Appendix 4

Air Power Australia's ZOCT Table

AIR POWER AUSTRALIA

ZOCT TABLE:

IS THE JSF REALLY A FIFTH (5TH) GENERATION FIGHTER?

Senate Estimates, 02 & 03 June 2014

Senator CONROY: …..You have been very emphatic that ***generation five*** against ***generation four*** is ***not a contest***. Other than the countries you have named, are there any other countries that you are aware of who have developed the fifth-generation fighter capacity at this stage?
Air Marshal Brown: The Chinese have two aircraft in development and the Russians have an aircraft as well. But the way I would characterise their development is that the JSF flew two prototypes probably 10 to 12 years ago, and that is about where both of those countries are at the moment. There is a fair bit of work to be done on all three aircraft. I do not believe that any of those three aircraft have the same stealth characteristics of an F-35.
Air Marshal Brown: I think it is on two bases: probably stealth technology, the inability to have low probability of detection on electronic emissions, and engine technology. This is where both the Russians and the Chinese are significantly behind Western engines.
Air Marshal Brown: No, I think that they *[the Russians]* would like to see it *[Su-50]* as a pure fighter aircraft. At the moment I am not aware of any air-to-ground munitions that it is able to drop.
Air Marshal Brown: One [Chengdu J-20] is probably a pure fighter. I would classify it more as an interceptor. The other one [Shenyang J-31] is a little bit more like an F35.
Some Data and Facts: ***Beliefs, feelings and conjecture are negotiable; data and facts are not!*** (1) Two X-35's flew in 2000; were Dem/Val proof-of-concept test articles; not representative of F-35. (2) Sukhoi contracted to design/develop the Su-50 in 2002, same year JSF SDD contract was signed. (3) Reports of Chengdu J-20 scaled and full scale test articles flown circa 2006. (4) Quality of finish of J-20 noted back in 2011 as being at level of pre-production prototype. (5) J-20 has equivalent of 4 x large weapon bays + 6 x external store wing stations. J-20 Serial No 2021 is first production aircraft. (6) Su-50 (T-50 PAK-FA) has similar weapon/store carrying configuration; is equipped with new A-A and A-G weapons as well as weapons/stores from extant inventory. Su-50 in full scaled production by 2017. (7) Unlike the F-35A JSF, the J-31 is a twin-engined, large finned, LO 'stealthy' design aircraft with shaping features more akin to those of the F-22A Raptor. Likely will also be carrier suitable.

Annex A: ZOCT (*Zero-One Comparative Technique*) Table

Is the JSF Really a Fifth Generation Fighter?

(Updated: 13 January 2016)

5th Generation Air Combat Fighter Capability Metrics	Operating Post 4th Gen Air Combat Capability Aircraft				Current Threat	NACC Aircraft
	F-22A Raptor	T-50 PAK-FA	Chengdu J-20	F-35A JSF Lightning II	Gen 4++ Su-35S	Super Hornet F/A-18F
	USA	Russia	China	Internat'l	Russia	USA
Super Cruise, Mach 1.5 or greater in MILPWR	Yes (0)	Yes (0)	Yes (0)	No (-1)	Yes (0)	No (-1)
Super Agility Supersonic / Subsonic	Yes (0)	Extreme Plus (+1)	Extreme (+1)	Neither (-1)	Extreme (+1)	Neither (-1)
Very High Specific Excess Power - P_s	Yes (0)	Yes (0)	Yes (0)	No (-1)	Yes (0)	No (-1)
Thrust Vectoring Control - TVC 2-D	Yes 2-D (0)	Yes 3-D (+1)	Accommodated	No (-1)	Yes 3-D (+1)	No (-1)
Advanced Highly Integrated Avionics	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
Electronically Steered Array (ESA) Radar	High Power Aperture (+1)	High Power Aperture (+1)	Yes (0)	Medium Power Aperture (0)	High Power Aperture (+1)	Medium Power Aperture (0)
Additional ESA Apertures	FFBNW (0)	Yes + L Band (+1)	Insufficient Data	No (-1)	Yes + L Band (+1)	No (-1)
High Situational Awareness (SA) - Onboard/Offboard	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
Large Supersonic Weapons Delivery Envelope	Yes (0)	Yes (0)	Highly Probable	Limited (Slab Doors / Toed-In SS) (-1)	Yes (0)	Limited (Toed-Out Carriage) (-1)
Large Thrust to Weight Multi-Engine Thrust Growth	Yes 2 Engines Large Growth (0)	Yes 2 Engines Large Growth (0)	Yes 2 Engines Large Growth (0)	Middling T/W Single Engine Little Growth (-1)	Yes 2 Engines Large Growth (0)	Middling T/W Little Growth (-1)
High Combat Ceiling Loiter/Operate (> 7 deg /sec sustained @ 30 kft)	Yes, > 55 kft Yes (0)	Yes, > 60 kft Yes (0)	Yes, > 50 kft Yes (0)	No, < 45 kft No (-1)	Yes, > 55 kft Yes (0)	No, < 45 kft No (-1)
Very Low Observable (VLO) RF Stealth	All Aspect Wideband (+1)	Yes but Partial (0)	Yes but Partial (0)	Yes but Partial (0)	No (-1)	No (-1)
Good Non RF Low Observables	Yes (0)	Yes (0)	Yes (0)	No VOVS/WVE (-1)	Yes (0)	Yes (0)
Large Internal Usable Fuel Load / Persistence (klbs)	Yes >18k lbs PLUS thermal cooling fuel (0)	Yes, ~23k lbs (+1)	Yes, ~25k lbs (+1)	18.2k lbs MINUS thermal cooling fuel (0)	Yes >23k lbs (+1)	No <13.5k lbs (-1)
Internal Weapon Carriage Hard Point Stations	Yes 6 + 2 (0)	Yes 6+2 (0)	Yes 6 + 2 (0)	Yes 4 (0)	Partial (Tunnel Pod) 2 - 4 (-1)	No (-1)
ZOCT Scoring by 5th Gen Metrics	+2	+5	+2	-9	+3	-11

ZOCT Scoring:

-1 Does not meet 5th Gen Metric

0 Meets 5th Gen Metric

+1 Meets 5th Gen Metric with Enhancing Characteristic/s

Notes:
(1) Though outside scope of this ZOCT Table, suitable and effective A-A/A-G weapons are crucial metrics of the overall air combat capability.

(2) Price is not a 5th Gen metric. Though, when it comes to comparative/competitive pricing of any aircraft let alone 5th Gen air combat aircraft, the fundamental tenets of any such analysis include:

a. Compare the 'total price', not some subordinate 'cost' (e.g. unit recurring flyaway cost).
b. Compare in US$'s applicable at the time of purchase, cogniscant of purchasing power parity (PPP) and the influence this has on comparative/competitive pricing outcomes.
c. Match 'price' to 'capabilities'- the price being total payment at time of purchase for what is needed.
d. Beware of 'order splitting', 'price splitting' and other techniques used to spread the price over various activities other than the acquisition. For example, in relation to the F-35 JSF, '*the never ending price*' baked into the designs.

Summary of Observations

a. Relative to most Fourth (4th) and evolved Third (3rd) Generation air combat fighter aircraft, Fifth Generation Fighters are large, twin engined quite stealthy (VLO-RF/LO-Other) designs with Super to Extreme Agility over the aircraft's total flight envelope (from post-stall to high supersonic), capable of super-cruising at up to Mach 1.5 or higher, with sufficient specific exess power (Ps) for both BVR and WVR engagements, inherent survivability and persistence (both weapons and fuel), and the ability along with the sensors and information processing and networking capabilities to provide their pilots and other operators with high levels of precise and accurate situational awareness in real time.

b. In terms of Fifth (5th) Generation Air Combat Fighter Capability Metrics, the F-35A JSF scores poorly, rating only slightly ahead of the F/A-18F Super Hornet - a Gen 4.5 design - yet well behind the Su-35S - the Russian Gen 4++ design.

Conclusions

1. The F-35A JSF's shortfalls in most of the cardinal Fifth (5th) Generation capabilities do not warrant this aircraft being called a Fifth (5th) Generation Fighter Aircraft, as defined by the marketplace.

2. This should come as no surprise to anyone familiar with the JSF JORD and its origins which sought a medium stealth fighter (MSF) with a single engine and relaxed aero-propulsive performance, both for reasons of affordability, and commonality of design with the STOVL F-35B variant being the baseline design for all three JSF design variants.