Towards a "boutique Air Force"

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downsizing the RAAF

An F-111 streaks across the Canberra skyline during a recent torching flypast.
Photo: Dept of Defence

Defence Minister Robert Hill has announced that Federal Cabinet had accepted a case put by the Department of Defence to retire the F-111 fleet from 2010 onwards, essentially without replacement. A gap filler capability comprising a standoff missile on the F/A-18A and AP-3C Orions was presented as the alternative until the F-35 Joint Strike Fighter is acquired.

This represents the most radical downsizing in RAAF firepower seen since the post World War II demobilisation and raises a series of very important questions about where Australia is heading longer term in firepower and strategic posture, and where it is putting its priorities in force structure development. This analysis will focus on the arguments supporting this decision and identify key incongruities.

The decision

The announcement to retire the F-111 fleet capped off a three-year campaign pursued by F-111 opponents within the Department of Defence to remove the platform from the force structure as soon as possible. The announcement was presented as part of the briefing on the Defence Capability Review conducted this year.

The central thesis of the argument presented is that the F-111 is perceived to be old thus presenting a risk of an unspecified catastrophic structural fatigue problem, which would ground the fleet permanently. The F-111 is also perceived to be a system that will become significantly more expensive to maintain over time. The strategy is to put a shorter-ranging cruise missile such as the AGM-158 JASSM on both the F/A-18A and AP-3C and, by supporting the Hornet with the 4 or 5 new tankers substitute the capability provided by the F-111 until the Joint Strike Fighter is delivered. The trigger point at which the F-111 could be withdrawn from service is thus likely to be attainment of Initial Operational Capability (IOC) on the second generation standoff weapon, and the replacement aircraft for the Boeing 707-338C tankers.

The 2010-2015 timeline discussed in the briefing does not fit the stated model for the phase out criterion. Weapons like the JASSM are very easy to integrate - they are not unlike a large Harpoon in delivery method, and supporting software in the aircraft is relatively simple. Therefore, an IOC for a weapon like the AGM-158 JASSM in RAAF service could be as early as 2006 to 2008. The IOC for the replacement tanker was originally intended to be 2006, with slippages perhaps 2008. Therefore the likely outcome would be that the F-111 would be withdrawn earlier than 2010, perhaps as early as 2006. The initial leaks to the press over this matter proposed 2006 as a withdrawal date, and it is not unreasonable to conclude that this is the actual target withdrawal date for the F-111. With allowances for slippage in the gap fillers, any date post 2006 is possible.

The strike capability gap

In terms of the capability to deliver raw firepower the F-111 typically performs the work of two F/A-18A Hornets and about one half of a supporting medium sized tanker. The F-111 fleet provides around 50 per cent of the RAAF's total strike firepower. Therefore, any gap filler must double the firepower available once the F-111 fleet is removed from the force structure.

Assuming that Hornets are employed and there is no demand for any air combat activity, this argument essentially asserts that the proposed gap filling measures will permit a doubling of the total firepower deliverable by the F/A-18A fleet. It has been argued publicly that this aim can be achieved by a combination of integrating JDAMs on the F/A-18A, fitting a weapon like the JASSM on the F/A-18A and AP-3C, and supporting the F/A-18As with tankers.

The notion that the AP-3C armed with a JASSM or similar weapon presents a credible strike capability is also unsupportable. The survivability of the AP-3C in a regional environment where most nations would probably be flying the Su-30 or Su-27 is very poor. In practical terms the AP-3C idea would result in a very high probability of AP-3C aircraft being destroyed in combat.

If we assume 20 AP-3Cs wholly committed to strike operations, each carrying four JASSMs, the 200 KTAS class cruise speed indicates that at best such a force can deliver firepower equivalent to 10 F-111s, each armed with four JASSMs, each JASSM with half the warhead size of a GBU-10/24/31. The F-111 can sortie, launch, return and reload at twice the rate of the AP-3C simply because it cruises twice as fast. Even without opposing interceptors and assuming the AP-3C fleet is needed for nothing else but strike sorties, in numbers alone the AP-3C is not a viable gap filler. We can surmise that the DoD used weapon count on the AP-3C as a key part of their force structure analysis, but forgot to apply the fourfold scaling factor required to adjust for the 50% reduction in warhead size and 50% lower delivery rate. It is worth noting that fighter escorts flown to protect the AP-3C would eat up the RAAF's planned tanker capacity, as a result of which use of the AP-3C would divert F/A-18As away from strike sortie.

Given that the AP-3C provides little more than a paper capability for strike operations, the next question which arises is whether the strike capability of the F/A-18A fleet can be effectively doubled, and if so by what measures or means.

The Hornet is also limited by its small size. Long range over water operations supported by tankers will require that the aircraft carry two or three 480-gallon drop tanks to provide a safe fuel margin for diversions. In practical terms this limits the aircraft to a pair of 2,000 lb class weapons, be they bombs or JASSM class standoff missiles.

In terms of raw numbers of weapons deliverable, the whole inventory of 72 Hornets equates in carriage capacity to 36 F-111s (F-111s have no difficulty in carrying four large weapons). Regardless of available tanker capacity to support the F/A-18A fleet, in raw numbers of aircraft, the F/A-18A fleet simply cannot double its strike capability. Physics cannot be escaped.

Long-range strike capability is bounded by the number of tankers and their size. If the preferred twin-engine tankers are to be acquired, at the very best five aircraft will support between 20 and 30 Hornets, equivalent to between 10 and 15 F-111s. However, tactics dictate that at least one-third of the package will be armed and loaded as an escort CAP. Therefore, the reality is closer to an equivalent 7 to 10 F-111s, which is a small fraction of the existing capability in the F-111 fleet.

US Navy F/A-18 Hornet carrying a Joint Direct Attack Munition (JDAM)

This argument will also apply to the Joint Strike Fighter, should it be eventually acquired. While it should achieve some range advantage over the F/A-18A as it carries its pair of 2,000 lb bombs and extra fuel internally, it will demand similar amounts of tanker support. The proposed extended range JSF using the larger Navy CV JSF wing and a fuel tank filling one bomb bay essentially delivers 25 per cent of the effective firepower of an F-111 to achieve an 800+ nautical mile unrefuelled radius - in effect four JSFs to replace each F-111 but demanding a little less tanking than the standard JSF.

Other metrics such as throw weight, widely used in arms control negotiations, also indicate that the loss of the F-111 will effectively halve the RAAF's punch. Without tanking factored in, a basic throw weight analysis indicates the loss of the F-111 reduces throw weight by 62.5%, and factoring in 5 tankers, a 56% reduction.

The assertion that "no strike capability gap existing post F-111" is not supportable by fact. At best, a fraction of the F-111's capability can be replaced, and only by diverting F/A-18As away from air defence tasks. The AP-3C armed with a standoff weapon is for all practical purposes unusable in the regional environment since the arrival of the Sukhoi fighters.

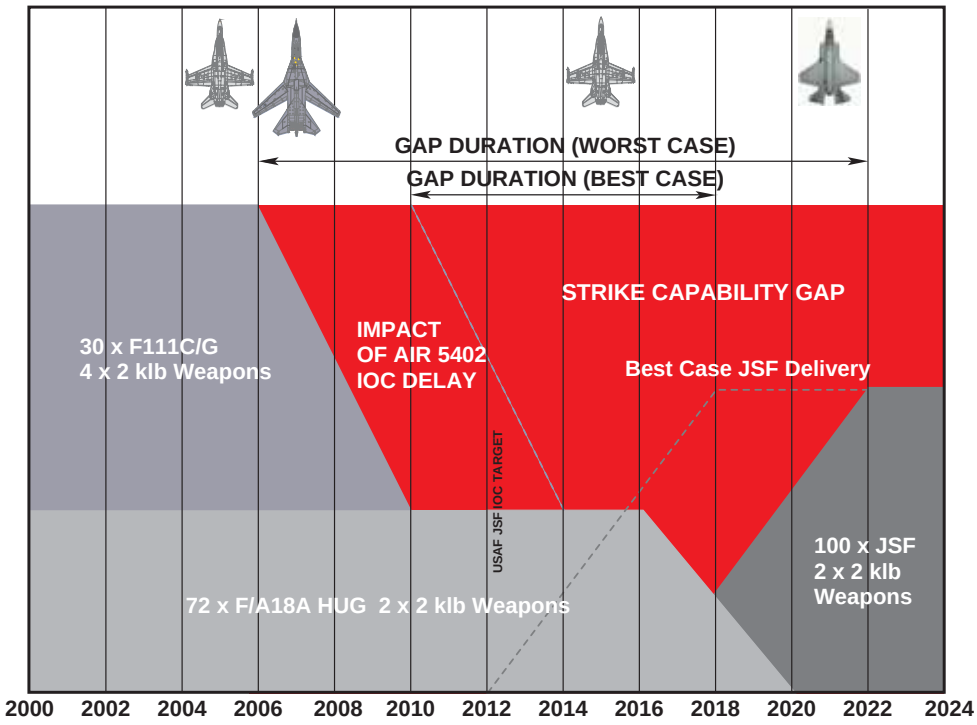
Removing 50 per cent of the RAAF's striking power cannot be explained away by any amount of sophistry.

Given that Indonesia is likely to end up with something between 16 and 50 Su-27/30s by the end of the decade, the prospects are very good that Indonesia will achieve effective parity with Australia in strike capability once the F-111 is gone. The F-35/JSF will provide only an incremental improvement over an equivalent number of F/A-18As, and at least 130 JSFs would be required to match the raw firepower of the RAAF's current F-111/F/A-18A force mix.

With the prospect now of the US Air Force cutting JSF numbers to pay for more F/A-22As, the resulting cost impact is likely to drive down the number of JSFs the RAAF could acquire and thus the intended 100 JSFs are unlikely to fit into the currently planned budget. If the basic cost of the JSF creeps up this will be exacerbated.

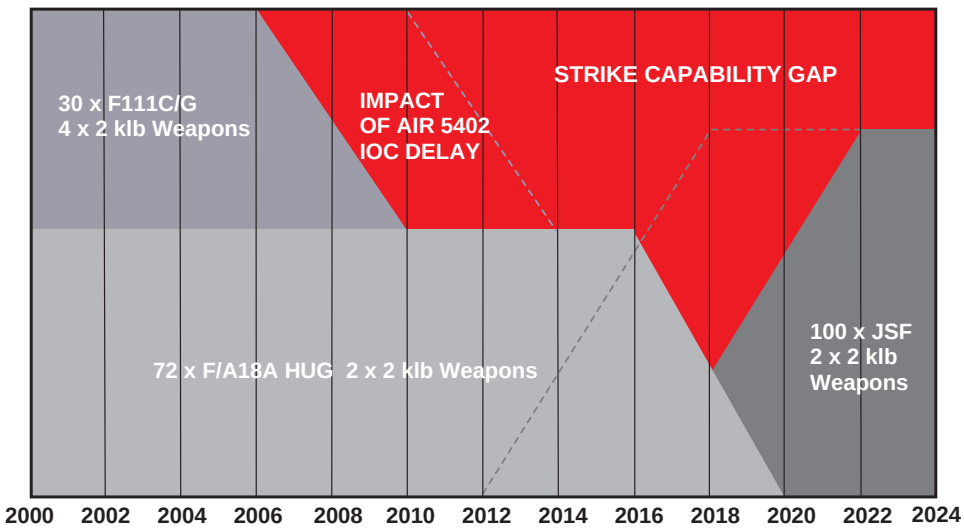
The use of smaller fighters supported by tankers typically costs 60 to 80 per cent more in raw operational expenses, compared to the use of the F-111 for the same tasks, further driving up operational costs longer term.

The argument about the increasing fragility of F-111 capability, the



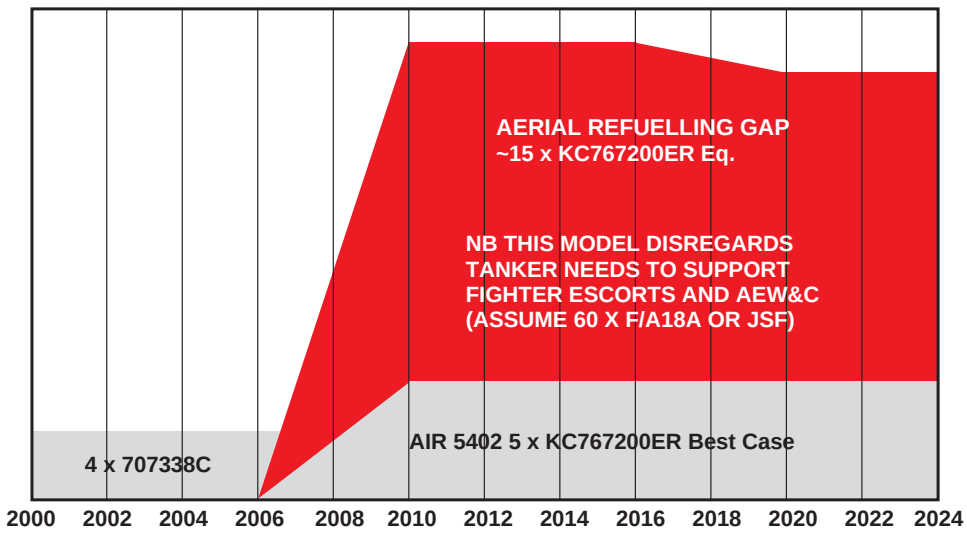
RAAF NORMALISED THROW WEIGHT

(Throw Weight = [Weapon Count] x [Combat Radius])



RAAF NORMALISED FIREPOWER

(Firepower = [Weapon Count per A/C] x [Number of A/C])



AERIAL REFUELLING TANKER GAP

(Number of tankers to offset F111 loss disregarding DCA/OCA CAP needs)

The age and cost arguments against the F-111

aircraft's age and the suggestion that it will be a very high cost platform to maintain are also open to question in the light of comparable programs overseas.

The US Air Force fielded the B-52H in 1961 and intends to fly it until 2040, which is also the planned withdrawal date for the last KC-135R/T tankers deployed during the mid 1960s.

The argument that the operating costs of the F-111 will increase significantly over the coming decade runs contrary to what has been observed at Amberley since Boeing took over the depot; it runs contrary to US experience with the B-52H; and it runs contrary to the mathematics of basic reliability theory that every time an old component is replaced with new, reliability improves, running costs reduce and service life is extended.

Last year's Hansard is most revealing: DSTO's preliminary F-111 Sole Operator Program findings cited by the former VCDF are that the F-111 structure and TF30 engines can be managed to 2020 with no difficulties. With around 200 mothballed AMARC F-111s there is an ample supply of spare bits to work with, and many of these mothballed aircraft have less than 3,000 hours of airframe time. As a refurbished set of AMARC wings can be swapped in three days, the RAAF could swap wings to extend fatigue life for decades to come.

As structures are not the critical cost-driving long-term issue for the F-111, avionics, wiring and engines remain as the other key hotspots in older aircraft. Most of the wiring and core avionics in the F-111C and G were replaced in the AUP/AMP upgrades and later block upgrades. The idea that this quite new hardware will incur unusual cost growth over the next two decades is clearly absurd.

In terms of engines, the RAAF acquired all remaining P109 series engines from the F-111D fleet, and could further acquire 77 ship-sets of mothballed F-111F engines – and now also the US Navy F-14A fleet TF30 engine stocks. The total pool of TF30 engines could last for decades. DSTO have stated that the existing stock of engines, with DSTO devised durability fixes, will last until 2020.

The only potential issues longer term are the remaining original analogue avionics: the steam-gauge cockpit, analogue radar and some boxes inside the Pave Tack. The overseas approach remains to replace such subsystems with new hardware and realise a net saving in total ownership costs usually within a decade. The plethora of recent glass cockpit, FLIR module, laser and radar retrofits seen in the US/EU speaks for itself. Australian industry put forth unsolicited proposals for such cost-saving F-111 maintainability upgrades two years ago.

F-111 availability and reliability has increased in recent times. Boeing now looks after the deeper level maintenance of the aircraft, and with Amberley F-111 SPO and DSTO Melbourne support launched an Ageing Aircraft Engineering program. During last year's Red Flag exercise the F-111s were more reliable than all of the newer types at the exercise - a clear indication that significant effect is being achieved.

Assertions concerning the age of the F-111 and the risk of "loss of capability" must also be questioned - essentially that some unsolvable structural fatigue problem will be found that cannot be easily fixed. Engine and avionic problems by definition do not fall into this category. The F-111 is structurally the safest aircraft in ADF service and due to ongoing structural Cold Proof Load Testing the only ADF airframe where the primary structural integrity can be demonstrated to be safe. The F-111 fleet has considerably more remaining airframe structural fatigue life than in the F/A-18A fleet – and if structural fatigue were the driving issue, the Hornets would have to be retired first. While most contemporary fighters are built for a 6,000-hour fatigue life, the F-111 was built for 10,000 hours, and that figure is driven by wing fatigue life.

The F-111 airframe was designed to be 85 per cent common for both the land based air force variants and the tail-hooked naval F-111B variant. While the F-111B never made it to production, the land based F-111s inherited a heavily overbuilt, and slightly overweight, common structural design. So tough is this airframe that several aircraft seriously damaged in landing and takeoff accidents were rebuilt under the 'FrankenVark' program and continued in operational use. The RAAF's A8-112 flew home after a fuel tank explosion, which would have torn a lesser aircraft to pieces.

The key fatigue issues in the F-111 have always been the wings, primarily the D6AC steel Wing Pivot Fitting (WPF) at the wing root. The often-maligned Wing Centre Carry Through Box (WCTB) has had very few problems statistically, and a number of US Air Force F-111s had their WCTBs replaced. DSTO Melbourne regarded the WPF as a priority and during the SOP devised a modification, which arguably 'fatigue-proofs' this critical component.

The RAAF's much publicised wing replacement program resulted from a confluence of historical gaps in the fatigue analysis of the FB-111A/F-111C 'long' wing and delays in analysing fatigue test articles in Australia. With the wingtip extensions fitted (all F-111 wings are otherwise identical) the different stress distribution reduces the life of the 'long' wing against the 'short' wing.

With perhaps 90 per cent or more of the key fatigue limited components in the F-111 airframe concentrated in the wings, the fatigue life of the current RAAF fleet can be extended by wing swaps for as long as surplus wings remain in AMARC mothballs. With 200 airframes, many under 3,000 hours of time, this is a lot of fatigue life. Additional hours can be added to F-111 wings by reskinning, fastener reworking and selective component replacement, as done with the B-52H, B-707 and planned for the B-1B. Other key structural components are available in abundance in AMARC.

The F-111's aluminum honeycomb sandwich skins can be replaced with more durable and tougher carbon-fibre composite replacements, using a DSTO devised reverse engineering technique.

There are no obvious engineering reasons why the F-111 cannot be life-extended into the 2030-2040 period, as will be the case with the US Air Force B-52H and B-1Bs, which are both programmed for use until 2040 using small block retrofits during scheduled downtime.

The arguments put forth on both costs and risks of fatigue related catastrophic failure are essentially speculative. They are, in engineering and strategic planning terms, little more than guesswork, not supported by hard engineering analysis we typically see in the US.

Conclusions

Arguments put forth to justify the early retirement of the F-111, and those asserting that no strike capability gap will exist, are by any measure very weak if not plainly incorrect. The strategic consequences of this decision, if followed through with, will be profound as Australia's strike capability dips to parity with other regional nations. The Amberley WSBU with its unique systems integration capability will wither away, damaging the industrial base possibly irreparably. Australia's credibility with the US will take a serious hit, as the US Air Force will have to beef up PacRim assets to offset a 50 per cent reduction in effective RAAF combat strength, likely to persist even with the introduction of the second tier JSF.

The RAAF is now well on track to becoming a 'boutique air force' suited primarily for second tier support roles and with a very limited capability for independent operations of any kind. In a period of increasing strategic risk across the region and globally, this is not a path Australia can afford to take.