, rockets, missiles and drones can destroy almost all types of targets. Given this, two factors will drive air warfare: accurately locating targets and deceiving adversary forces to avoid being targeted. To address these factors the heterogeneous air force design brings an incredible variety of operational and tactical level possibilities; crewed aircraft can provide human 'forward air controllers' at the battle's edge to direct uncrewed systems operating deep, while these uncrewed systems can be as diverse as the needs require (Dahm, 2025). Such air forces can exploit their resilience to prudently discount the impact of attrition, use scalability to be as large as necessary at the times the war requires, and use mass to overwhelm the defences to devastate air, land and maritime target sets.

The air forces that undertake these heterogeneous air operations will be remarkably dynamic in actively balancing across the many diverse capabilities, having constantly changing numbers of force elements available, and featuring embedded innovation. To build such air forces will require changes in what the ADF terms the Fundamental Inputs to Capability (FIC) (Department of Defence, 2025). These are ten defined capability elements or inputs that when purposefully combined could create, sustain and continually remake a heterogeneous air force.

5. Building a heterogeneous air force

5.1. Organisation

Air forces today rarely change organisationally. Given the long in-service life of their crewed combat aircraft, the organisational structures and competencies of traditional air forces can be set and forgotten about for several decades until a new aircraft type is acquired. However, a

heterogeneous air force would be continually changing to meet strategic and operational needs. This would particularly be the case for the rocket, missile and drone elements of the heterogeneous air force, although some believe crewed combat aircraft with new open software may also become more adaptable to new conditions (Dahm, 2025).

The organisations that comprise a heterogeneous air force would need to be designed to be adaptable to quickly respond to rapid changes in the multiple diverse capabilities added, improved, degraded, lost or removed from service. These organisations would need to be more aware of their internal states than presently and, unlike in traditional air forces, be constantly looking ahead to influence production types, rates and timings. Rapid organisational learning would be an imperative.

5.2. Command and Management

The inherent complexity of the heterogeneous air force design with its diverse capabilities favours the mission command approach of centralised command, distributed control and decentralised execution (U.S. Air Force, 2023). Current conflicts, including the Russia-Ukraine War, have highlighted that adversaries will deliberately attack command and control structures and systems with numerous hard and soft-kill weapons. Moreover, in a future major war involving the great powers, there is likely to be a considerable focus on shattering the adversary's battle networks (Layton, 2023). Heterogeneous air forces will need to function within a harsh and hostile command and control environment.

In a technology sense, the inherent complexity noted earlier favours assisting command and management through the use of artificial intelligence (AI). In this, the use of Lavender by Israel in the Gaza War and Ukraine's use of Delta indicates the usefulness of agentic AI in the relational and networked staff approaches respectively (Layton, 2025a). This experience suggests the preferred approach for heterogeneous air forces is the adaptive staff approach with its feedback loop and context input by human staff. This approach is resilient when attacked, best leverages real-time monitoring of the battlespace, allows rapid plan adjustment and dynamic force reallocation, and can incorporate own force preparedness data, logistics aspects and estimates of hostile force actions (Jensen & Strohmeyer, 2025, pp. 10–13, 33–38). While not preferred, networked staff could be a viable option and has the advantage of being combat proven.

5.3. Personnel

The diversity of capabilities presents training difficulties in terms of achieving economies of scale; many small training facilities would be a challenge to sustain from a workforce perspective. However, as noted for FPV drones, some drone and missile training may be able to be much more quickly undertaken than that needed for personnel involved with crewed combat aircraft. Moreover, using the AI adaptive staff approach could flatten command and management structures reducing the workforce size.

An issue would be having sufficient personnel to move seamlessly to 24/7 operations when necessary. Rocket, missile and drone forces may in peacetime involve relatively few personnel as the work required would be mostly sustainment. However, the advent of conflict may quickly necessitate large numbers of warfighting personnel. In this case, there may be a role for reserve personnel available and trained to quickly supplement permanent staff. Reserve personnel involved in the rocket, missile and drone elements of a heterogeneous air force may be able to make extensive use of virtual training in locations remote to the actual equipment.

In general, the focus in a heterogeneous air force would be on having small numbers of skilled personnel albeit with the balance within this favouring support personnel more than operational personnel. Automated uncrewed systems can be operated by small numbers of personnel but require sophisticated technical support to sustain functioning.

5.4. Collective Training

The heterogeneous air force is well suited to the emerging high fidelity networked simulation technologies and computer-generated wargames (Jung, 2024). Diverse capabilities can be synthetically used together and the overall force virtually exercised.

On the other hand, the end-to-end testing of equipment and concepts that occurs in real-world collective training is much harder. Rockets, missiles and drones may be only rarely launched and then under tightly controlled, test range conditions. Consequently, it will be difficult to validate whether the whole force can work together without some damaging interference between the various elements. This becomes even more challenging given the dynamic, always evolving nature of a heterogeneous air force. The first time the whole force might be tested, evaluated and verified might be in a war and that verification might only be valid for a short time. Until then, the performance of a heterogeneous air force will only be known to the level the quality of the simulation and wargaming modelling allows.

5.5. Major Systems

A heterogeneous air force by design is balanced across crewed aircraft, rockets, missiles and drones. Its resilience, scalability and ability to generate mass depends on getting this balance appropriate for the war being fought. Britain's latest strategic defence review offers a useful way to think about this. Using its 20-40-40 conceptualisation, 20% of combat power might come from crewed aircraft, 40% from expendable autonomous systems such as rockets and ballistic and cruise missiles, and the remaining 40% from reusable assets like drones (Wharton, 2025). This construct highlights that current homogenous air forces would need to shift to embrace lower cost air systems able to be rapidly produced at scale.

For example, the RAAF operates four Tritons (five from 2028), arguably the world's most sophisticated and expensive uncrewed system, and is buying fewer than ten of the highly capable MQ-28 Ghost Bat. These are high quality

drones but can only be afforded in strictly limited numbers. Moreover, in being highly sophisticated there are similar issues to crewed aircraft in terms of slow production rates and long production times. Using the British 20-40-40 conceptualisation, Triton and Ghost Bat will not constitute the 40% of the force mix allocated to drones, only a small fraction of it.

Heterogeneity can tolerate using less sophisticated elements providing these can be acquired in very large numbers. Iran has long done this, allowing Russia to leverage the Iranian Shahed drone design and manufacture large numbers for its war against Ukraine (Layton, 2025b). Between 2022 and June 2025, Russia had launched almost 29,000 Shahed drones at Ukraine (BBC Monitoring, 2025).

In building a heterogeneous air force, an emphasis should be placed on designing simplified missiles and drones that can be mass produced quickly and at low cost from readily available local materials and components. Being able to rapidly scale up heterogeneous air power to meet urgent strategic and tactical demands arguably requires adopting such an engineering philosophy. Interest in such an approach is growing.

The US Air Force is funding the Rapidly Adaptable Affordable Cruise Missile (RAACM) project (CoAspire, 2025); and Ares Industries, Anduril and Lockheed Martin are developing low cost, quick-to-make cruise missiles. Russia is already using the comparable 250 nm range Banderol cruise missile (Newdick, 2025).

Simplification, however, implies accepting a reduced operational performance including having lower reliability drones, rockets and missiles. Even so, fielding a cruder form of air power can still be effective, as Houthis' success in attacking Red Sea merchant shipping demonstrated.

5.6. Facilities and Training Areas

A heterogeneous air force requires a diverse facilities set: some complicated and expensive; others simple and affordable. As an illustration, crewed aircraft require large functioning airbases whereas many missiles and drones might be easily stored for years in hardened warehouses. There is a distinct lack of facilities commonality across the various aircraft, rocket, missile and drone elements.

This shortcoming extends to training areas. Rockets and missiles will usually require tightly controlled instrumented ranges. Drones may have significant constraints on their usage to avoid hazarding civilian crewed aircraft traffic. Crewed combat aircraft have fewer flight limitations but, to maximise the training value of each sortie, should work in an electronic warfare environment that may be classified and adversely impact non-military airspace users.

5.7. Data

The adaptive staff agentic AI command and management approach relies on the various elements of the heterogeneous air force all being able to share and integrate secure data. There should only be a single data view, even if the data is stored across multiple disparate systems. Good data hygiene would be crucial; the data needs to be clean,

that is, mostly error free. In contrast, dirty data includes redundant, erroneous and incomplete data, and outdated information. A heterogeneous air force would need to have sophisticated data strategies that address data availability, collection, hygiene and governance.

Of note is that the task of cleaning data needs human involvement. Data-cleaning tools can expedite the task by automating many processes. However, these tools are not autonomous and require column-by-column guidance by a skilled data scientist. More complex issues that arise during data cleaning as a result of unknown unknowns tend to be unique to each dataset and, therefore, not well suited for automated tools. Data scientists with experience in specific datasets may be required (Lingel et al., 2020, pp. 37–38).

5.8. Support

From a support perspective, the context in which a heterogeneous air force will operate is dominated by avoiding being targeted. The traditional airbase used by crewed combat aircraft is increasingly vulnerable to rocket, missile and drone attack as these weapon systems proliferate widely. The necessity for basing agility during war now drives support requirements and practices. However, this is inherently problematic for crewed combat aircraft given their maintenance needs and consumables demands, especially for fuel and weapons. Sortie generation rates can drop off albeit attrition from hostile action is also reduced.

On the other hand, rockets, missiles and drones can operate from widely dispersed locations. Their support requirements are quite varied. Rockets and missiles can be all-up rounds that are boxed until use or needing to be returned to a distant maintenance facility for testing and rectification if necessary. However, the launchers that rockets and missiles use can be bulky and difficult to move. For example, a single Patriot SAM battalion, with its radars and four batteries, took 73 C-17 flights to be deployed from a Pacific base to the Middle East (Epstein, 2025). Similarly, drone support varies greatly; small FPVs can be hand-launched while Triton needs a major airbase.

5.9. Supplies and Industry

These two Fundamental Inputs to Capability (FIC) have considerable conceptual overlap as they relate to heterogeneous air forces. As noted earlier, the loss rates of crewed aircraft would need to be judiciously managed as they are effectively irreplaceable. In contrast, the production rates and the types built of rockets, missiles and drones would be constantly adjusted to meet the war's changing demands. Folded into all this is the need for continual innovation.

In the Russia-Ukraine War, both sides co-evolved hoping to get a combat edge; this was achievable because of the technology used. In general, uncrewed systems are inherently easier to develop and then manufacture at large scale than crewed combat aircraft. Rapid innovation is both possible and necessary in the context of a major war with both sides using the heterogeneous air force model.

Importantly, this innovation would need to be in quick-to-make systems that ideally use locally made components.

Most contemporary missiles are high performance but slow to manufacture. For example, Australia's new Naval Strike and Joint Strike Missiles factory will have the capacity to assemble only up to 100 missiles per year from Australian and imported parts (Australian Defence Magazine, 2022). Similarly, the Ghost Bat is high performance but not necessarily quick to make and uses some imported components whose availability may be determined by other nations, not Australia's needs.

In a major war, the nation's defence industrial base would need to have been prepared for continual innovation and quick-start mass production before the peacetime force structure was lost. Such preparation would rely entirely on government funding. Commercial companies do not invest in building factories to be on standby just in case a need for them arises at some future time. In peacetime, there would be a trade-off between using defence budgets to acquire new force structure or instead to prepare the defence industrial base.

Such preparation might include government owned/government operated facilities being established in peacetime to develop new innovative rocket, missile and drone designs to a level that they can be quickly manufactured. As the government would own the intellectual property, in a war these designs could be easily passed through to pre-arranged manufacturing facilities equipped to mass produce. This approach could meet peacetime needs, provide relevant industrial experience and allow rocket, missile and drone inventories to be gradually built up. However, the approach would be unlikely to provide the scale or breadth of new capabilities as swiftly as a major war might demand.

To address this, government-owned/contractor-operated facilities could also be established pre-war and run by selected private companies to develop innovative technologies. These companies might further use government funding to build suitable dormant mass production factories capable of quick activation to manufacture the innovations the companies have devised. Importantly, both the government and contractor-run facilities are likely to need extensive use of subcontractors.

A problem in this mix of methods is operating in the context of ongoing rapid innovation and fast design change. The network of facilities involved would need to be established years before a conflict to have the processes, subcontractors and skilled staff in place to allow a quick startup. Easing this somewhat is that the production is probably of light-weight small items, rather than large platforms. Small facilities may be able to exploit additive printing, precision machining, composite fabrication and rapid production refreshes to very quickly meet new operational demands.

6. Conclusion

The heterogeneous air force model is not a simple one. It adds rockets, missiles and drones to the traditional crewed combat aircraft model which is already at the leading edge of technology. However, the technologies used in rockets, missiles and drones are well-known. Moreover, implementing the heterogeneous air force model both makes possible,

and is enhanced, if the rocket, missile and drone designs are simplified, quick to manufacture and affordable.

Heterogenous air forces are not defined by a single piece of equipment: the crewed aircraft. This may trouble traditionalists but the requirement to be able to fight a protracted major war kills old ideas about air forces and air power. In such a conflict, modern crewed aircraft simply take too long to build and this inflicts serious operational deficiencies. To overcome these obstacles, air forces facing the prospect of fighting long, big wars need to become able

to quickly recover from losses, be rapidly expanded on demand, and possess large numbers ready for use. You may not like heterogenous air power but as Margaret Thatcher declared about capitalism: 'there is no alternative.'

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