

HEADSUP SPECIAL

Is the JSF *really* good enough? – analysing the ASPI paper

By Dr Carlo Kopp and Peter Goon

AM Houston's paper entitled 'Is the JSF good enough?' published in the glossy ASPI Strategic Insight series in August is replete with misunderstandings and – more importantly – omissions of a great many key issues. It is, however, important as it raises the profile of the F/A-22A as a JSF alternative, a huge departure from the one-liner dismissals to date. Perhaps the biggest impediment the F/A-22A has faced in Australia has been a lack of wider public visibility – AM Houston's paper, despite its negative spin, provides exactly that.

The paper argues that new build fourth-generation fighters are not viable long term. This is beyond dispute – the smart investment strategy is clearly the technology seen now only in the F/A-22A, JSF and (expected) FB-22A. A much less convincing argument is the claim that further upgrading beyond 2020 of existing F/A-18A and F-111 'present[s] risks and high costs' – the risk/cost of life extension and upgrades to both types is a fraction of the risk/cost of any new aircraft, the bigger issue being the strategic non-viability of the F/A-18A in the developing region, the downtime resulting from rebuilds and poor return on investment in structural rebarrelling. If bomber-fleet life extension to 2040 is viable for an overstretched USAF, why can it not be so for the RAAF's F-111s?

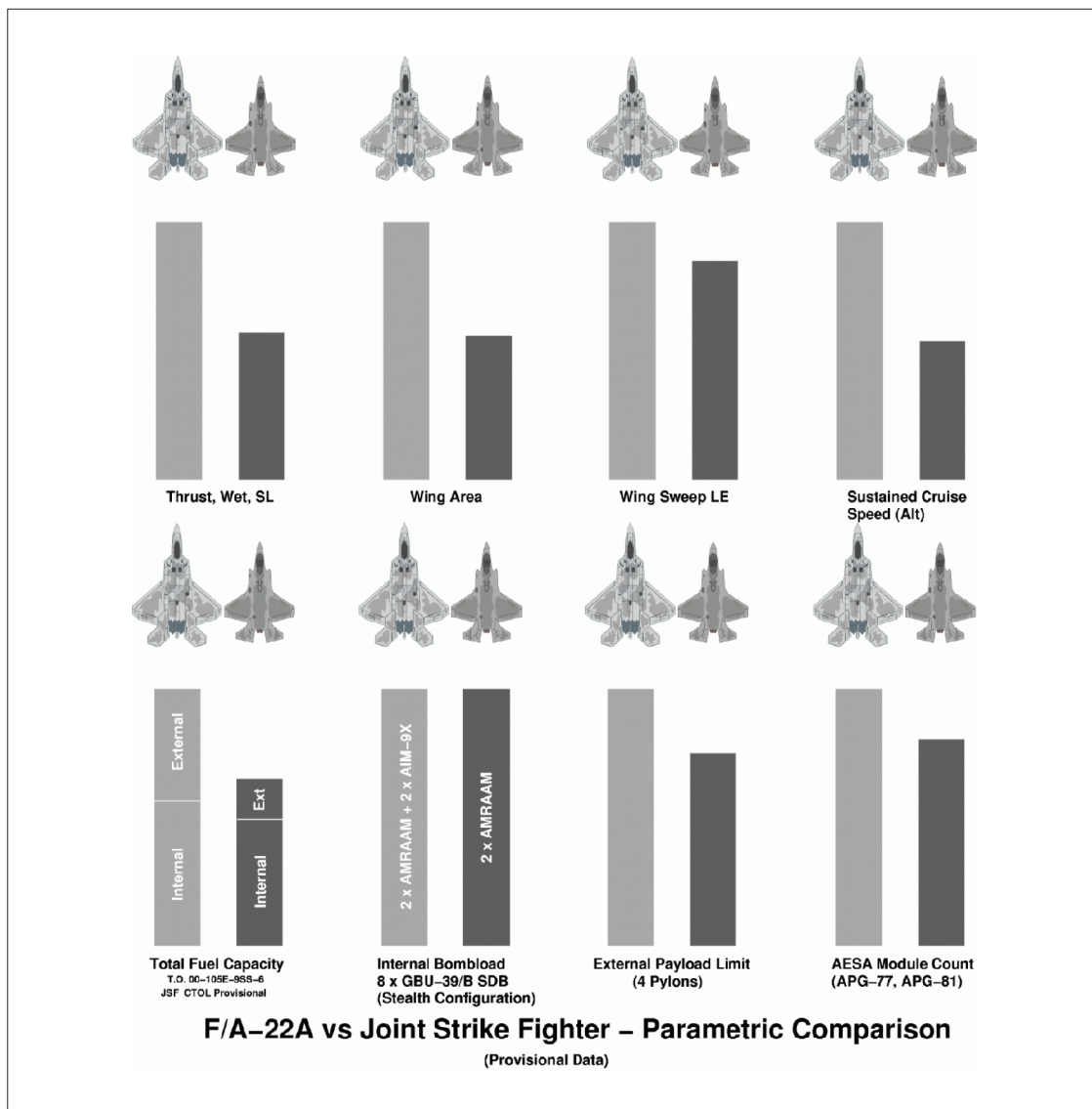
The paper correctly argues that air wars are best won by destroying the opponent's air power on the ground, rather than by sustained attrition; but cites the Iraq campaigns of 1991 and 2003 as examples, despite their complete irrelevance to the strategic future Australia now faces in the region. The massed coalition effort against Saddam's largely obsolescent and, by 2003, grounded air force cannot compare with future conflicts in Asia, with possible opponents operating Su-27, Su-30, J-10, A-50 AWACS, Il-78 tankers, digital datalinks and modern AAMs and PGMs.

Given developing capabilities across the region Australia may not have the choice of 'orchestrating' a campaign, let alone have the mix of capabilities to conduct one, unless investment is put in the proper places early.

Arguing for the single aircraft type force structure is to misunderstand the 1970s Cold War 'swing fighter' concept, designed for the central European theatre and always intended to be used in concert with top-end air superiority and strike aircraft. F-16 and F/A-18 'swing fighters' would initially provide the second tier of air defence, supplementing F-15s and F-14s, and then be retasked with close air support and battlefield interdiction to supplement the A-7s, A-10s, Jaguars, Tornados in grinding down Russian

armour in the Fulda Gap. The 'swing fighter' model was not intended as a standalone force structure then, and this is still the case today, with high-performance, long-range Sukhois in the game and a battlefield-strike optimised JSF.

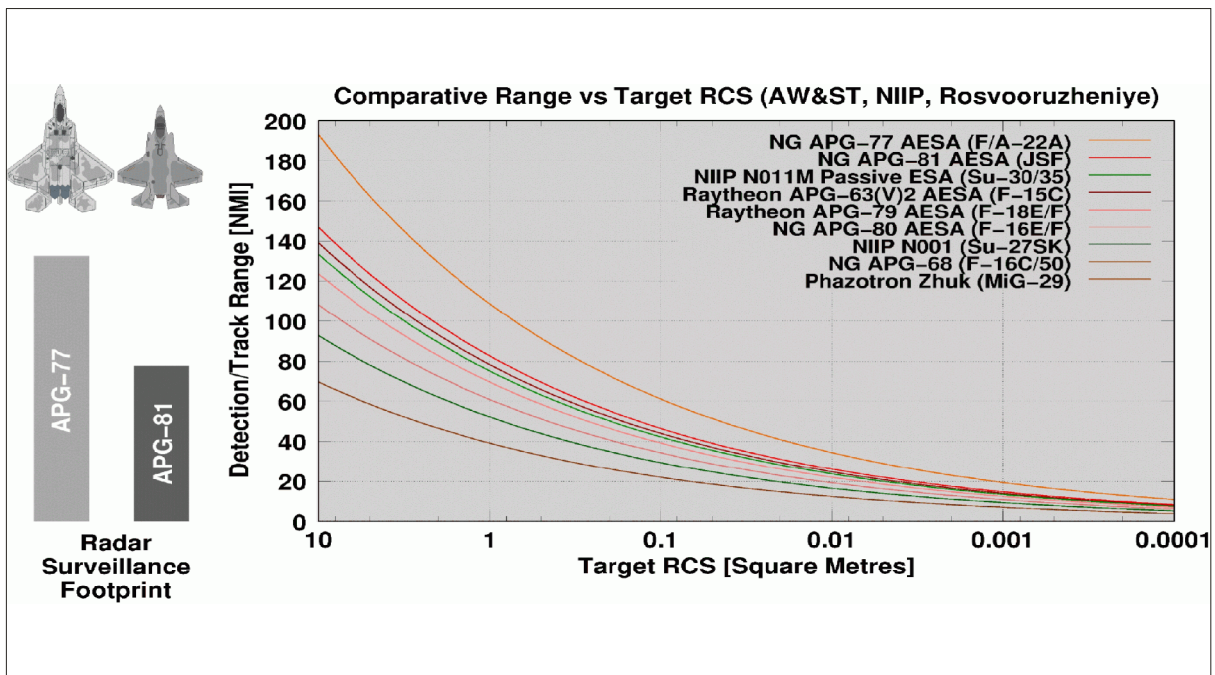
No differently, the claim that 'the performance of an effectively networked system will exceed the sum of its individual parts' misunderstands how networks improve capabilities and is mathematically unsupportable – platforms set bounds on achievable capability, not the network supporting them. With Russian datalinking hardware and AEW&C now being acquired across the region, networking is a necessity simply to maintain parity with regional air forces. Of more concern is the thinking process which ignores the arrival of anti-AWACS missile and high power jamming technology in this region – both capable of crippling the network and leaving fighters to fend for themselves.



The paper opens the discussion of the JSF by claiming it to be a 'high-performance stealth aircraft' despite the reality that it has aerodynamic performance set at the level of the obsolete F-16 and F/A-18 and its stealth capability is optimised only for the upper

frequency bands, mostly in the forward sector. That the JSF's internal fuel capacity matches an F/A-18A with two large external tanks is presented as 'extraordinary' despite this being a natural consequence of trying to meet a very basic range requirement while retaining stealth.

The paper expends many words extolling the virtues of the JSF avionics suite, but fails to observe that virtually all of these functions and systems are *de-rigueur* in many evolved third generation fighters, and with the exception of the electro-optical systems used for battlefield strike and close air support are already being incorporated or being flown in the F/A-22A.



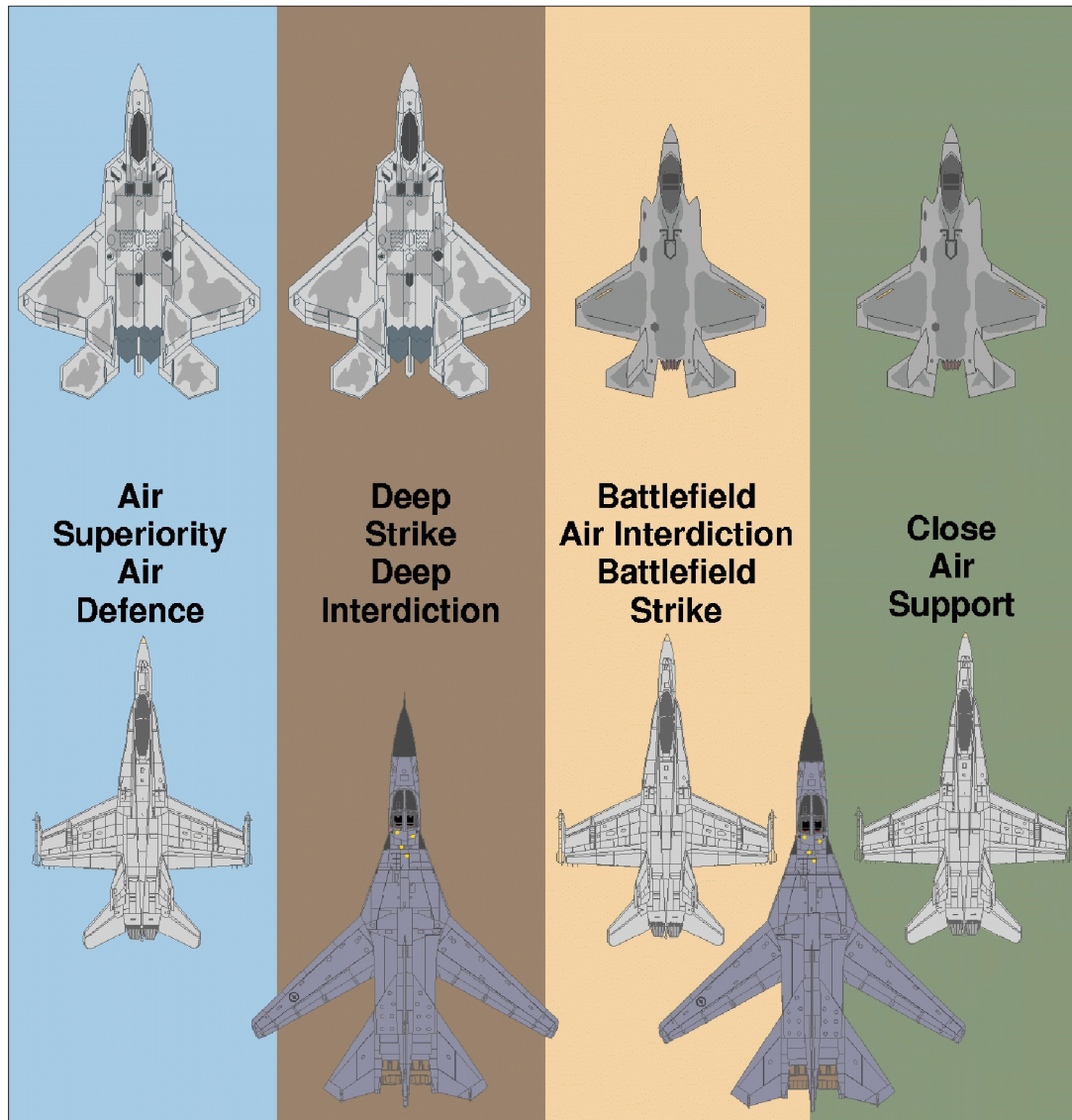
The issue of development risks is presented without actually discussing the impact of the risk factors on the aircraft's utility for Australia. Weight and software are canvassed but how they might impair aerodynamic performance and capability is not. The prospect of 3,000 JSFs being built is presented, without mentioning existing reductions in US buy numbers. 'Growth potential' is argued without exploring the hard limits imposed by the aircraft's aerodynamics and internal power, cooling and volume constraints.

The paper opens the discussion of the F/A-22A by correctly observing that it 'will be the most outstanding fighter aircraft ever built'. While it makes the reasonable observation that the F/A-22A's 15% greater internal fuel load is similar to the JSF, it fails to mention that the total fuel load of the F/A-22A, with external tanks, is 54% greater than the total of the JSF with external tanks and larger than the internal fuel load of the F-111. It is unclear why exact fuel figures for the F/A-22A are not cited, since portions of the applicable document (US Air Force Technical Order T.O. 00-105E-9) were provided to Defence this January.

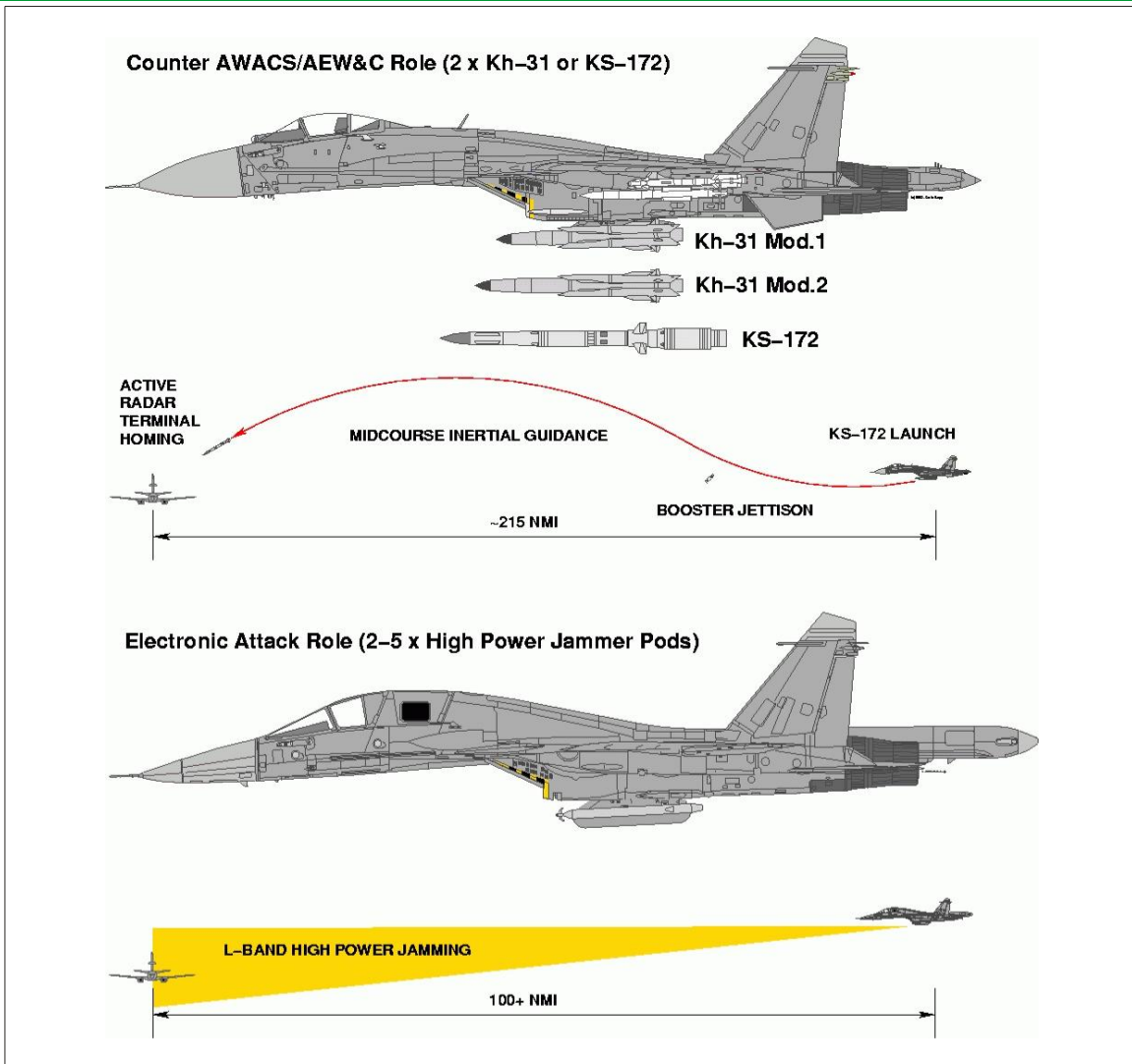
F/A-22A supersonic cruise is mentioned but its enormous impact on sortie rates, combat persistence and patrol footprint is not discussed – advantages in bang/buck which the JSF can never acquire due to its basic aerodynamic design. The stealth of

the F/A-22A is mentioned, but its large superiority in angular and frequency coverage performance over the JSF is not mentioned; also not the inability of the JSF to acquire such stealth performance, nor the limitations and associated operational risks in the JSF's stealth design.

The plan for comprehensive strike capability in the F/A-22A is described as 'relatively recent' despite a history which dates back to the early 1990s and the F/A-22A's post Cold War role shift into the fighter bomber domain.



The paper raises the issue of obsolescence in F/A-22A Block 0 computers despite the reality that in 2012 it is already planned to have the same generation COTS-technology computers planned for the JSF, which is unlikely to be in full rate production at that time. Later block F/A-22A radars are incorrectly described as 'a development of the JSF radar' despite the much higher power rating and detection range performance of the F/A-22A's APG-77, which will use higher power derivatives of the module technology common to JSF to reduce costs. Sharing parts, alas, maketh not for the same radar.

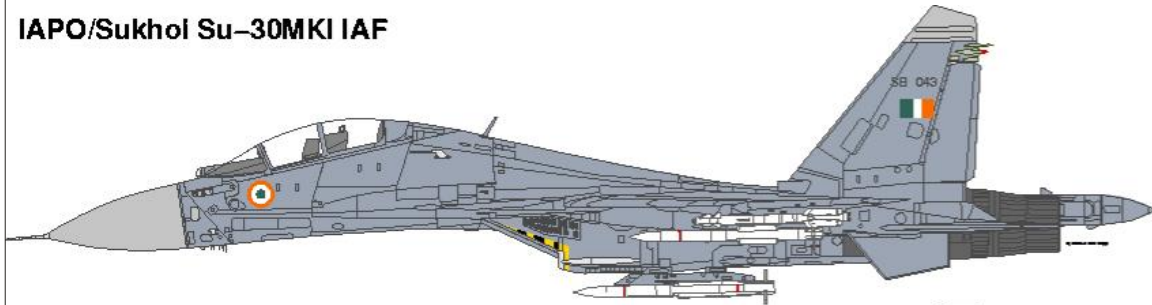


The discussion of F/A-22A build numbers cites the Congressional funding cap limiting initial builds to 277, without explaining that declining production costs may yet see a larger number built out of that budget. No mention is made of the longstanding USAF requirement for 380 F/A-22A to replace F-15Cs.

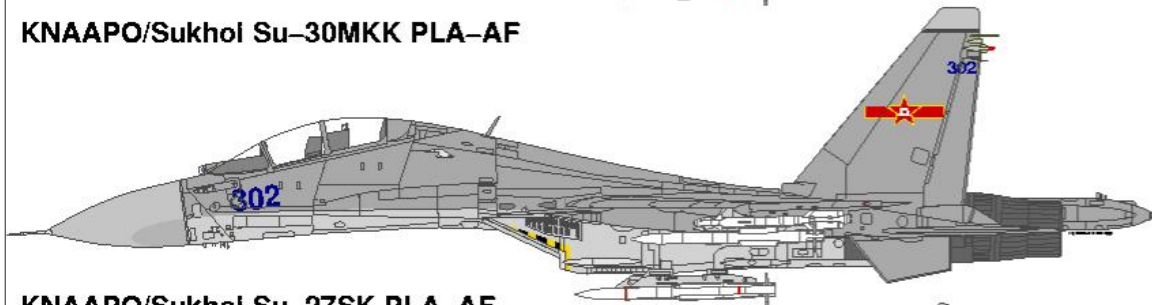
The comparison between the F/A-22A and JSF starts with a claim that there will be no aircraft to match the F-111's range performance, without mentioning the much larger delta wing FB-22A bomber derivative which could materialise before 2015 and match the F-111 in range, but also will have supercruise and full stealth capability.

The paper observes that there is no public data on F/A-22A combat radius performance (curious it is that Defence could not approach the US Air Force for this data), but fails to mention that in many roles not requiring stealth the ~50% greater total fuel load of the F/A-22A will provide it with F-111-class radius performance. Moreover, as the F/A-22A has jettisonable pylons to retain stealth, it can fly out with four external tanks, punch off the tanks and pylons once the tanks are emptied, and still fly a fully stealthy mission with internal bombs to a much greater radius than the JSF.

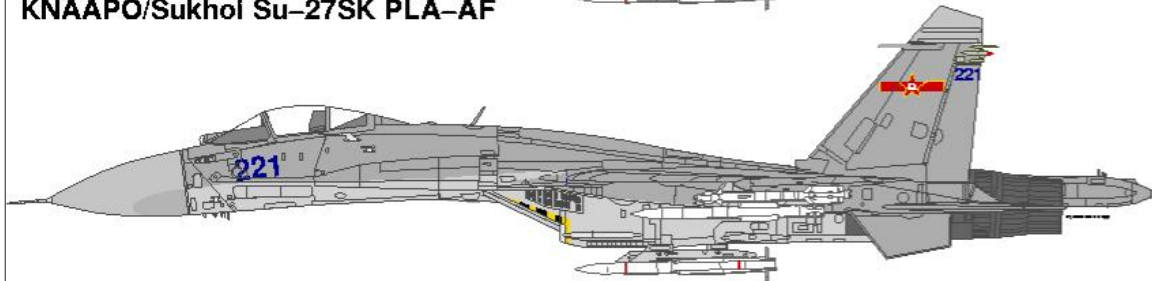
IAPO/Sukhol Su-30MKI IAF



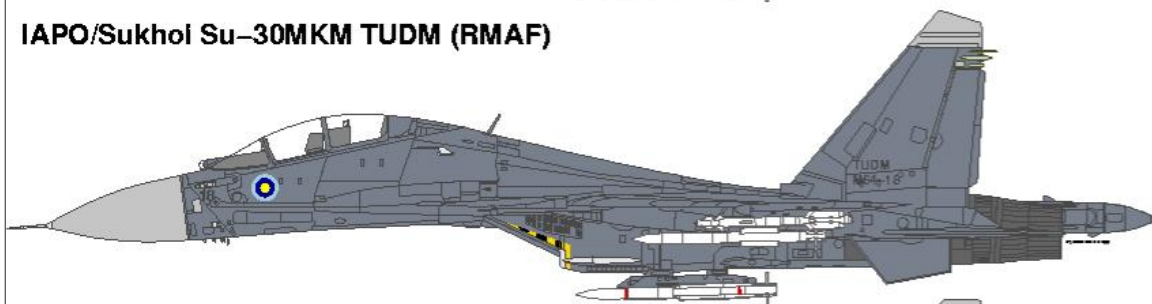
KNAAPO/Sukhol Su-30MCK PLA-AF



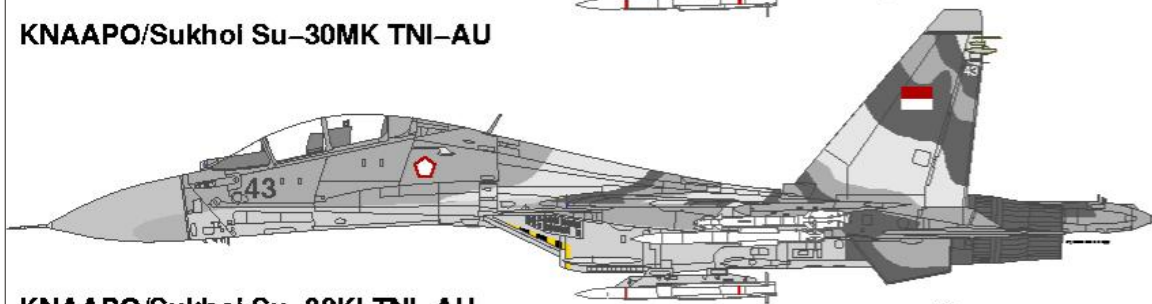
KNAAPO/Sukhol Su-27SK PLA-AF



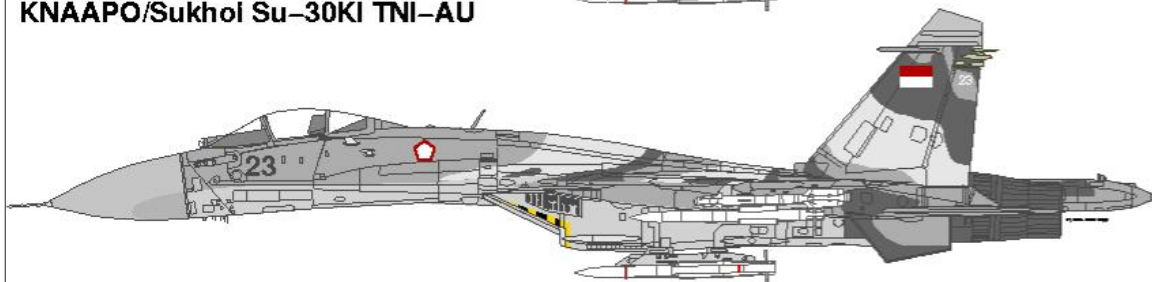
IAPO/Sukhol Su-30MKM TUDM (RMAF)



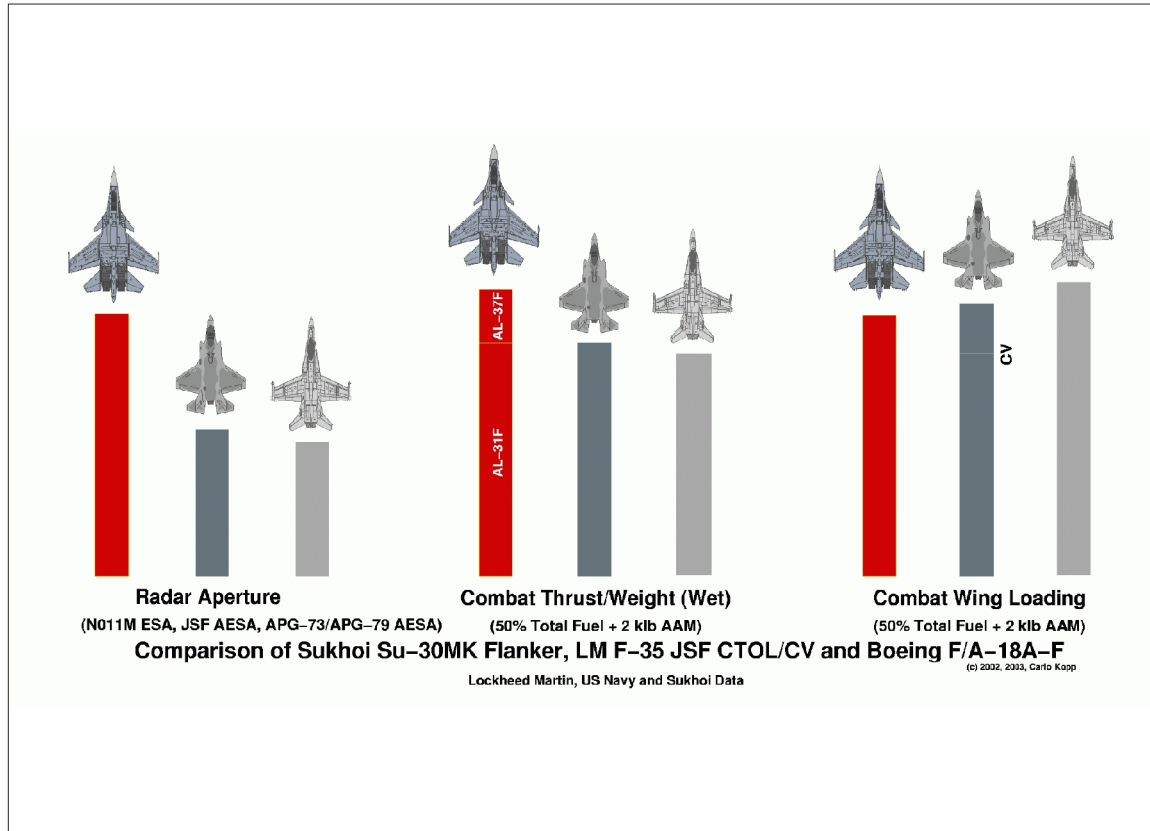
KNAAPO/Sukhol Su-30MK TNI-AU



KNAAPO/Sukhol Su-30KI TNI-AU



The currently planned F/A-22A air to ground radar capability will be delivered to squadrons in 2007, yet is presented as ‘proposed’ rather than ‘planned, budgeted and fully funded’. Similarly, no mention is made of the two-way JTIDS datalink and the GBU-39/B Small Diameter Bomb capabilities delivered in the same production block within the existing production budget. The satcom networking programmed for 2009 IOC is not even mentioned.

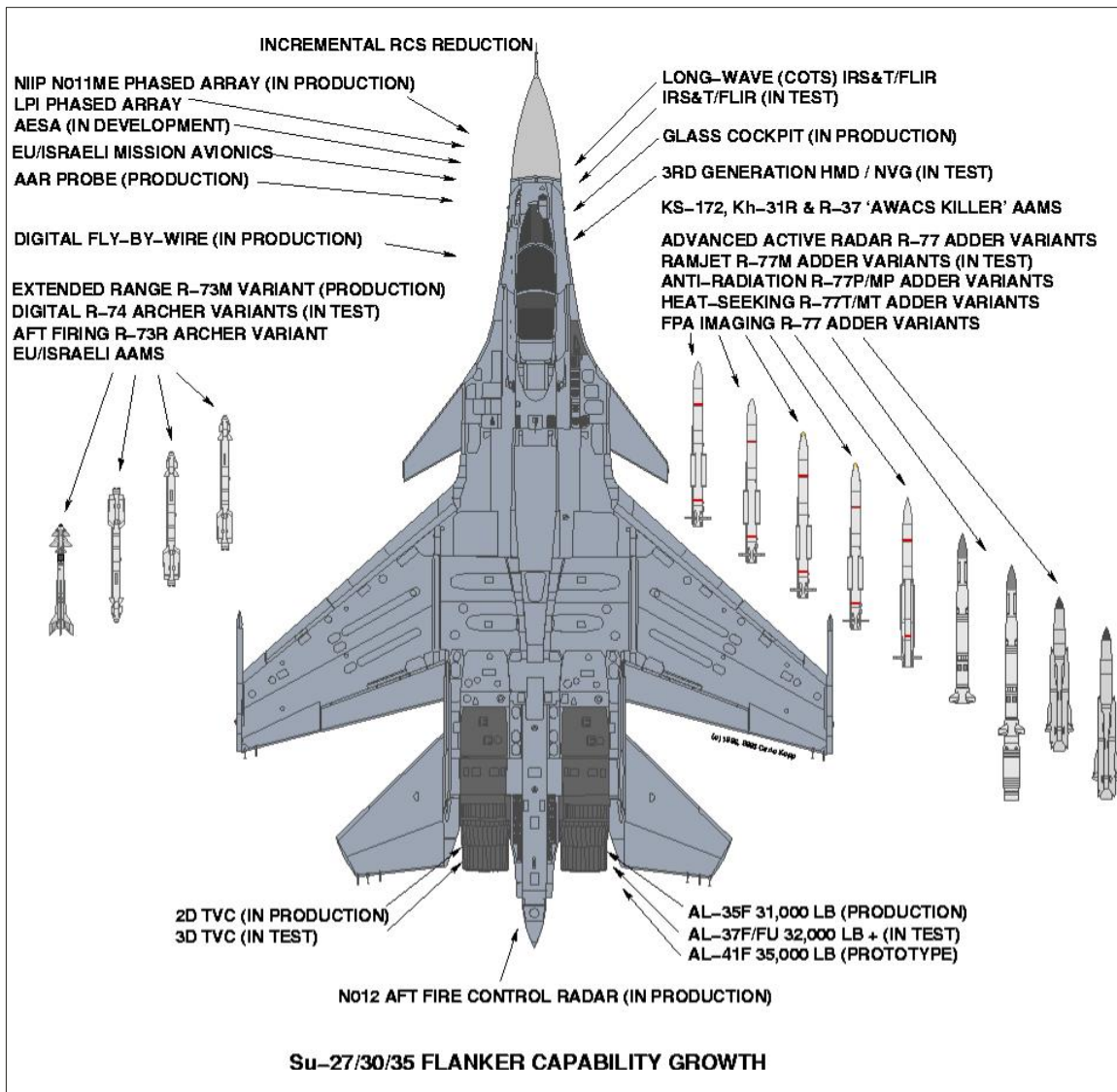


The JSF’s ability to carry 2,000 lb bombs internally is cited as a decisive advantage over the F/A-22A’s current limitation to 1,000 lb bombs, a curious reversal of emphasis after the protracted argument as to why 1,000 lb warhead class cruise missiles on F/A-18A and JSF are good enough vs 2,000 lb bombs on F-111s. No mention is made of the identical basic payload of GBU-39/B Small Diameter Bombs carried internally by both the F/A-22A and JSF, nor the additional air-to-air missiles carried internally by the F/A-22A with that bomb payload. The F/A-22A’s capacity to carry 33% more external payload than the JSF is also not mentioned.

The JSF’s Electro-Optical Targeting System is presented as an advantage not currently planned for the F/A-22A; but the internal bay for an electro-optical system in the F/A-22A is not mentioned.

Perhaps the most worrying aspect of the comparison in strike capabilities is the lack of comparison in survivability especially against fighter threats, although the paper admits the F/A-22A will do better against SAMs. How much better against an Almaz S-300PMU-2 (SA-10), S-400 (SA-20) or Antey S-300VM (SA-12) is not discussed – a

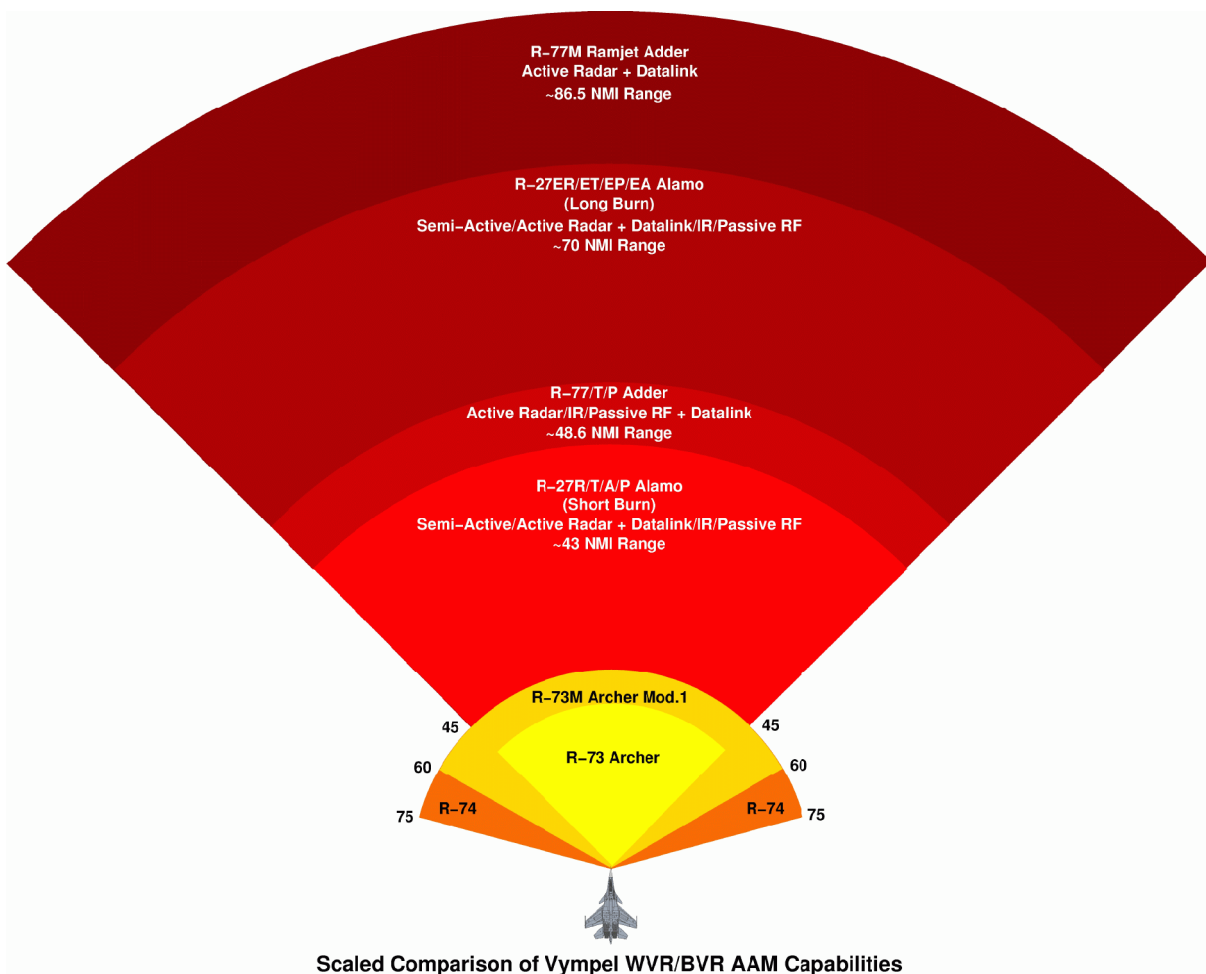
major issue given the built-in stealth limitations in the basic JSF design, and the prospect of further reduced stealth performance export variants being sold to Australia.



The comparison of air superiority capabilities is no less problematic, and trivialises many issues. Much of the discussion is predicated on the assumption that the JSF implicitly has F/A-22A class wideband, all-aspect stealth capability, which is demonstrably untrue given the shaping and detail design of the JSF, especially its engine inlets and nozzle. Therefore many of the built-in assumptions underpinning the cited BVR combat model simply do not hold.

The paper argues that the JSF can operate supersonic 'more often' than opponents due to the absence of external weapons drag and its 'large' fuel load. This presupposes that the opposing aircraft is an F/A-18 or F-16 – the Sukhois it will have to oppose carry about 25% more fuel, semiconformal centreline tunnel missiles and have wings designed for low supersonic drag, unlike the subsonic cruise optimised JSF wing.

In discussing agility, the paper notes that the JSF combines manoeuvre features common to the F-16 and F/A-18, but it fails to mention that Sukhois were designed from



the outset to out-maneuvre both these types. More recent Sukhois with higher thrust engines and thrust vectoring can do this even better. Helmet-mounted sights have been available on Sukhois since the 1980s, so arguing that these provide a key advantage is moot. The paper observes that it ‘might be hyperbole to suggest that entering the WVR air combat arena in future will result in mutually assured destruction’, another curious reversal of previous public statements.

The paper argues that a ‘threshold’ level of agility is needed for success in close-in combat – in addition to suitable missiles, helmet-mounted sights, situational awareness and counter-measures – and claims that the JSF meets these needs. This will be cold comfort for any RAAF pilot facing a Sukhoi in 2020 that has short- and long-range heat-seeking air-to-air missiles, helmet-mounted sights and IR counter-measures of similar capability, data-linking with similar capability and a significantly more agile, faster and more persistent airframe.

There is no discussion of air defence interceptor roles flown against fast bombers or cruise missiles, both being problematic for the JSF due to its lack of top-end supersonic performance, lesser radar capability and smaller Air-to-Air missile payloads. All are important strengths of the F/A-22A.

The argument is concluded with a dubious claim that the 'JSF will do the [air combat] job very well too, and it is a more versatile strike aircraft', neglecting to mention that the multi-role F/A-22A is significantly more survivable in all roles due to better stealth and supercruise, can achieve higher sortie rates in strike roles by supercruising, can be configured to carry significantly more total fuel and weapons payload than the JSF, and outclasses all opponents in both BVR and close-in combat. The proper conclusion should have been that the F/A-22A outperforms the JSF in all air-combat roles and outperforms the JSF decisively in the critical long-range strike and interdiction roles, but is not equipped at this time with the electro-optical equipment for close-air support and battlefield interdiction, limiting the F/A-22A's autonomy in these two niche roles.



The limitations of export JSF capabilities are raised, but not discussed in any specific detail, especially the impact of reduced export stealth on a design which already has built-in stealth limitations to reduce cost. Motherhood statements presented do not deal with this issue.

The discussion on numbers and costs is the largest item in the paper, and is wholly predicated on the idea of a single type F-111 and F/A-18A replacement. That aircraft of the F/A-22A and JSF generation permit smaller squadron sizes is a given. That the RAAF needs some critical mass in numbers is also a given. What the paper fails to address is the large disparity in the amount of work which can be performed by a supercruising F/A-22A against a conventional JSF – the numbers argument is approached with the inappropriate assumption that numbers alone are the principal driver, instead of deliverable capability per dollar, or per airframe.

Of much more concern is that this argument is framed against a citation of a US GAO 'unit cost' figure of US\$153m for the F/A-22A. In fact, this figure is a slightly overstated

version of the average total unit procurement price (to the US Government) of US\$149m (in FY04 dollars) for full-rate production of 277 aircraft. This production number is based on the Congressional budgetary cap which, when announced, was referred to by the Budget Committee of Congress as 'a floor rather than a ceiling'.



The total unit procurement price includes the unit fly-away cost plus support equipment, spares, training, contractor and government charges and logistics support for initial operational capability. However, the figure of US\$45m the paper cites for the JSF is only the projected unit fly away cost; that is the estimated cost of the aircraft off the production line and, again as the paper states, 'this is for aircraft well down the production run'. If this is the AVERAGE unit fly-away cost (UFC), then this would be the projected UFC for an aircraft produced sometime after the 1,200th aircraft off the production line which, considering performance and risk estimates, may roll off the line sometime after 2020. Interestingly, in September 2002, the UK MoD committed some £10 billion (US\$15bn) for its planned buy of 150 JSFs (F-35Bs). This yields a total unit price of some US\$100m per aircraft system.

The paper, therefore, performs an 'apples vs oranges' comparison, by using a post-2020 mature production unit fly-away cost as the 'price' for the JSF, comparing it against an unrepresentative average total unit procurement price for the F/A-22A, rather than the price which would apply at the end of planned production, which would be when Australia would enter the program if it were to buy the F/A-22A.

On the latter point, in May 2002, information on the then planned full rate production run of 333 units had the average total unit procurement price at US\$115.2m per

F/A-22A aircraft system and the average unit fly-away cost at US\$97.8m per aircraft with the UFC for aircraft #333 being stated as US\$82m (all in FY 01 dollars).

This information was made available to Defence seeking their confirmation of these figures. No response has been received and there is no indication that any attempt has been made to test the veracity of these figures.

This is surprising since, if Australia were to join the F/A-22A program at the planned end of production around 2012, even a very conservative analysis of these and the 2004 cost figures – which are far more robust than those of the JSF for the very simple reason that the F/A-22A is flying in operational test and evaluation and is therefore on the other side of the ‘risk hump’ which the JSF has yet to reach – shows that the median budget of A\$13.5bn in DCP 2004-14 would support a purchase of more than 70 F/A-22A aircraft systems.

Coincidentally, expenditure of the same median budget figure to buy 100 JSFs would make the total unit price some A\$135m per aircraft system or US\$94.5m in FY04 dollars. Expenditure of the full budget (A\$15.5bn) would put the total unit price per aircraft system at A\$155m or US\$108.5m. One can only wonder why the authors of the ASPI paper chose not to advise the public on the actual figures they are using in their planning.

No genius is required to see that ~70 F/A-22As provide a lot more capability than 100 JSFs across the breadth of roles to be performed. But the F/A-22A can also perform many roles where the JSF cannot survive. The F/A-22A is larger, has more growth potential and, factoring in external stores options already assumed with the JSF, provides for greater aggregate fleet punch in strike roles.

The paper does not explore the option of mixed fleets, be they F/A-22A + JSF, F/A-22A + FB-22A, or even F/A-22A + life extended F-111, all of which are options in the 2020 timeframe, and all of which present opportunities to reduce and/or spread fleet replacement costs, against the ‘big bang’ block buy of about 100 JSFs.

The final conclusions are unconvincing, unless the reader is prepared to accept errors of fact, omissions, non-sequiturs and misunderstandings as the truth. The JSF:

Will not provide a robust margin of capability over Russian Sukhoi

Its networking capabilities will only be similar to the F/A-22A

It is not ‘truly multi-role’ as its design is biased strongly to battlefield strike

The numbers it can be bought in will not be significantly greater than a mature F/A-22A

Its growth potential will be limited by its size and internal volume – not determined by build numbers

And the industry program is biased to component supply rather than systems integration where the long-term returns accrue.

Overall, this ASPI paper lacks substance and any visible evidence of intellectually rigorous analyses having been done to support the JSF recommendation to Government. In relation to the JSF, the language used is subjective and flowery. Much of the argument presented appears to be based on supposition and wishful thinking. In all, this paper appears as an attempt to justify a ‘best guess’. When facts disagree with the

adopted position they are either conveniently left out or dismissed through supposition, unsupportable and unsupported statements and further guesswork.

Further reading:

http://www.aph.gov.au/house/committee/jfadt/Defenceannualreport_2002_2003/report.htm

http://www.aph.gov.au/house/committee/jfadt/2002_2003/dar_subs.htm