

How expensive is the F-111?

Dr Carlo Kopp



Combat aircraft of Air Combat Group (RAAF): an F/A-18 Hornet of No 2 Operational Conversion Unit, an F-111 of No 1 Squadron and a Hawk Lead-in Fighter of No 76 Squadron in formation. Photo LAC Clint Siggins, 81 Wing RAAF.

“Repeat a lie a thousand times and it becomes the truth ...” - usually credited to Dr Joseph Goebbels, Propaganda Minister of the Third Reich.

Perhaps the most pernicious of the various commonly heard myths about the F-111 is that it is an unusually expensive asset to maintain, or indeed that it presents a particularly expensive way of delivering bombs to targets. While such assertions might appear reasonable at first glance to a lay observer, expert observers with exposure to overseas cost structuring models tend to see such comments for what they really are - malicious and unsubstantiated bunk. To best understand why such a criticism of the F-111 is unreasonable, we might explore the problem from a number of different perspectives. The first is the

relative cost to operate the aircraft, in comparison with alternative combat aircraft, and the others lie in the domain of ‘bang per buck’.

A document to explore very closely is the Defence Annual Report, which summarises ADF/DoD expenditures in specific areas, and provides some metrics on achieved Rate of Effort against planned Rate of Effort - these are defined as activity levels in operation. Scanning through subsequent Defence Annual Reports from 1997/1998 through to 2000/2001 is quite revealing. The 1999/2000 report is by far the most comprehensive and best prepared - not surprisingly done during the incumbency of Defence Minister John Moore, an

Two F-111s scorch across the Brisbane skyline as a spectacular finale to the annual RiverFire festival.

Photo: CPL Errol Jones, 82 wing RAAF.



accountant by training.

That annual report puts the whole annual cost of operating the then Strike Reconnaissance Group at A\$787.1 million - 35 F/RF-111C/G aircraft on the books in total - and the cost of the then Tactical Fighter Group at A\$1,398.1 million - this including the 72 F/A-18As and a number of Macchis. More recent reports do not deviate grossly from these figures.

From these numbers we can infer an annual ownership cost per unit which aggregates the complete cost of operating the aircraft and providing its support. For the F-111 this number comes in of the order of A\$22.5 million per aircraft annually, for the F/A-18A with the assumption that 85% of TFG costs are incurred by 72 F/A-18As, this number is of the order of A\$16.5 million annually. In terms of gross costs, all inclusive of infrastructure and 'back end staffing', this suggests that the F-111 costs about 36% more than an F/A-18A to operate.

Is this a reasonable number? US GAO documents detailing US Air Force and Navy operating costs during the mid 1990s indicate that in US service the F/A-18C cost around 9.6% more to operate per aircraft than the US Air Force F-111F did, despite the overwhelming difference in fleet numbers favouring the F/A-18C.

Why the difference against the US? This is primarily due to the need to wholly support the aircraft in relatively modest numbers - the economies of scale are lesser and this shows.

The big question is whether a unit cost of ownership, which is 30% to 40% higher than that of the F/A-18A is reasonable or not. In some Canberra circles this differential would indeed be cause for much consternation - how can the ADF possibly afford to operate a 'medium bomber', which costs around a third more to operate than a 'lightweight fighter'?

What is it that the RAAF gets for its expenditure here?

The F-111 is 'medium bomber' so the best measure is to compare directly what it would be costing the RAAF to do the same amount of work the F-111 does, using a

dual-role F/A-18A.

Scenario A

We assume the F-111 is trucking bombs to a target that is at the range limit of the F/A-18A, and we compare the tonnage of bombs delivered - an excellent Measure of Effectiveness (MOE) for Army support air operations. Neither aircraft is using a tanker to support it and both rely on internal fuel and external tanks in the case of the F/A-18A. Making some reasonable assumptions about the profile, the Hornet will deliver a pair of 2,000 lb guided or dumb bombs to a radius of around 410 to 430 nautical miles. An F-111C/G flying on internal fuel only to a combat radius of 450 nautical miles has the payload capacity to carry 20,000 lb to 24,000 lb of guided or dumb bombs, or half of the typical payload of a B-52H. If the F-111 is carrying 2,000 lb guided bombs the payload is limited by pylon numbers to 8,000 lb.

If we look at the MOE of deliverable bomb load to a 450 nautical mile class combat radius, a single F-111 does the work of between 2 and 3 F/A-18A Hornets. So if we compare the ownership cost model against bomb delivery performance, doing the same amount of 'short range' bombing work with F-111s costs between 45% to 68% of the cost to do the same work using F/A-18As. Conclusion? The F-111 is a very cheap way of trucking bombs to short distances, very much cheaper than the F/A-18A.

Is this the only way to assess comparative value for money? Obviously other scenarios exist, and this permits us to explore the issue of overall 'force structure cost' per capability.

Scenario B

We assume that a target is to be bombed at a radius of 1,000 nautical miles. This is a very reasonable

target radius for coalition warfare, but also for 'defence of the Australian continent' scenarios. The F-111 can be flown unrefuelled to this radius - nominally with four 2,000 lb guided bombs - but needing careful fuel management. The alternative using the F/A-18A is illustrative here, since in the same configuration as in Scenario A it will need to be refuelled using a tanker.

To equal the F-111's payload radius we need to sortie a pair of Hornets and a 'fraction' of a tanker - the tanker providing fuel for the remaining 1,100 nautical miles of round trip. What amount of tanker capacity do we require? That depends on which model we use. The 'rule of thumb' approach using gross figures from 1990s air campaigns suggests around 4 fighters per KC-135R/KC-767 tanker, or slightly less for a runway length limited Boeing 707. Using more accurate performance numbers, with little allowance for reserves, yields a similar number of around 5 fighters per tanker. So a reasonable and conservative conclusion is that each Hornet requires about 25% of the offload capacity of a single tanker, or a pair of Hornets around 50% of the offload capacity of a single tanker.

What does half a tanker cost in force structure terms, annually? The RAAF's Boeing 707-320s are too problematic to cost easily so we instead look at US Air Force hourly operating costs - and normalise these against then applicable US Navy F/A-18C hourly operating costs. The result is that the hourly operating cost of the Hornets goes up by about 20% to account for the cost of one half of a tanker. Let us compare this against the F-111 - to do the same amount of work in Scenario B requires a pair of Hornets plus a 20% or greater cost loading to account for aerial refuelling. In raw dollar terms, using the previous cost model, the Hornet plus tanker solution costs 76% more than the F-111 solution - with a more expensive to run Boeing 707 tanker this is apt to be closer to twice the cost of doing this work with a

single F-111.

Can we consider other representative MOEs?

One is comparing the 'persistent bombardment' regime of operations we observed over Afghanistan and more recently Iraq, in which combat aircraft loiter over the battlefield for many hours hunting for ground targets.

Scenario C

We assume that a bomber needs to loiter over a target area performing persistent bombardment. With an F-111 and assuming a 450 nautical mile distance to the target area, we get an on-station endurance without refuelling of around 2.8 hours. With an F/A-18A, making similar assumptions, we get around 0.3 hours - consistent with earlier Scenarios. Without aerial refuelling, to maintain one Hornet on station for the period an F-111 can orbit, we would need to sortie around 9 Hornets - clearly impractical! If we assume the use of a tanker, then we incur equivalent cost ratios to Scenario B - the refuelled Hornet solution costing around 76% more than the F-111 solution.

What does this tell us?

First and foremost, that an F-111 is exceptional value for money at current operating costs and that any further reduction in operating costs due to relevant maintainability upgrades would make it even better. Replacing the analogue cockpit with a glass cockpit would yield between a 10 and 100 fold reduction in associated recurring costs, replacing the radar with an active phased array would yield a five to tenfold reduction in associated recurring costs, replacing failure prone Pave Tack components would yield similar numbers - all while enhancing the aircraft's basic capabilities in strike and recce roles. The second conclusion we can draw from this is that those who choose to complain loudly about the cost of the F-111 evidently have little or indeed no idea of the operating costs of alternative force structure solutions. Even were an F-111 to cost twice what a Hornet costs to operate, it would still be good value for taxpayer's money.

We might ask the question of how the 'myth of the expensive F-111' came to be?

Its earliest origins lies in the late 1970s and 1980s when the F-111 flew in its original avionic and flight control configuration. The complex analogue avionic suite and hydromechanical flight control system were expensive to maintain and did not make for exceptionally good flightline availability. The airframes were structurally quite new and costs were dominated by avionics and flight controls. Compared to much simpler avionics in aircraft of that period, such as the Mirage III or F-4E Phantom, the F-111 was indeed much more expensive - even though it was vastly more capable. The recurring operating costs of the F-111

plummeted when the RAAF completed the Avionic Update Program (AUP) in which the flight controls and core mission avionics were replaced with digital hardware. This was the period of the mid 1990s, when the RAAF flew large Red Flag deployments and parties in Canberra would knowingly comment to outside observers that the F-111 'costs about the same to operate as an F/A-18A does'.

So what has produced a revival in the complaints about F-111 operating costs?

Primarily the difficulties seen during the latter part of the 1990s in the somewhat haphazard transition from ADF support to the eventual Boeing operated WSBU (depot) support, compounded by cost overruns in the AUP which were frequently, and wrongly so, associated with recurring operating costs of the aircraft. The inadequately funded introduction of the F-111G was a source of heartache in its own right. During this period the RAAF had to set up its own support infrastructure to replace US facilities being decommissioned, deal with genuine funding difficulties, set up support for the F-111Gs, initiate an ageing aircraft program, initiate the DSTO Sole Operator Program and deal with cumulative ageing aircraft issues on the airframe. Sadly not all was planned well enough, and not all plans worked as intended, resulting in around a year of fuel tank related groundings, and months of wing related groundings.

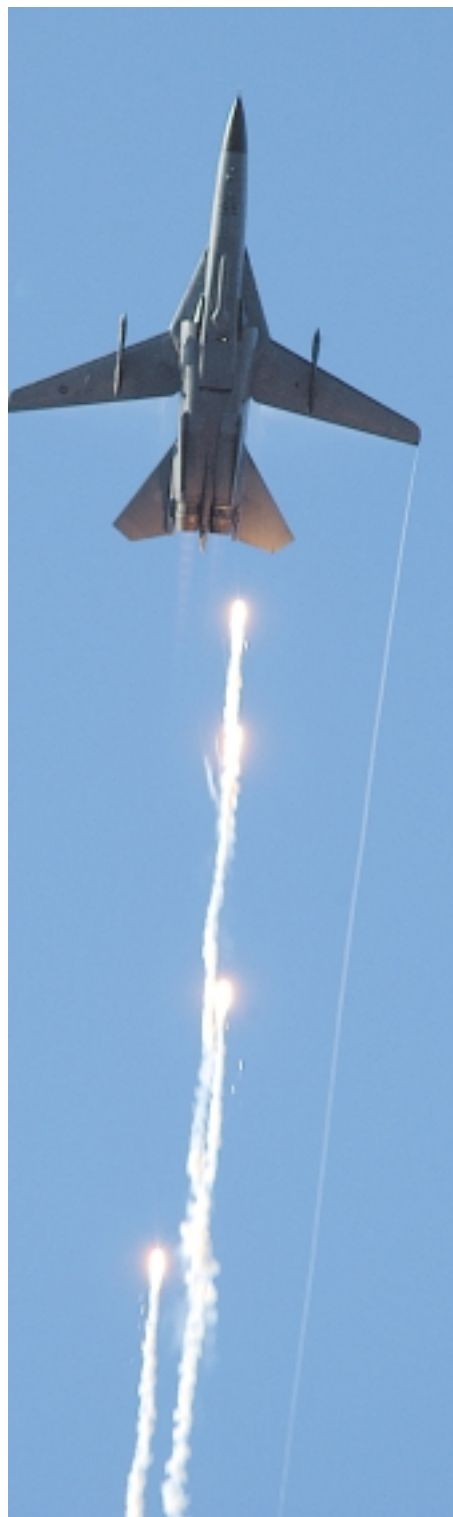
An issue in its own right was deskilling in the Amberley 'depot' resulting from downsizing and early attempts to commercialise: critical airframe support skills were lost and not replaced, tooling was lost or fell into disuse, and many pieces of documentation were not maintained. During this period, before the Boeing operated WSBU depot effected vital ageing aircraft program fixes, availability dipped dramatically, in turn driving down annual hours flown, and skewing statistics.

Since then, the original wings have been largely replaced, fuel tank desal-reseal operations restarted, and a plethora of outstanding airframe maintenance problems were fixed by Boeing's engineers, working in concert with the RAAF SPO and DSTO Melbourne. The availability of the aircraft is now regarded by some as being better than during the halcyon AUP period of the mid-1990s. The recent Red Flag deployment saw the RAAF's F-111s deliver better uptime than any other aircraft at that exercise, yet it was the oldest type. However, the traumatic experience of several years ago remains alive in the minds of many in Canberra who see the future in terms of a past crisis, and this has perpetuated and indeed amplified the historical pre-AUP mythology about the aircraft's operating costs.

In real terms, when properly maintained, the F-111 represents exceptionally good value for the Australian taxpayer's dollar. Moreover, it has some very unique and useful capabilities, which are wholly absent in current production fighters. With over 200 F-111 airframes mothballed in the US,

the RAAF is very much in an analogous position to the US Air Force with its B-52H fleet, and it could continue to operate the F-111 well past 2020. It is worth noting that the mature B-52H is the cheapest to maintain of the three US heavy bombers.

As a final observation, if value for money, balance of payments, longevity and combat capability were the decisive issues in ADF force structuring, then it would make good sense to mothball a squadron of F/A-18As and replace them with a squadron of currently mothballed Pave Tack capable F-111Fs - or F-111Gs. Mythology is not a substitute for hard numbers.



An F-111 dispenses anti-missile flares as it climbs vertically. Photo: LAC Rob Mitchell, 82 Wing RAAF.