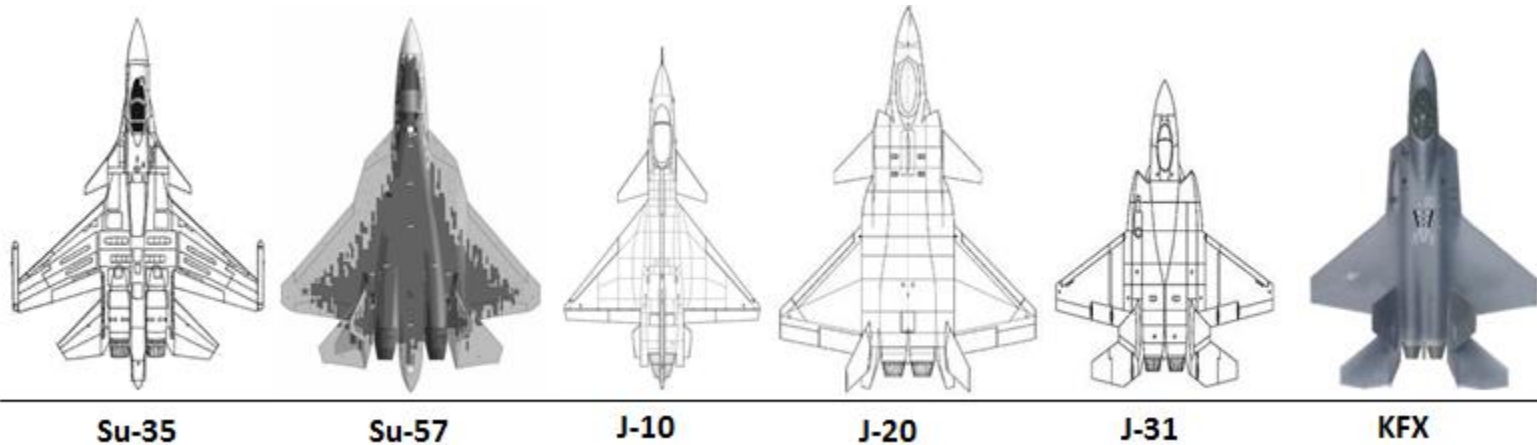
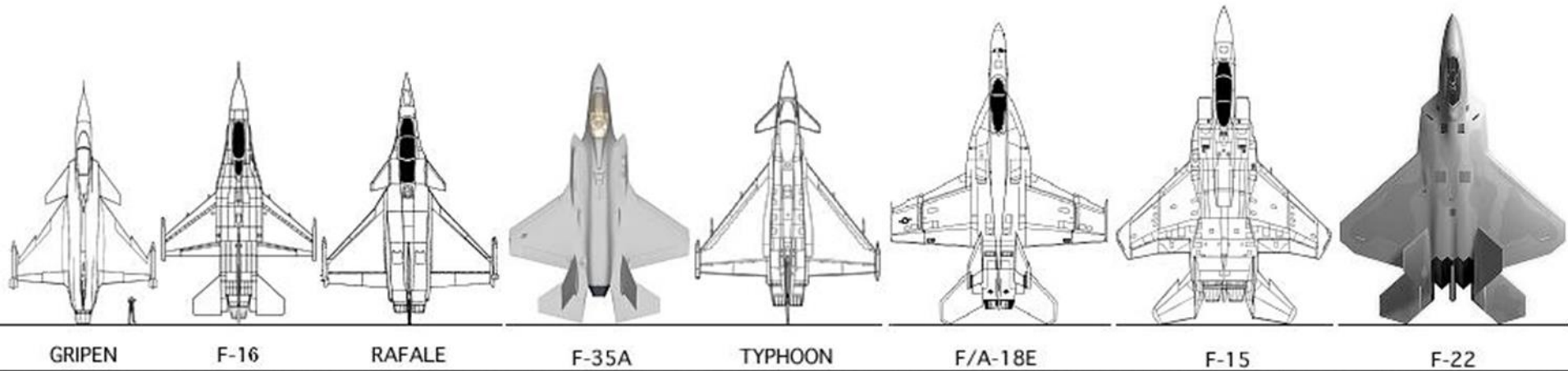


# Fighter Aircraft Design



## Fighter Aircraft Design



**Burt Rutan and I have been fighting the evil global warmers.  
Burt is the world's most distinguished aeronautical engineer.**

**David Archibald**

### What Australia has: Light Bombers



**Super Hornet – too heavy relative to thrust to survive in combat now  
– should be tasked to carrying anti-ship cruise missiles**

**Australia has 36 Super Hornets in service, of which 12 are electronic warfare variants (Growlers).**

---



# Fighter Aircraft Design



- F-35 – this dog will suck all the money out of the defence budget**
  - and then get shot out of the sky in combat**
  - actually a light bomber with low survivability**
  - a triumph of marketing over reality**
  - Australia doesn't have any fighter aircraft – just light bombers**
-

## Fighter Aircraft Design



**Sukhoi Su-35 – very big, maneuverable, carries up to 14 air-to-air missiles  
Not as agile as the Euro-canards**

**Su-35 is 12% heavier than the Su-27, 15% more thrust, 22% more internal fuel. It has an internal fuel fraction of 38% - 11.5 tonnes of internal fuel.  
But the Gripen is going to see the Su-35 far earlier than the Su-35 sees the Gripen - radar, infrared, visual.**

---

## Fighter Aircraft Design



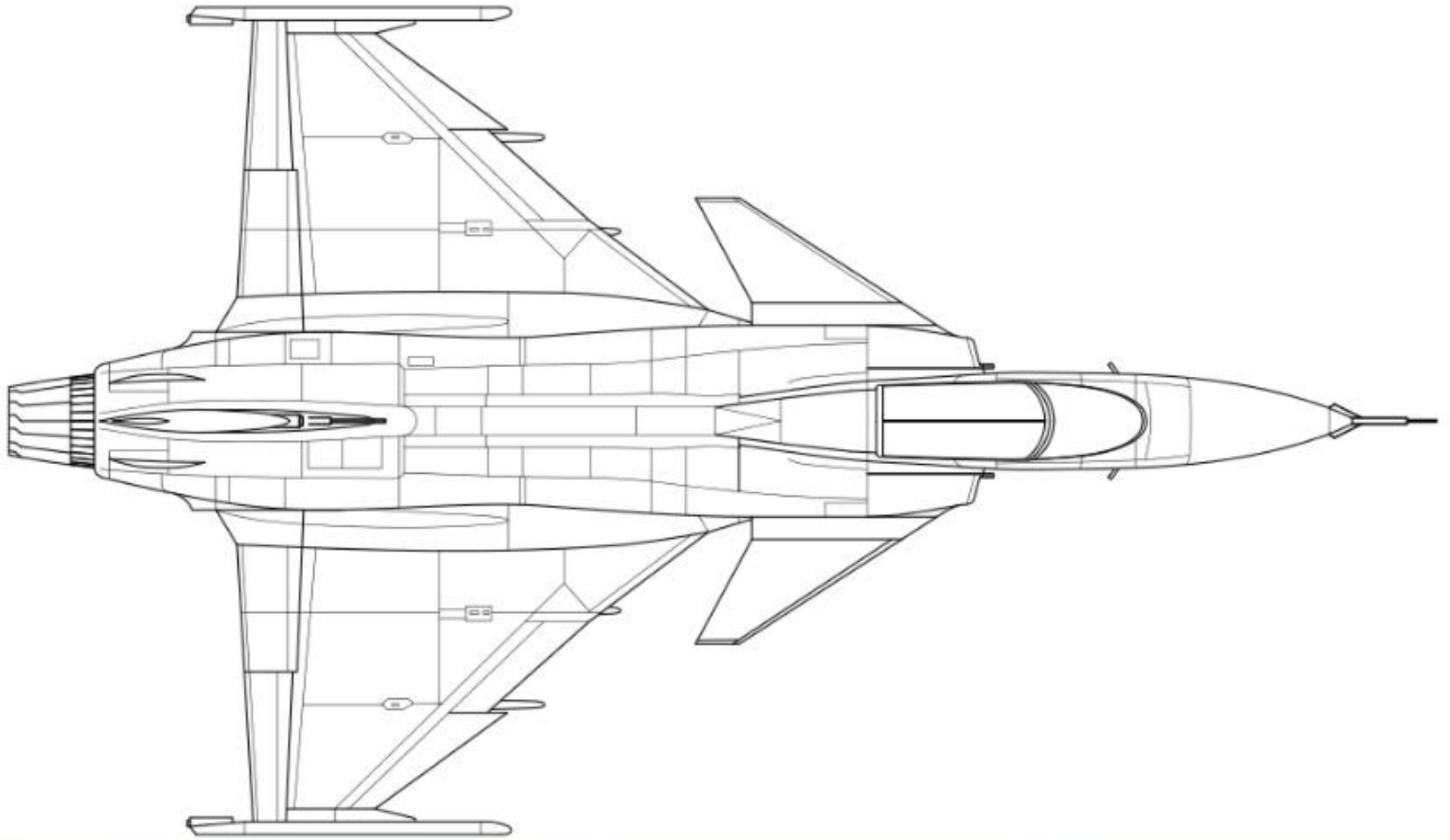
**Saab Gripen – a pure fighter put together from MOTS components**

**Our best chance of getting air superiority over the Su-35**

**Saab has priced the Gripen to be half the cost of the Rafale for similar performance**

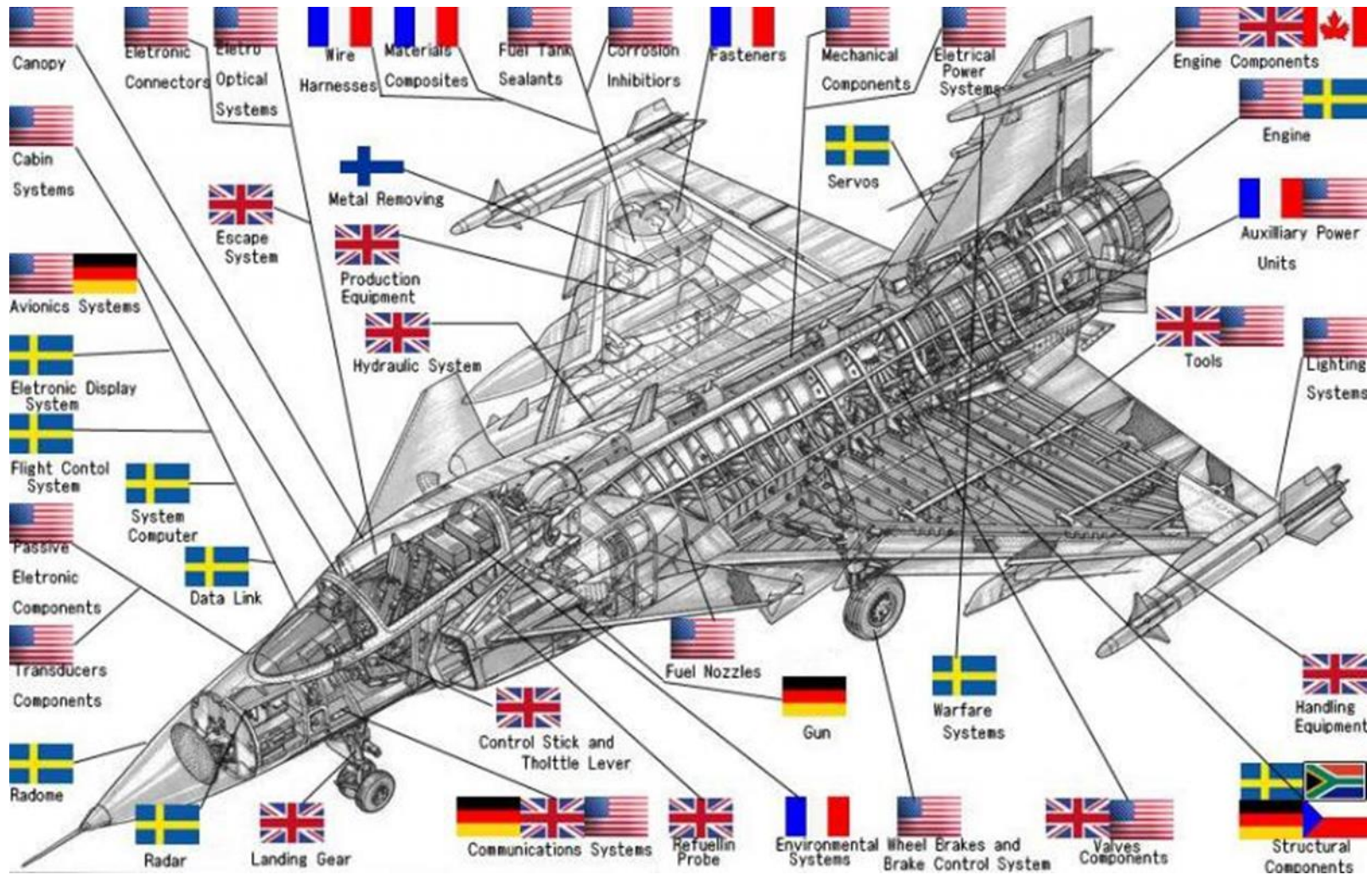
---

# Fighter Aircraft Design



**Gripen E plan view – 15.2 metres long, 8.6 metres wide**

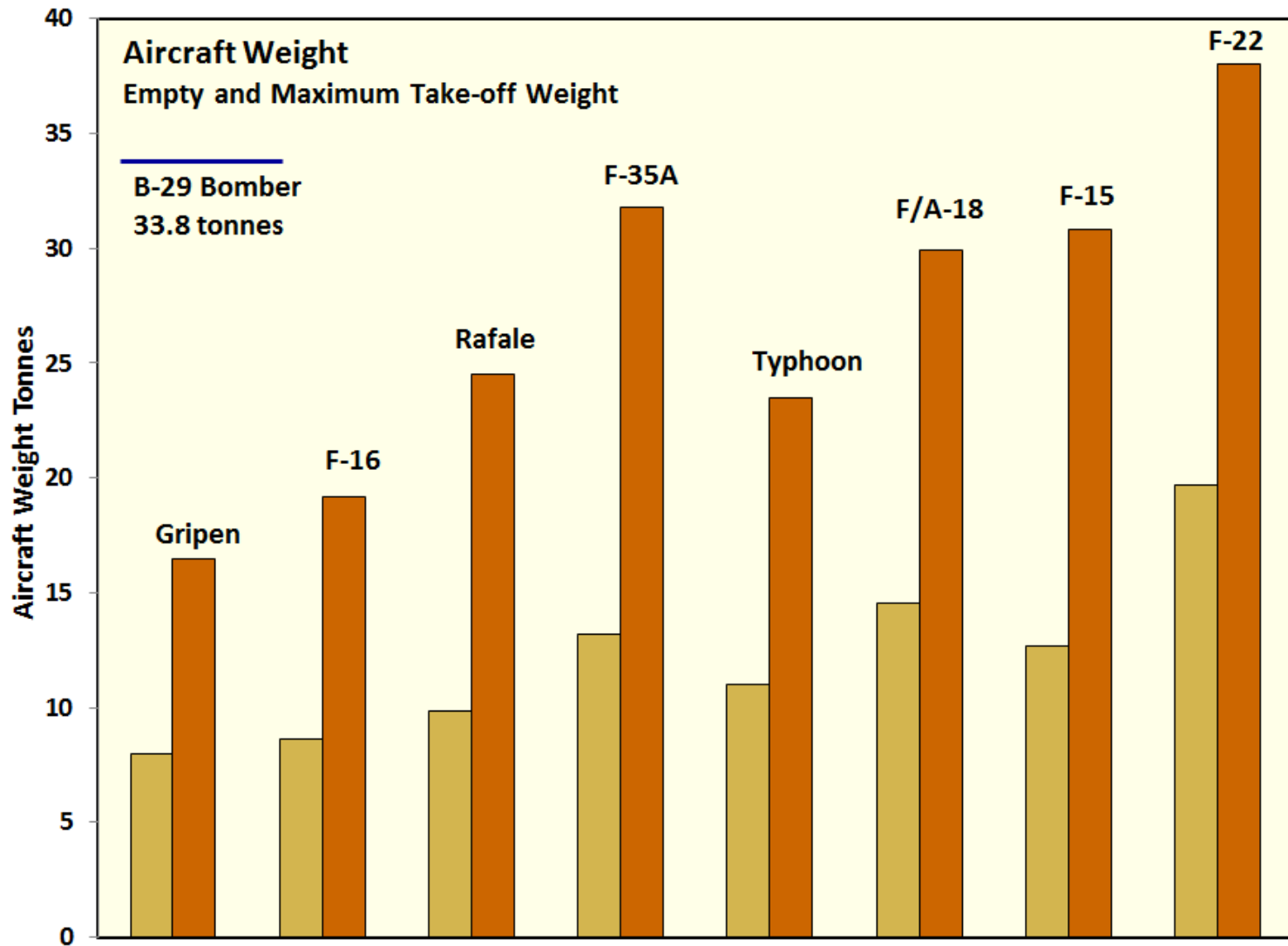
# Fighter Aircraft Design



**The Gripen E is built around the same engine as that of the Super Hornet, the General Electric F414.**



# Fighter Aircraft Design



**The F-22 is 2.5 times the size of the Gripen.**

# Fighter Aircraft Design

I	ACHIEVE SURPRISE BOUNCES WITHOUT BEING SURPRISED	<ul style="list-style-type: none"><li>● FROM WWI TO VIETNAM, 65% TO 85% OF ALL AIR-TO-AIR LOSSES WERE SHOT DOWN UNAWARE</li></ul>
II	OUTNUMBER THE ENEMY <u>IN THE AIR</u>	<ul style="list-style-type: none"><li>● 70 VASTLY SUPERIOR ME-262s WERE GROUND DOWN BY 2000 INFERIOR P-47s AND P-51s</li></ul>
III	OUTMANEUVER THE ENEMY TO GAIN FIRING POSITION	<ul style="list-style-type: none"><li>● ALWAYS DOMINATED BY PILOT ABILITY/TRAINING</li><li>● ENERGY MANEUVERABILITY PLUS TRANSIENT PERFORMANCE</li></ul>
IV	ACHIEVE RELIABLE KILLS DURING ANY SPLIT-SECOND OPPORTUNITY	<ul style="list-style-type: none"><li>● AIR COMBAT HAS ALWAYS REQUIRED VISUAL ID</li><li>● THE MORE AIRCRAFT ENGAGED, THE MORE FLEETING THE FIRING OPPORTUNITIES</li></ul>

**John Boyd formulated the rules, as summarised by Pierre Sprey in 1982: *Comparing the Effectiveness of Air-to-Air Fighters F-86 to F-18***

---

# How to win in air-to-air combat

- 1. Surprise the opponent without being surprised.**
    - better situational awareness
    - ability to supercruise
  - 2. Outnumber enemy in the air.**
    - lower purchase cost without losing qualitative edge
    - lower operating cost per hour of flight
    - low maintenance requirement for higher sortie rate
  - 3. Out-maneuver the enemy to gain firing position.**
    - low wing loading for high turn rate
    - ability to decelerate and accelerate
  - 4. Outlast the enemy while out-maneuvering him.**
    - have a high fuel fraction of the fighter's loaded weight
  - 5. Achieve reliable kills.**
    - carry enough missiles and rounds for the gun
-

## Performance: Air-to Air

In the words of Lieutenant General George K. Muellner, USAF ...

- ▶ *JSF design: 70% for air-to-ground, 30% for air-to-air.*

Director and program executive officer, Joint Advanced Strike Fighter

- ▶ *... the JSF complements the F-22 in the high-low mix. The F-22, as the high-end of the force mix, is designed to dominate the air superiority arena through the combination of stealth, supercruise, integrated avionics, and large internal weapons bays. The JSF, as the low-end, will be designed as a stealthy multi-role air-to-ground fighter reliant on the enabling force of the air dominant F-22. ...*

PRESENTATION TO THE HOUSE NATIONAL SECURITY COMMITTEE  
SUBCOMMITTEE ON MILITARY PROCUREMENT

Principal deputy, Office of the Assistant Secretary of the Air Force  
(Acquisition)

---

**We need another fighter to protect the F-35 on its bombing runs.**



## Fighter Aircraft Design

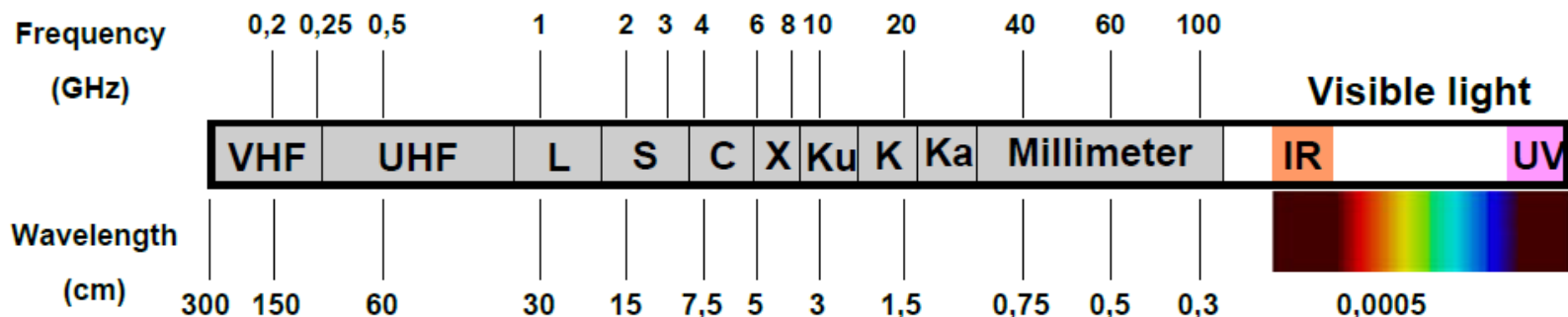
**Gripen's infrared detector is looking at the sky.**



**F-35's infrared detector is looking at the ground.**

## Stealth isn't that important anymore.

1. Aircraft don't fly with their radars on because it just attracts radar-homing missiles and tells the enemy where the emitting aircraft is. "He who emits, dies."
2. Stealth only works in the X band that aircraft radars use. Ground-based VHF radars can detect stealth fighters hundreds of kilometers away. So can AWACs that use the L band such as Australia's Wedgetail. Russian fighters now have L band radars in their wings.
3. The electronics of infrared detection have improved and infrared is the best passive way of detecting other aircraft.



## Stealth negated

Long range radars, sophisticated ESM (coordinated DF), lower frequency L-Band radar and infrared scan and track sensors on aircraft when cued by HF OTH radars that can track current generation stealth aircraft, effectively negate Stealth, especially over water where there is no “fog of war” in which to hide;

**ESM** – **electronic support measures**

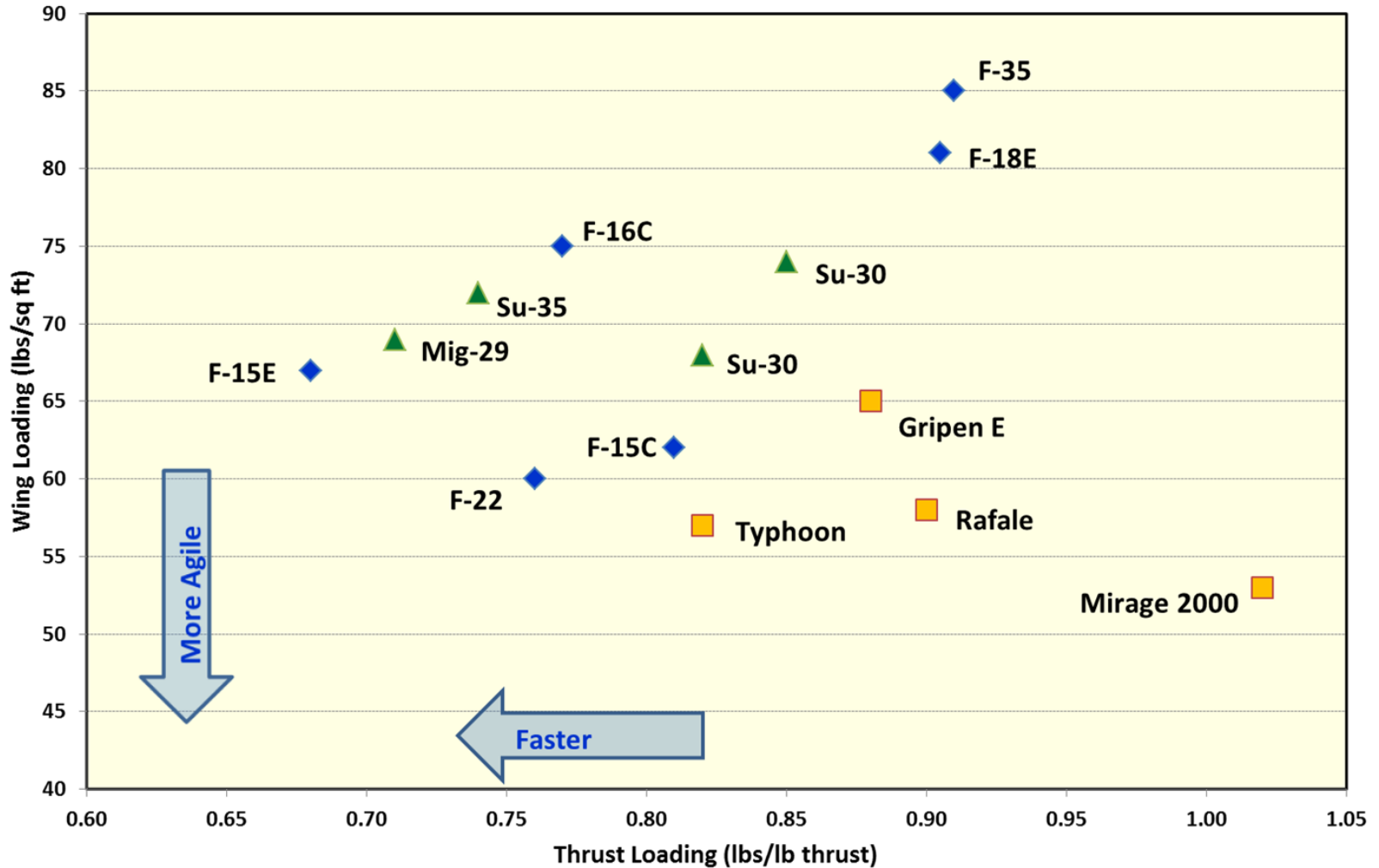
**DF** - **direction finding**

**HF** - **high frequency**

**OTH** - **over the horizon**

---

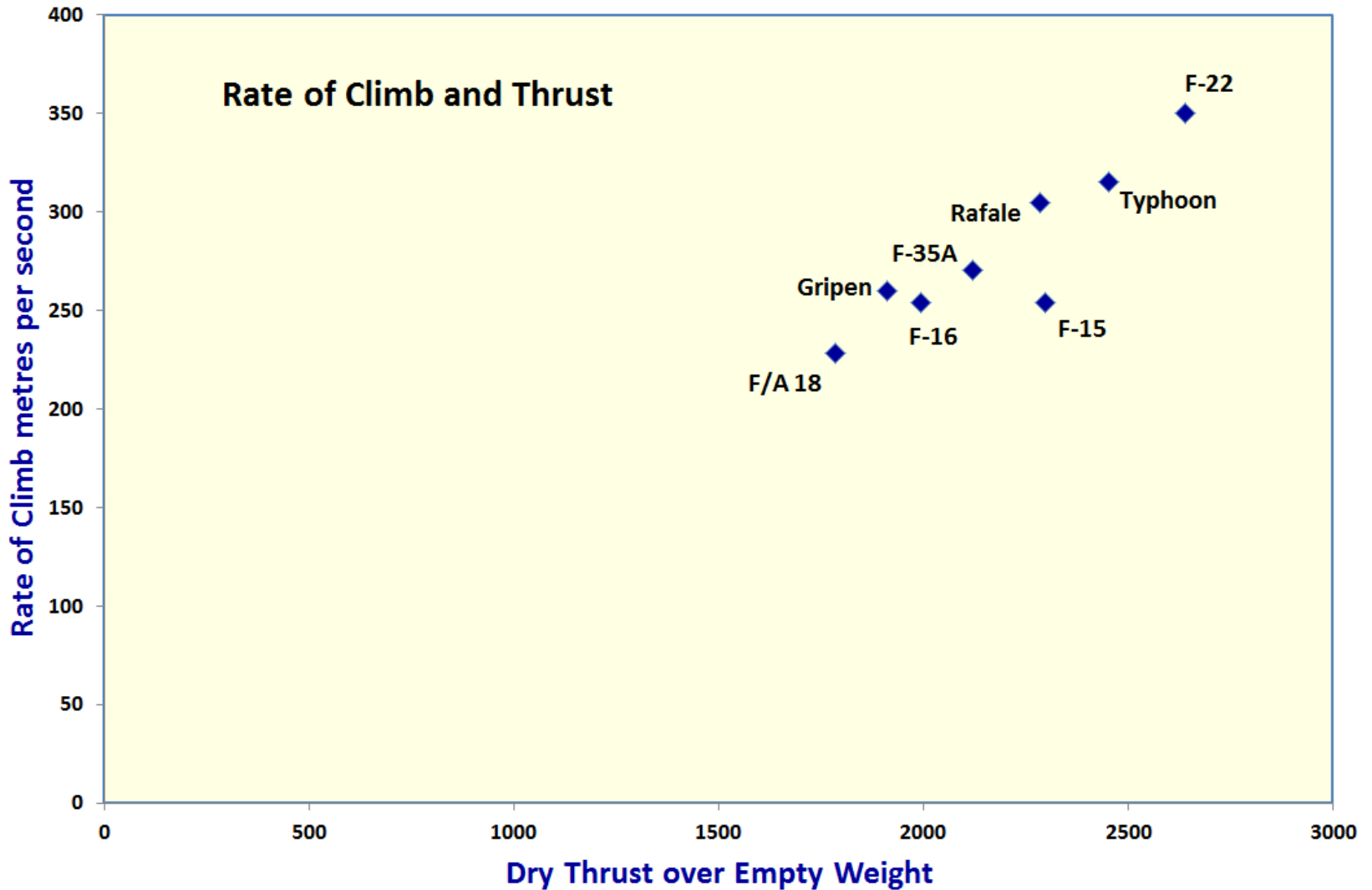
# Fighter Aircraft Design



Australia's two light bombers, the F-35 and the Super Hornet, will be outmaneuvered by everything else in the sky.



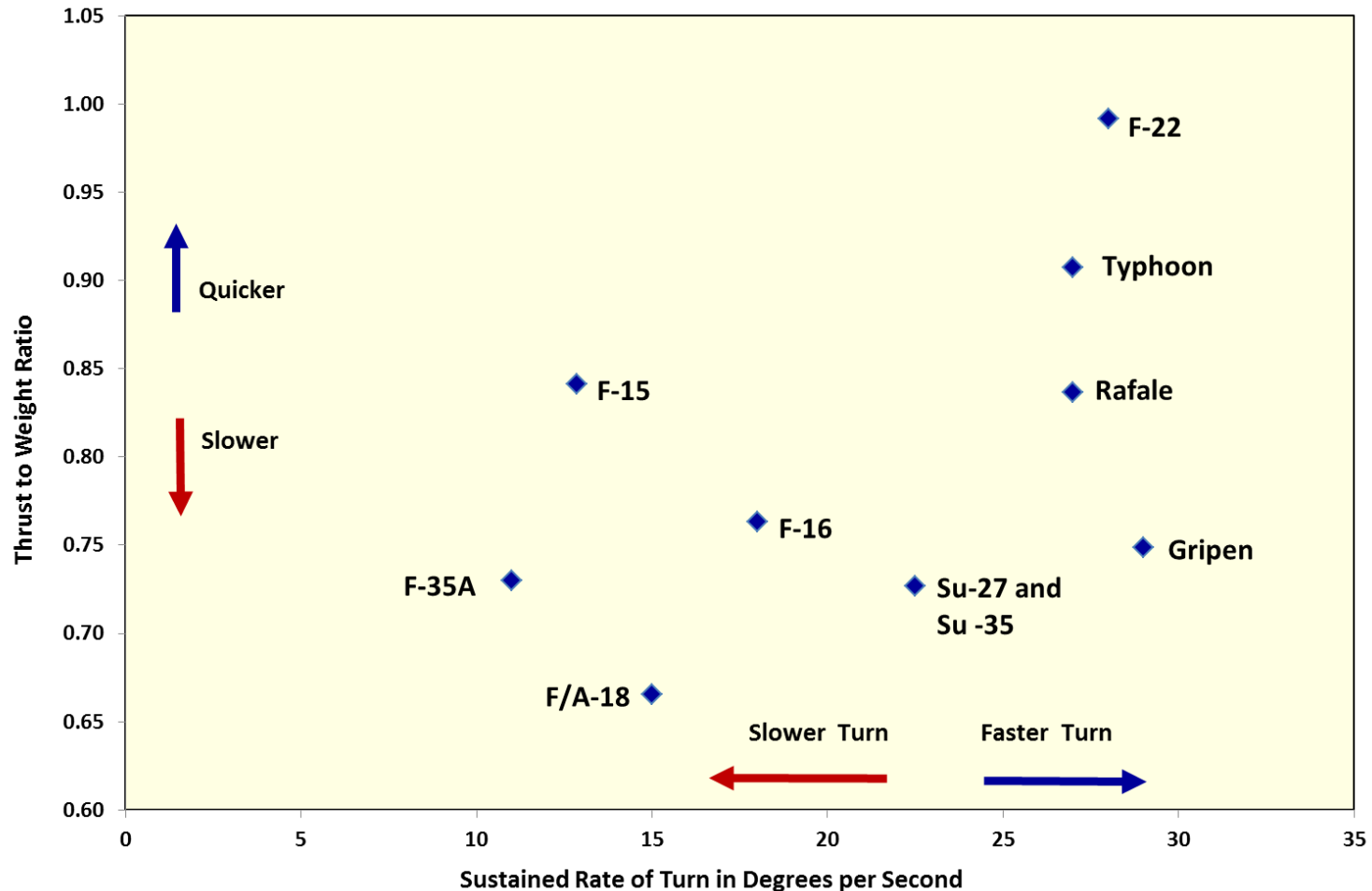
# Fighter Aircraft Design



**The bigger fighters are more muscular.**

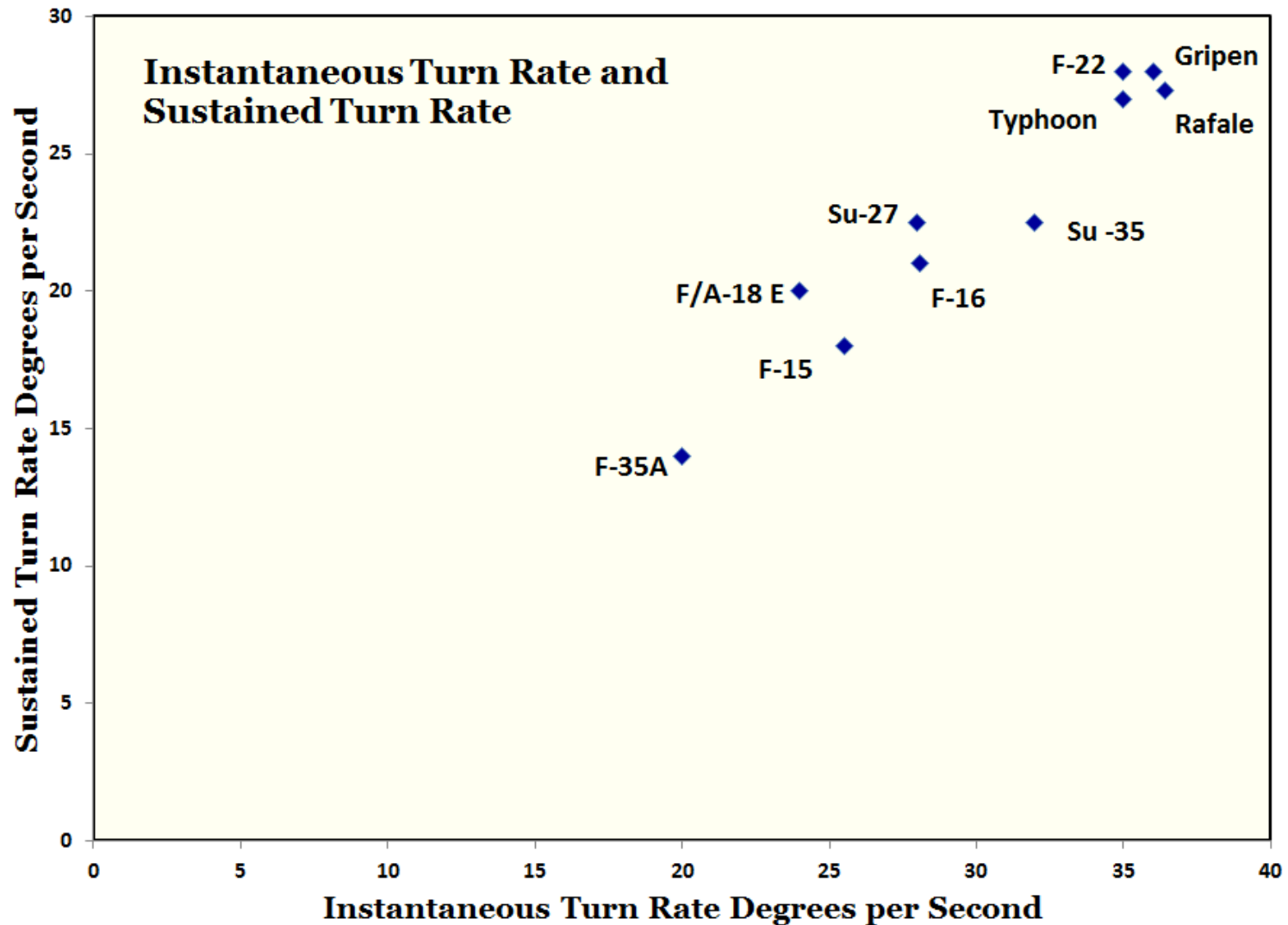
# Fighter Aircraft Design

The can't turn and can't run of the 2008 Rand study's "Can't Turn, Can't Climb, Can't Run" assessment of the F-35.



Australia has the two dogs.

# Fighter Aircraft Design



**The aircraft on the right will be far better at dodging missiles and then will out-turn in the following dogfight.**

## Fighter Aircraft Design

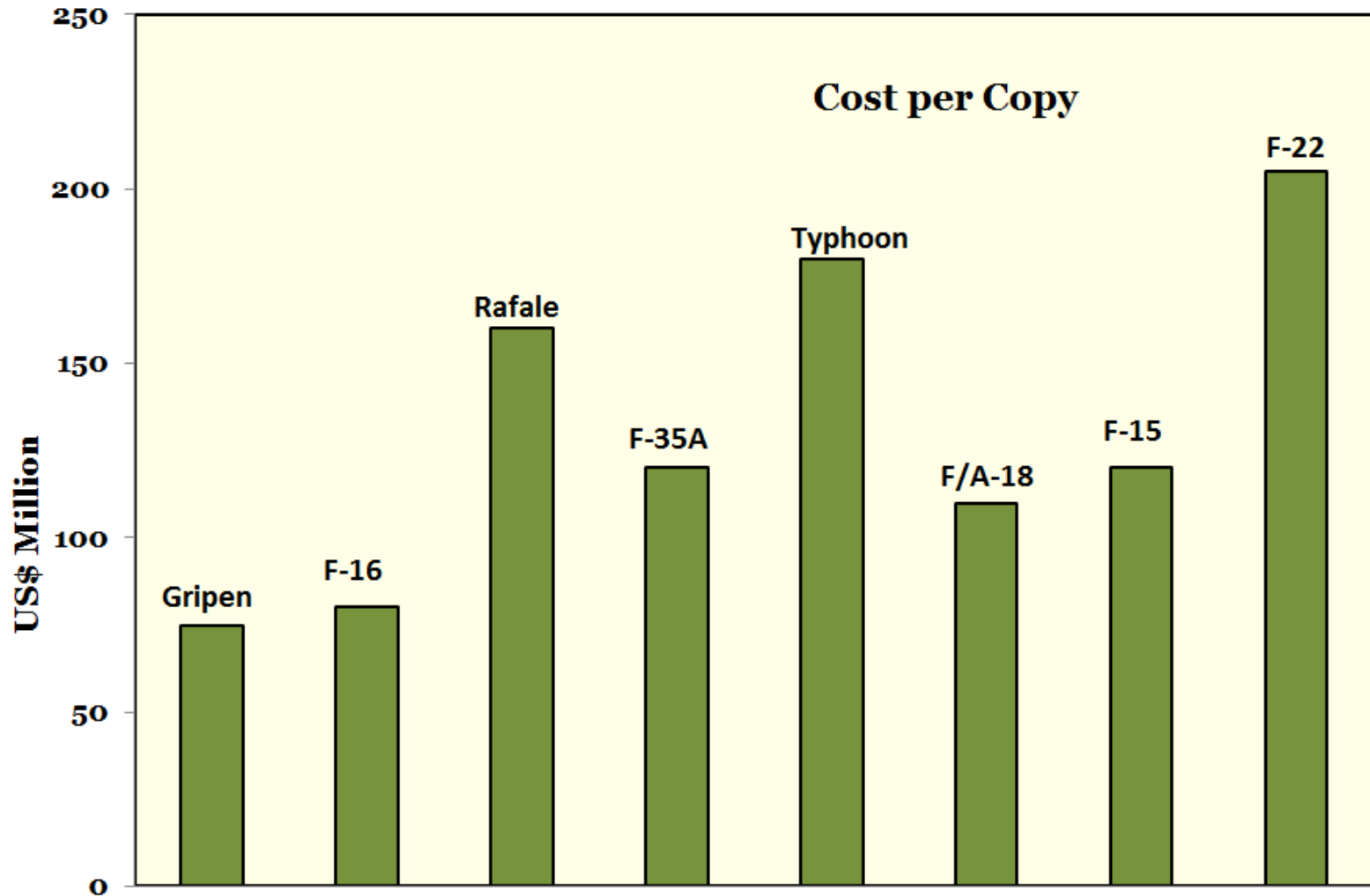


**Three F-22 kills on a German Typhon from Red Flag Alaska 2012**  
**“In the end, the F-35 will have a good situational awareness  
of the fighter that kills it.”**

---



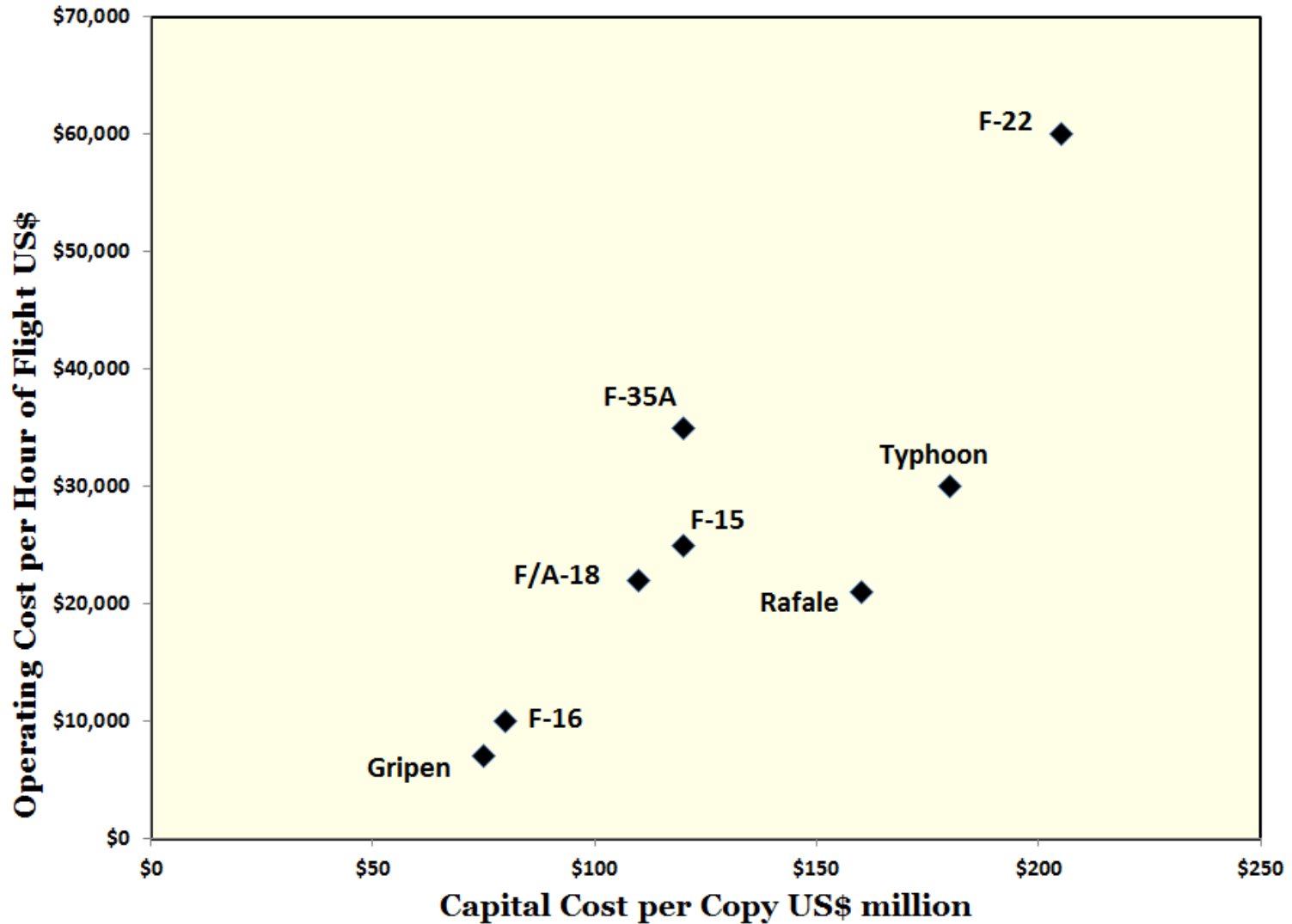
# Fighter Aircraft Design



At one stage Lockheed Martin were quoting the F-35 price with the engine separately.

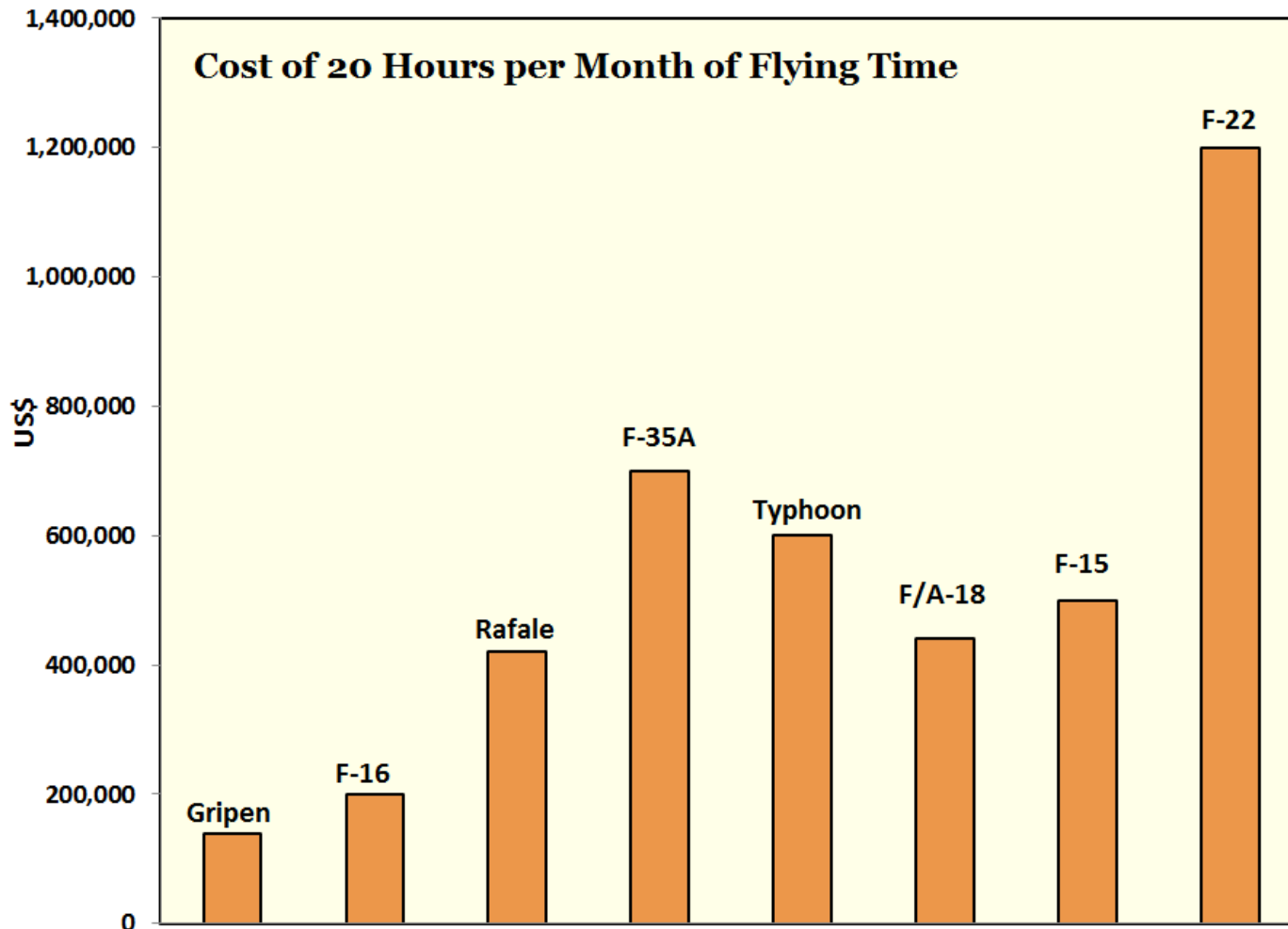
Like quoting the price of a car with the engine as an optional item.

# Fighter Aircraft Design



**Double whammy – operating cost is proportional to capital cost.**

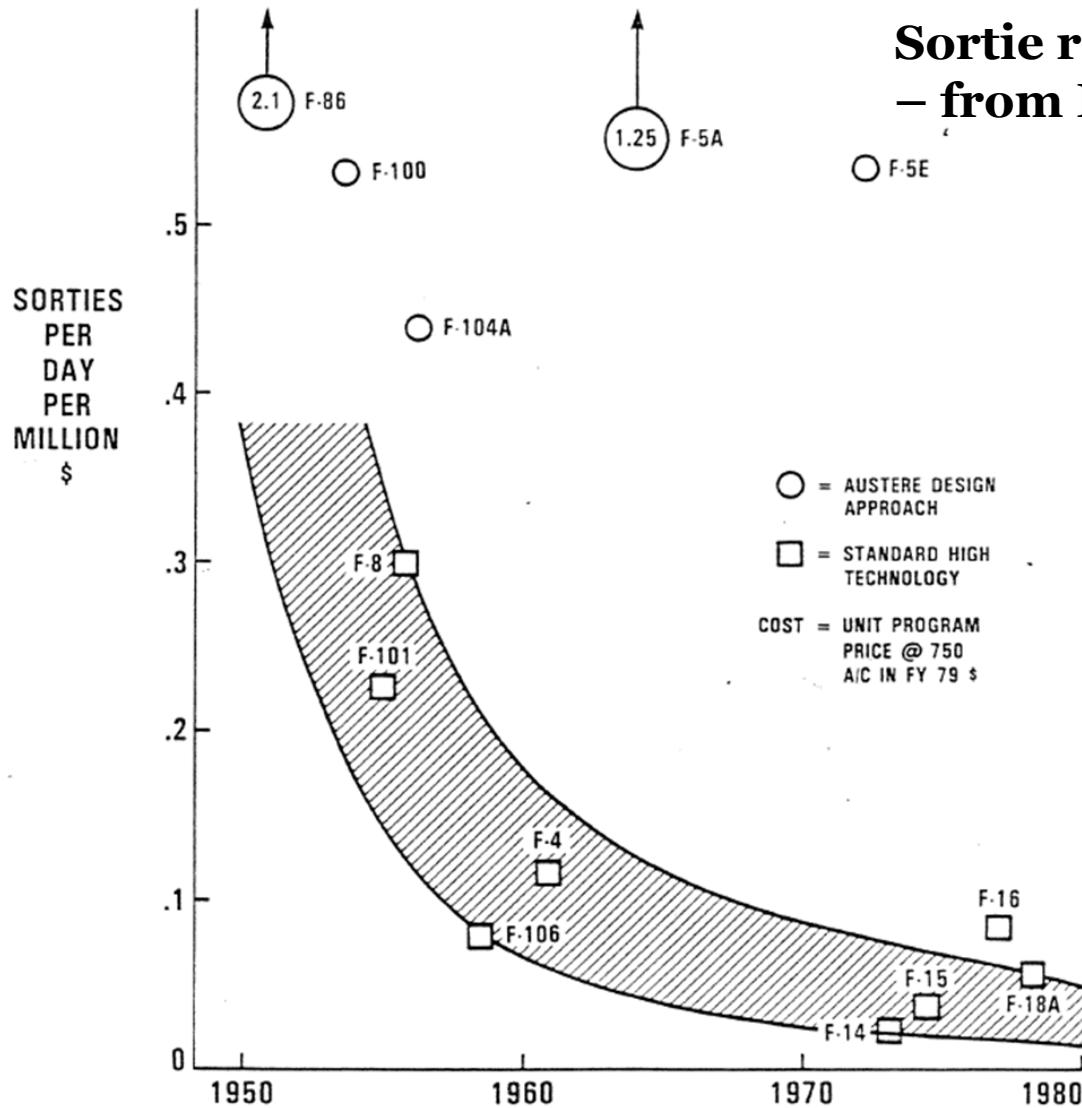
# Fighter Aircraft Design



**To keep 72 F-35 pilots proficient would cost A\$1.5 billion per annum.  
To keep 72 Gripen pilots proficient would cost A\$116 million per annum.**

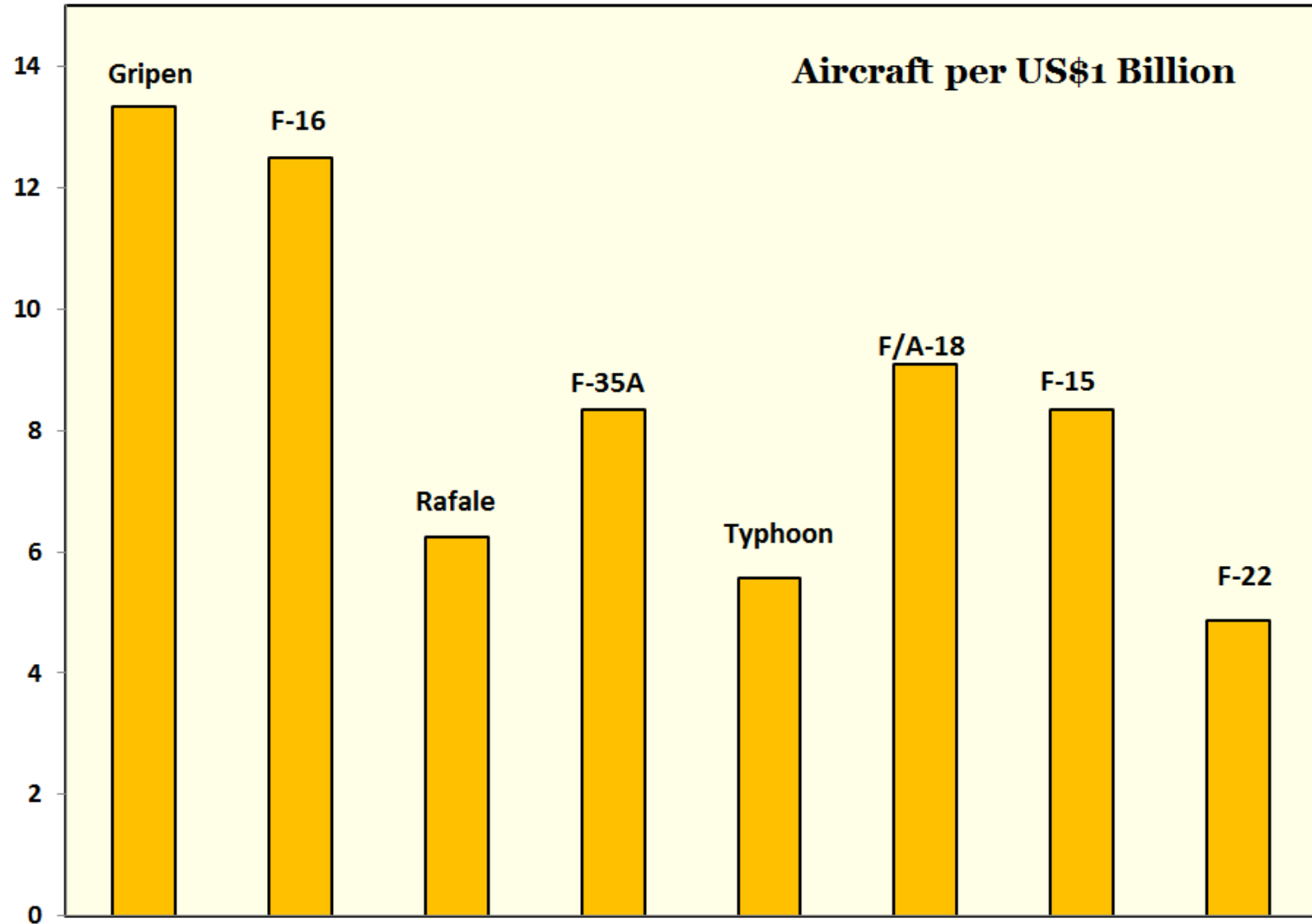
# Fighter Aircraft Design

**Sortie rate is important  
– from Pierre Sprey's 1982 report.**



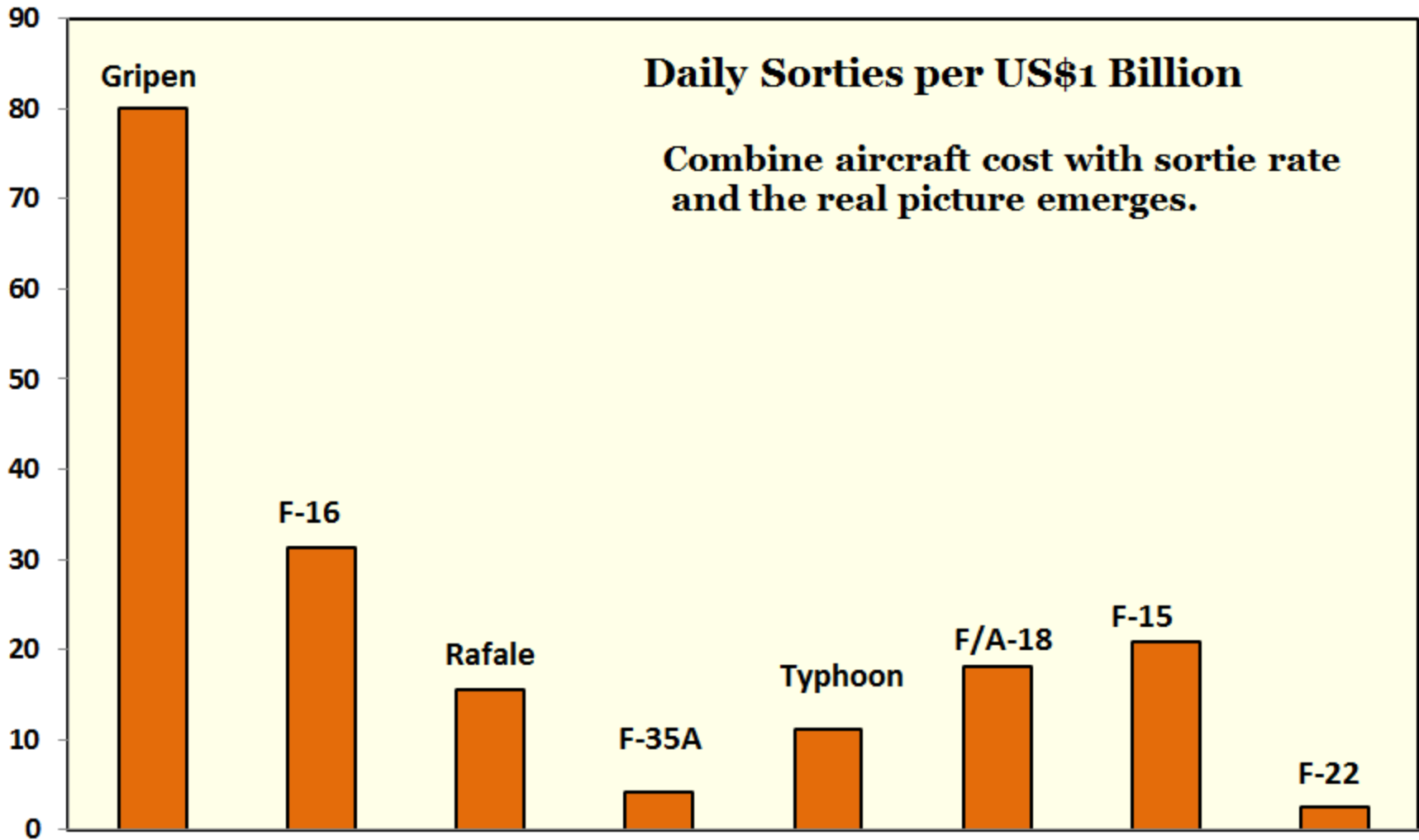


# Fighter Aircraft Design



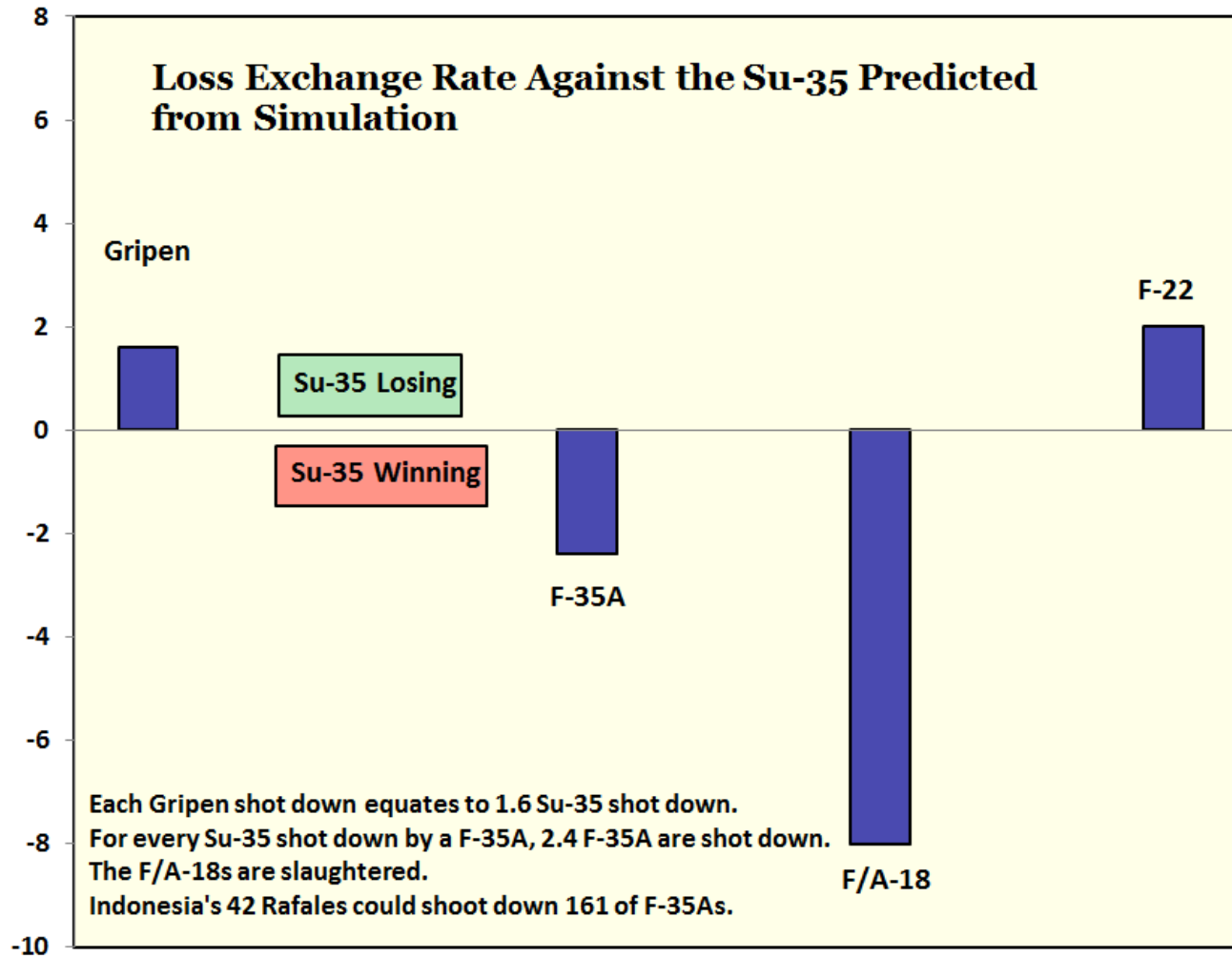
**A good path to air superiority is to get more aircraft, of equal capability, for the same outlay.**

# Fighter Aircraft Design



Avionics components tend to produce cycle-related failures, whereas hydraulic pumps fail in relation to the hours of use that they have accumulated.

# Fighter Aircraft Design



**And then what happens in battle. We should give our pilots a better than even chance.**

# Fighter Aircraft Design

## Loss Exchange Ratios

F-22 v Su-35	F-35A v Su-35	F/A-18F v Su-35
1 to 2.1	2.4 to 1	8.0 to 1
Not bad at all	Depressing	Devastating

Today, the Navy's F/A-18E/Fs provide the nation with a powerful instrument for precision strike in non-contested operating environments at very short ranges, or at longer ranges when enabled by aerial refueling. As for survivabil-

**From: CSBA Report September 2010 "Sustaining America's Strategic Advantage in Long-Range Strike"**

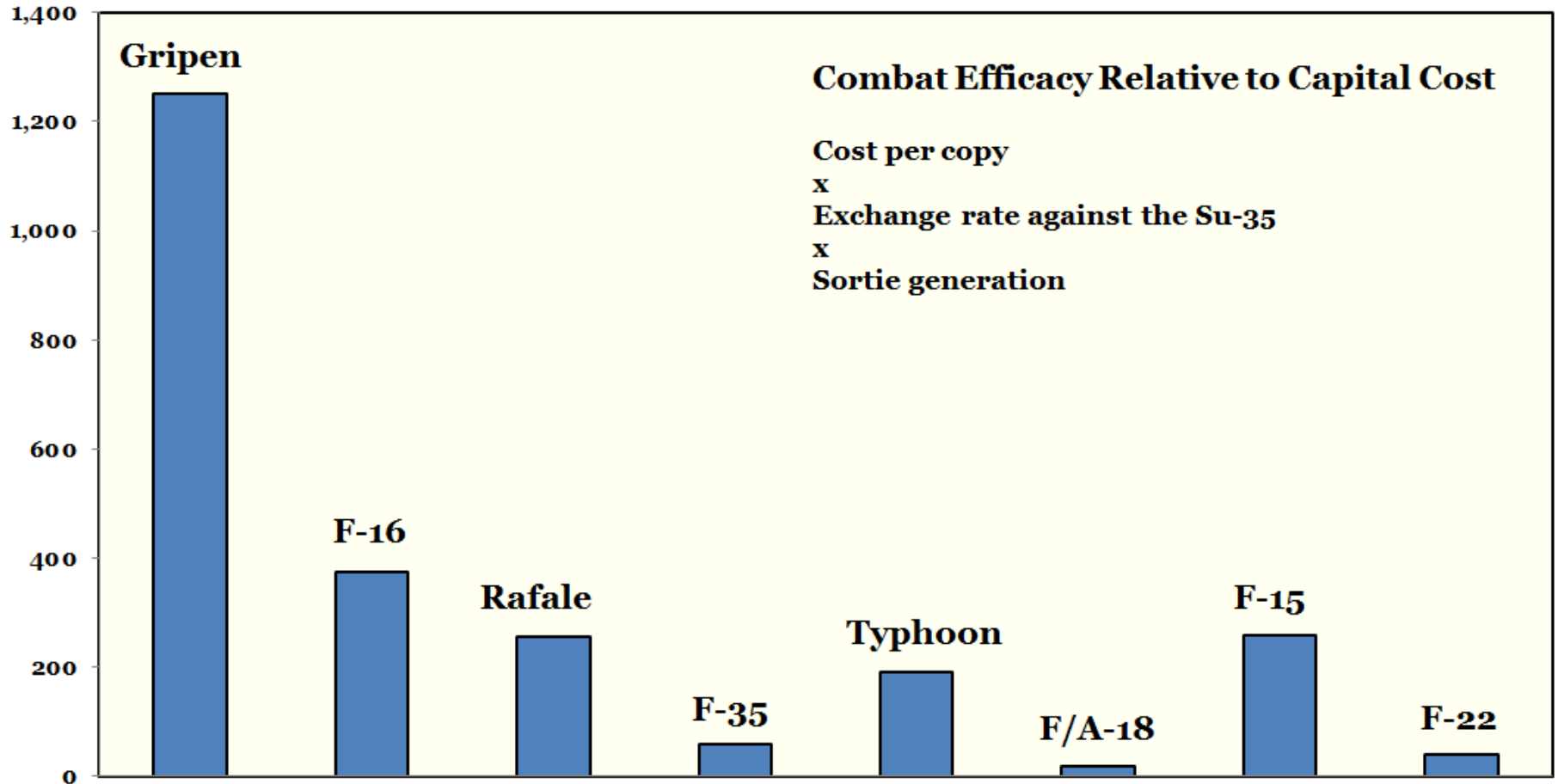
**So why are we still buying Super Hornets? They are just another light bomber.**

**The loss exchange ratio of the Gripen to the F-18 Super Hornet is 1: 21.**

---

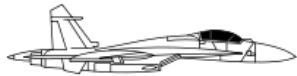
# Fighter Aircraft Design

## Combat Efficacy Relative to Capital Cost



**A dollar spent on the Gripen is 21 times more effective than a dollar spent on the F-35.**

## Optimum Cruise Altitude



**Su-35**



**F-22**

— 70,000'



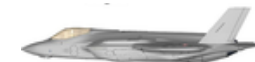
**Gripen**

— 60,000'



**F-18 Super Hornet**

— 50,000'



**F-35**

— 40,000'

— 30,000'

— 20,000'

— 10,000'

---

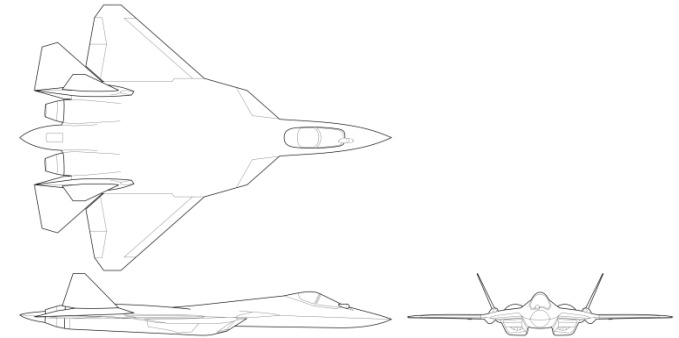
**BVR missiles from the F-35 have to climb 15,000 feet to the Su-35, decreasing range.**

**“No Escape Zone” of the Su-35’s missiles increased relative to the F-35.**

---



## Up next, the Su-57



**The outcome of Gripen E versus Su-35 is loss-exchange-rate of 1: 1.6, increases to 1: 1.9 if ASRAAM seekers are used on the Meteor missile.**

**The result is a combination of sensors, countermeasures and Meteor capabilities.**

**Gripen versus Su-57 loss-exchange-rate depends upon how the fight is flown.**

**Gripen's detections will be hampered by the LO of the Su-57, but if the Gripen flight uses ESM / IR and a Meteor with an IR seeker, the results should be about even.**

**Then there is 'cueing'. If the Gripen E flies in JORN coverage which will find the Su-57 (and an F-22 and a J-20) then the search box is reduced to about a cubic kilometre, and detection probabilities will rise. This would give Gripen E a slight advantage.**

---

# Fighter Aircraft Design



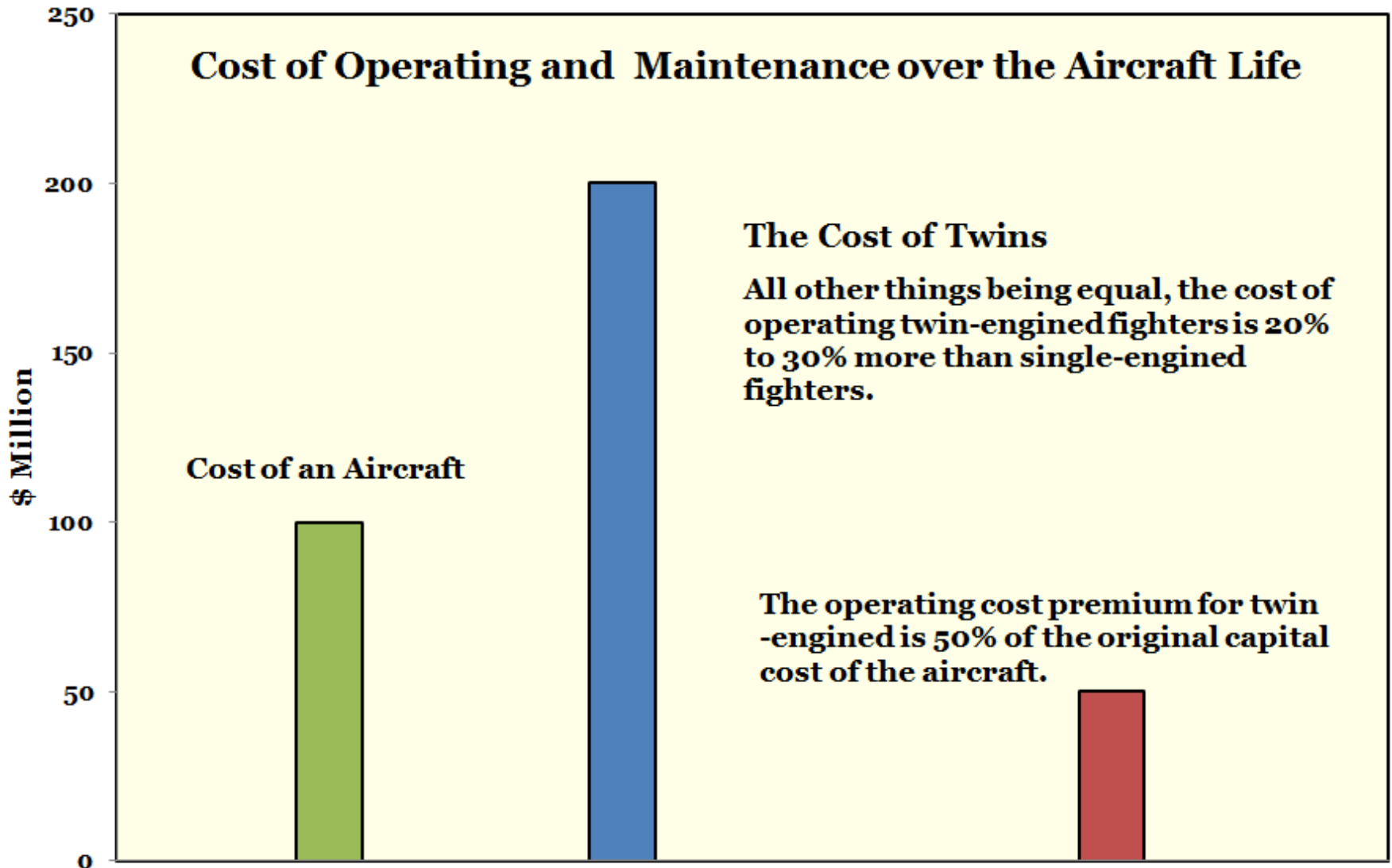
## Combat Radius

**Su-35** 1,600 km

**F-35** 1,080 km

**Gripen E** 1,000 km

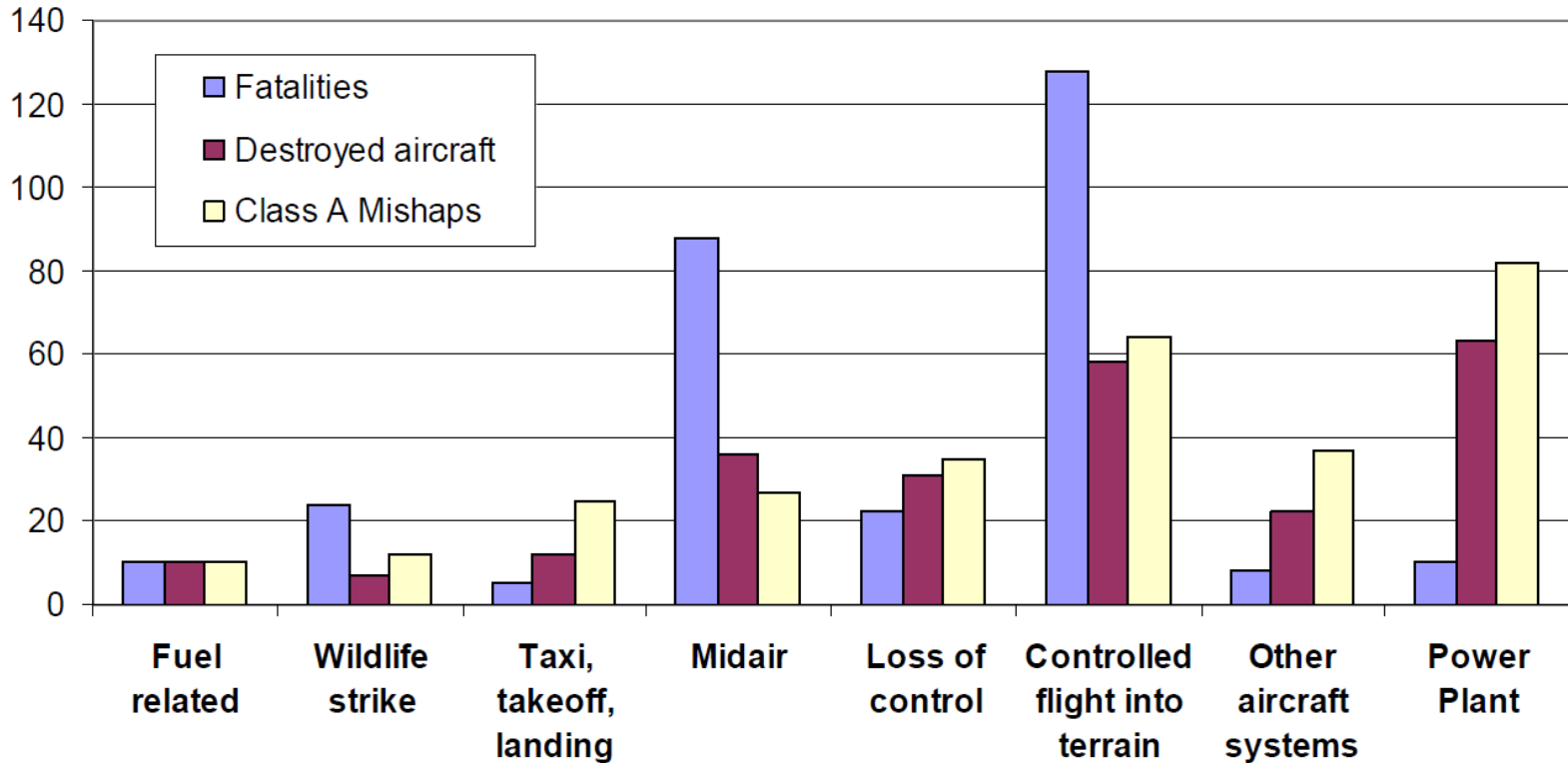
# Fighter Aircraft Design



# Fighter Aircraft Design

## USAF FY1993-2002

(source: Air Force Magazine Feb 2004)



**Which is unnecessary because jet engines have become far more reliable over the last 20 years. Engine-related fatalities are only slightly higher than taxiing, takeoff and landing fatalities.**

---

### **Basing – not a trivial consideration**

**Don't underestimate the value of operating from short airstrips.**

**RAAF Williamtown was extended to 10,000 feet to support the F-35 because of its execrable performance.**

**How many 10,000 ft airstrips are there in our region?**

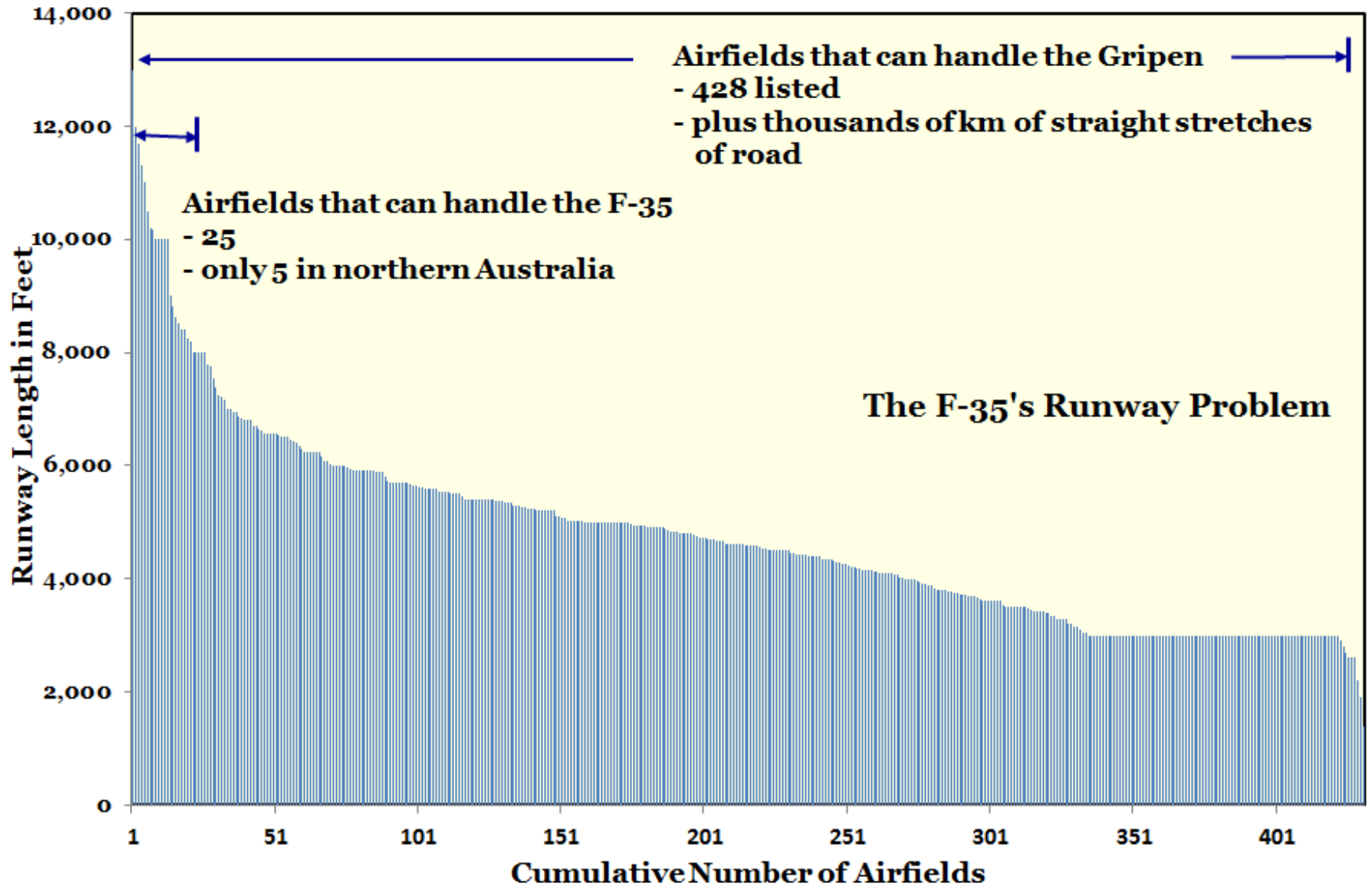
**Gripen was designed to operate on short, icy roads, so it needs about 800 metres of 16 metre-wide road.**

**There are about 350 Fokker Friendship-class airstrips across Australia and in the nearby islands. The Gripen can operate from these - the F-35A cannot.**

**And it is easy to maintain – an NCO and five conscripts rearm and refuel in a 15 minute turnaround.**

---

# Fighter Aircraft Design





## More on the F-35

- 1. Software upgrades on the F-35 are very difficult because the avionics were not separated from the weapons systems.**
- 2. The gun is useless - all other fighters have higher sustained turn rates than the F-35. Also useless in air-to-ground – inaccurate and the F-35 flies like a rock with tiny wings, thus must pull out of a strafing run before getting close.**
- 3. There is no date set for the Initial Operating Capability test – may not go into main production. The existing fleet will be orphans.**
- 4. The USAF is buying perhaps more than 400 F-15EX because of its lower operating cost.**
- 5. The Israeli Air Force was given F-35s but wants to buy more F-15s.**
- 6. Internal payload is incapable of carrying large enough missiles to compete with the upcoming competition – more like the glove compartment of a Ferrari.**
- 7. Bomb bay of the F-35 is at 100°C – cooking the electronics of the missiles it is carrying.**
- 8. F-35s at RAAF Tindal in the NT have not been able to take off because their fuel is too hot.**

## Yet more on the F-35

- 1. The aircraft is called "Fat Amy" by the actual pilots for a reason.**
- 2. It's of little value as an air to air superiority aircraft as it carries almost no missiles in its stealth configuration.**
- 3. The gun is useless, as attempting to fire it creates a massive amount of drag on the gun's side of aircraft, pulling it off target.**
- 4. It's of low value as a strike craft because of its extremely poor air time to maintenance time ratio and extremely low payload capacity in stealth configuration.**
- 5. It's sole area of actual expertise is as stealthy heavy reconnaissance and light strike aircraft. Just ask Israelis, who use it exclusively in this exact role.**
- 6. For heavy strike they use F-16 and the F-15 for air to air work, which are far superior to F-35 in those niches.**

# Fighter Aircraft Design



## YF-23

Lost the competition to the YF-22 which became the F-22. The YF-23 is actually the best mix between stealth and aerodynamics the world has ever seen. The YF-23's frame is low drag and area ruled, it also features incredibly large lifting surfaces that give the YF-23 an incredibly low wing loading of  $280\text{kg/m}^2$ . For reference, the F-22 has a wing loading of  $377\text{kg/m}^2$ .

The F-22 had to be spackled up with stealth coating to meet its radar cross section requirement and this weight increase reduced range from 1,000 km to 700 km. Maintaining the stealth coating means that the F-22 operating cost is US\$60,000 per hour of flight. The F-22 fleet will be retired by 2030 and replaced by the Next Generation Air Dominance (NGAD).

## Some Mission Capable Rates

	2007	2021	Drop
<b>USAF</b>			
F-35A		69%	-
F-22	59%	51%	-8%
F-15E	75%	66%	-9%
F-15C	80%	69%	-11%
F-16C	83%	72%	-11%
A-10	75%	73%	-2%

<b>French Air Force</b>	2016	2018
-------------------------	------	------

Rafale	49%	54%
--------	-----	-----

<b>Royal Air Force</b>	2019
------------------------	------

Eurofighter Typhoon	65%
---------------------	-----

# Fighter Aircraft Design

## MISSION CAPABILITY RATES OF SELECT U.S. AIR FORCE AIRCRAFT

Airframe	FY20 Mission Capability		FY21 Mission Capability
F-35A *	71.40%	▼	68.80%
KC-46A	66.53%	▲	71.37%
B-1B	52.78%	▼	40.69%
CV-22B	54.21%	▼	50.95%
F-22A	51.98%	▼	50.81%
C-130H	70.02%	▼	69.49%
T-1A	68.43%	▲	74.03%
MQ-9A	90.77%	▼	89.91%
RC-135W	81.03%	▼	66.42%
HH-60G	68.99%	▲	71.06%

Maintenance costs for an aircraft rise at 2.5% per annum. The F-35 is supposed to last until 2070 so maintenance costs in that year will be US\$98,000 per hour.

## Born of a Yak

The first vertical takeoff plane to fly supersonic was the Yak-141 of the Soviet navy.

Lockheed entered into a collaboration with the Yalovlev Bureau and the Yak-141 flew at Farnborough in 1992. The F-35 flew at Farnborough in 2016.



The thrust-specific fuel consumption (TSFC) of the F-135 engine is 0.889 lb/hr/lb of thrust.

The TSFC of the F100-PW-229 engine that powers the F-15 and F-16 is 0.726 lb/hr/lb which is 18.5% lower. This is because the B variant for the Marines requires a large air mass to be accelerated from zero speed which in turn requires an equivalent amount of fuel, as kerosene-air mixtures will burn in only a narrow range of mixtures near the stoichiometric ratio.

This means that all the F-35 variants have a wide, draggy, thirsty engine with a range penalty.

Vertical takeoff is the original sin of the F-35.

---



## Fighter Aircraft Design

### The F-35's Granddad is the Yak-38



# Fighter Aircraft Design

## F-35B in the infrared



The design of the F-35 was compromised so that one variant could do this - suck in a lot of still air at full afterburner and support the weight of the aircraft on a pillar of fire.

# Fighter Aircraft Design

## Selected Villains of the F-35 procurement process

Marine Corps declared F-35B Initial Operational Capability (IOC) on July 31, 2015 while it was still a bag of bolts.

General Dunford commanded the USMC at the time.

Lockheed Martin had expected the F-35 program to be cancelled. The IOC declaration kept it alive.

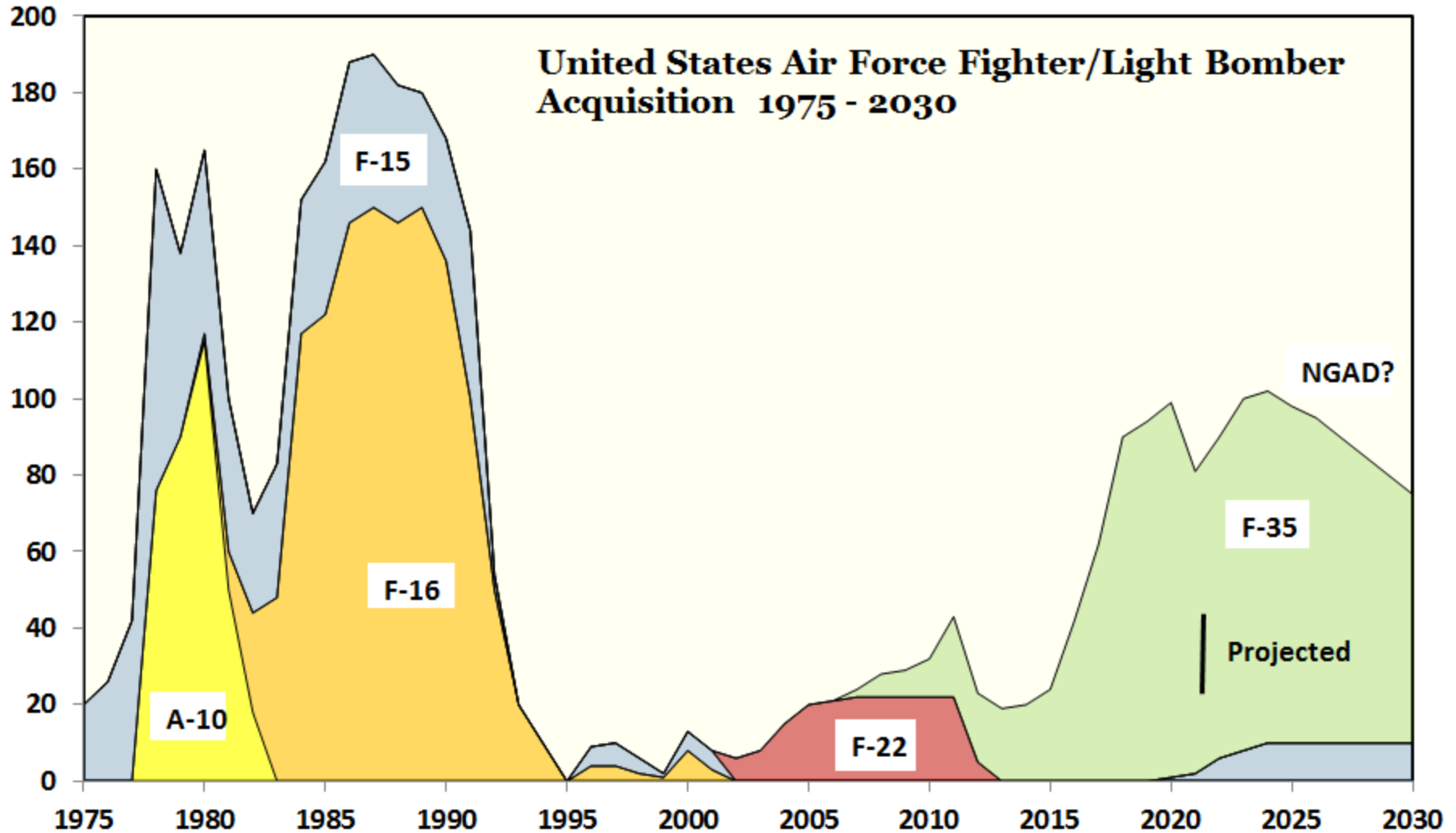
Four months and eleven days after retiring in 2019, Dunford was appointed to the board of Lockheed Martin.

Dunford sold his troops down the river for a seat on one of Lockheed's Gulfstreams.



Nasty piece of work

# Fighter Aircraft Design

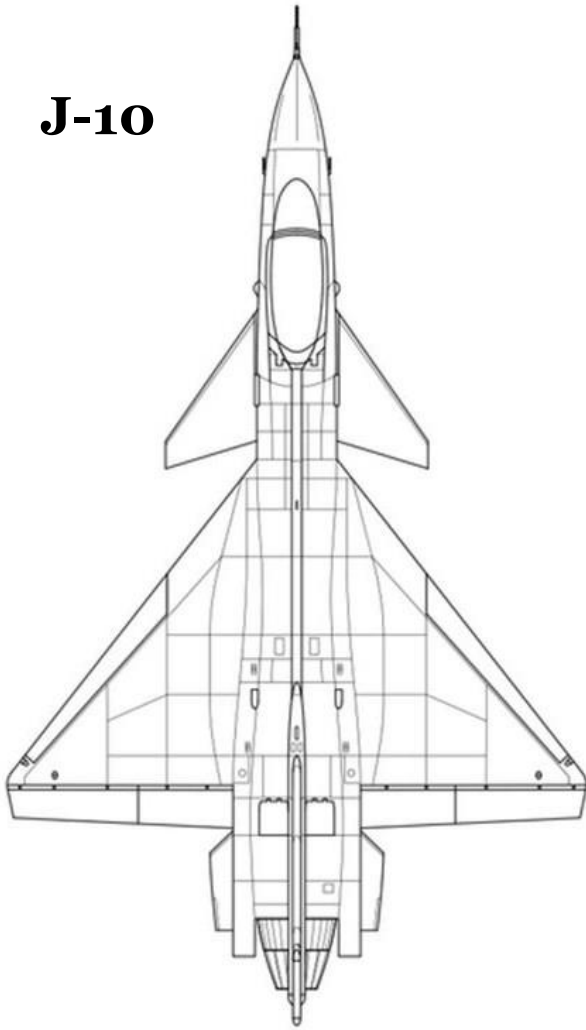


F-35 production will continue until the foreign orders are filled.

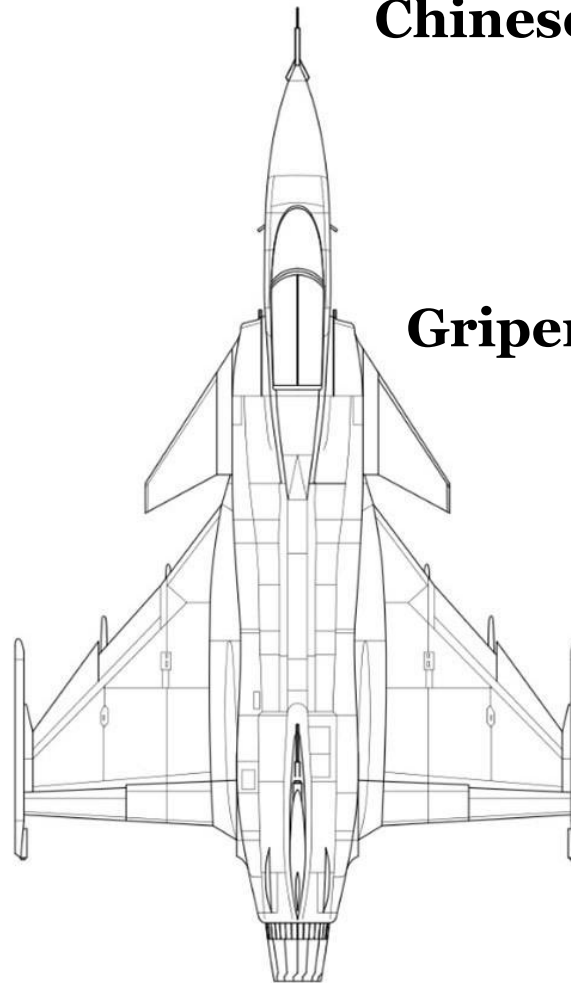
# Fighter Aircraft Design

## Chinese Fighter Aircraft

**J-10**



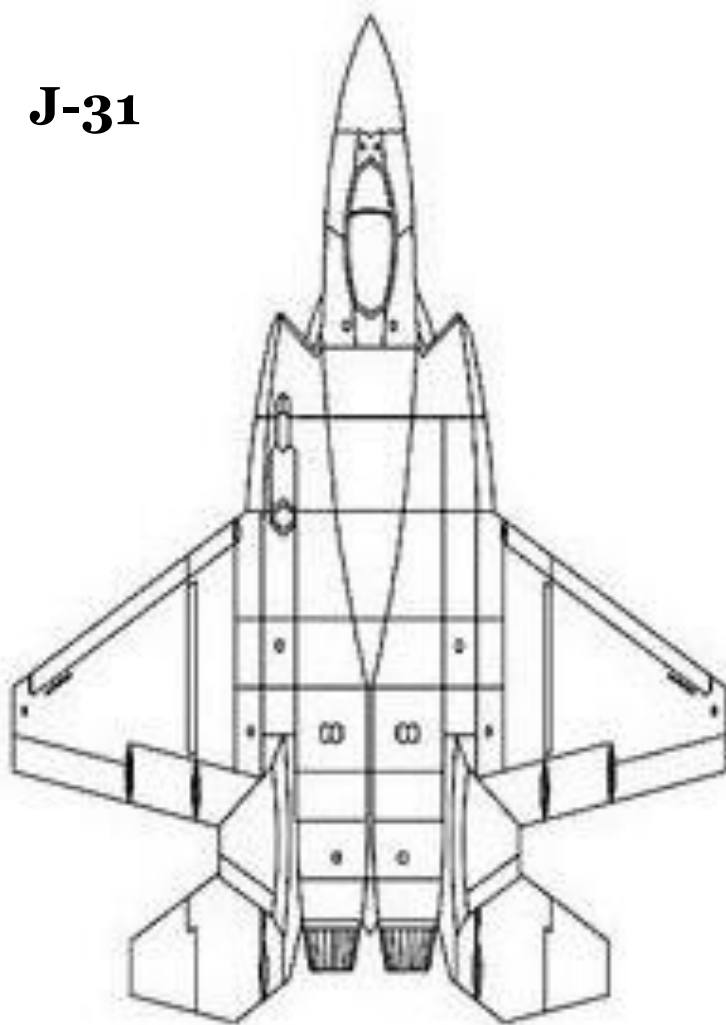
**Gripen**



**Started as the Israeli Lavi. China bought the plans for US\$200 million and the J-10 first flew in 1998.**

# Fighter Aircraft Design

**J-31**



**Copy of the F-35 except twin engine.**

**From plans stolen in 2006.**

**First flew in 2012.**

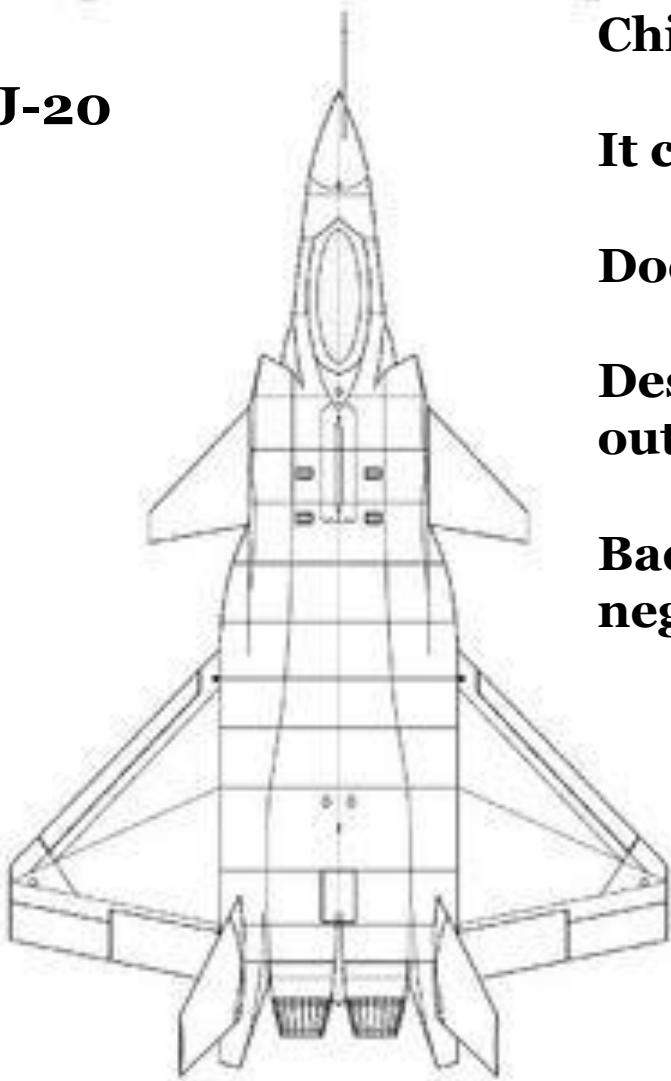
**Like the F-35 it is short and dumpy, thus draggy.**

**The J-31 suggests that the Chinese have little understanding of fighter aircraft design.**



# Fighter Aircraft Design

**J-20**



**China's second draggy dog of a stealth fighter.**

**It can't supercruise.**

**Doesn't have a gun.**

**Designed to fire long range missiles to take out AWACS planes and tankers.**

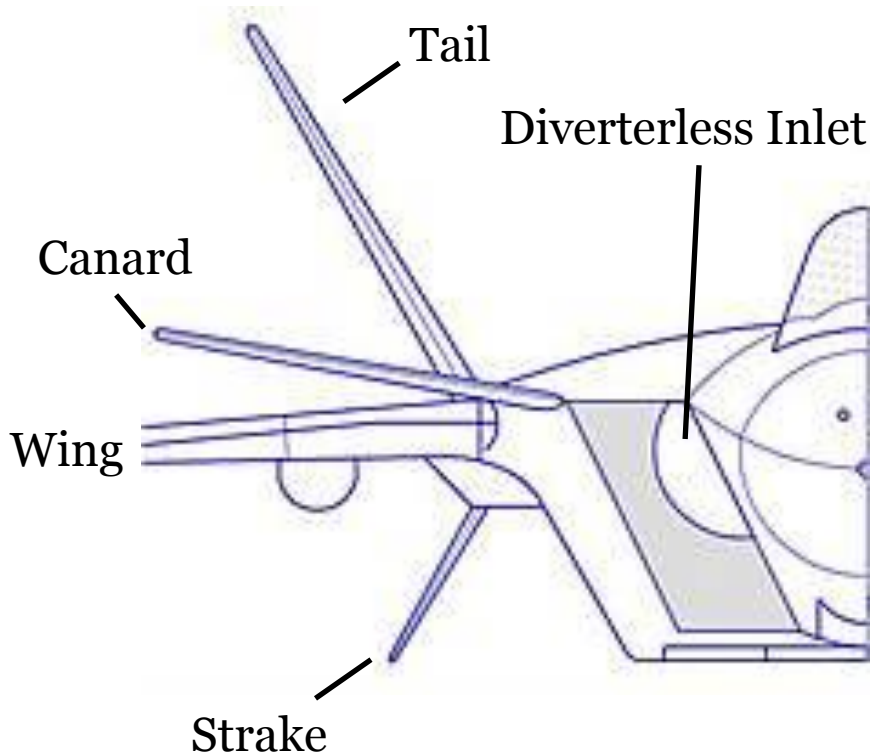
**Bad positioning of the canards is a major negative.**





# Fighter Aircraft Design

## The inherent dragginess of the J-20



**The canards are effectively in the same plane as the wings.**

**Which means they interfere with the airflow over the wings.**

**Lift will be reduced as opposed to additive as in the Euro canards.**

**The J-20's cross sectional area is at its maximum at the rear of the aircraft – gross violations of the area rule.**

**The strakes means that hardware instead of software is used to control lateral stability – drag that could be avoided.**

**Too much stuff hanging out in the breeze.**

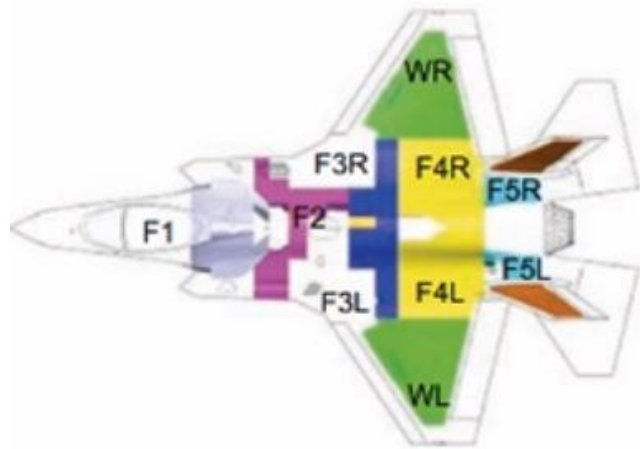
## Fighter Aircraft Design

**As opposed to the effort of the French in mounting the canards of the Rafale in the right position.**



# Fighter Aircraft Design

**Why the F-35 will burn as soon as it is hit  
- it is the Mitsubishi G4M of the modern era.**



Seven tanks: Nominal 18,001b of fuel

F1 Centre Fuselage

F2 Centre Fuselage

F3 Engine Feed Tank (F3L & F3R) F4

Wing carry-Through (F4L & F4R) F5

Aft Fuselage (F5L & F5R)

WL Left Wing Box

WR Right Wing Box



**Fuel tanks of  
the F-35**

**Aerial refuelling is problematic – 11 fuel tanks and the fuel has to be pumped around to maintain balance. A flight of four takes 20 minutes.**



# Fighter Aircraft Design



**How stealth is achieved if you have an unstealthy shape – spackle it up with paint containing a lot of tiny iron balls. F-35Cs on the USS Carl Vinson have a rusty hue. Iron has an SG of 12. Vaccine injury took out an F-35C.**

# Fighter Aircraft Design



**Boeing – RAAF Loyal Wingman**

**Excellent stealthy shape maximises internal volume relative to drag.  
Carries two AIM-120 radar-guided missiles, reportedly.**

**David Archibald**



# Fighter Aircraft Design

## The Drones of Others



# Fighter Aircraft Design



## **Russian Okhotnik drone**

- **Based on the technology of the Su-57**
- **Can drop full-sized bombs**

## Fighter Aircraft Design

**Be aware that missiles mostly miss.**

**USAF QF-4 Phantom is shot at by an F-35 with two AIM-120s during last unmanned mission (and survives)**



**So if you aren't carrying a lot of missiles in the first place, you have a problem.**

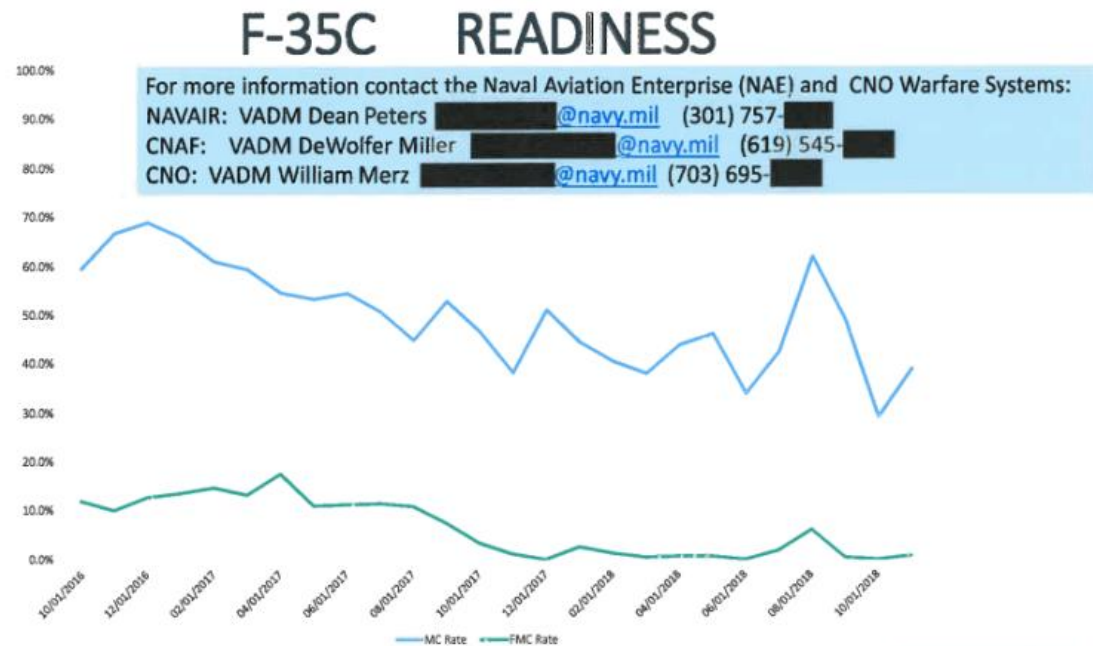


# Fighter Aircraft Design

## The F-35 requires everything to be perfect

If the power provided to the F-35 is not the perfect voltage, amperage or harmonics, the aircraft will not turn on when the ground crew needs to perform functional checks.

The F-35's multiple electronic systems generate significant heat. During maintenance, the fighter requires preconditioned air (PCA) cooling at just the right temperature. The air must be very dry at a higher pressure than standard commercial preconditioned air.



## The F-35 and Lightning

1. The F-35's outer skin is coated in a composite metal structure that "does not provide inherent passive lightning protection".
2. F-35s must be accompanied by lightning rods when they're parked outside at bases.
3. Lightning strike occurred in August 2021 when an F-35A was struck in midair. The jet's canopy and body panels suffered damage requiring between \$600,000 and \$2.5 million to repair.
4. In 2020, the Joint Program Office restricted the F-35 from flying within 25 nautical miles of thunderstorms or lightning.
5. It will be difficult to operate the F-35 in northern Australia during the monsoon season.

## Fighter Aircraft Design



### Su-57 Checkmate

**Obeys the Area Rule to minimise drag. The philosophy of the F-16 keeps being reincarnated. Russia's last single engine fighter was the Mig-21**

David Archibald

## What Australia Should Do

- 1. Sign with Saab for production of the Gripen E in Australia using Saab's deal with Brazil as the template.**
- 2. Buy the parked-up Gripen C and Gripen D of the Swedish Air Force.**
- 3. Build to a force of 300 fighter aircraft.**
- 4. Make our own Anti Ship Cruise Missiles under licence. You need an average of seven to sink a ship.**
- 5. Make versions of the Loyal Wingman that can operate independently.**
- 6. Make seaplanes so that we can pluck survivors from the open ocean.**
- 7. Convert 737s and A320s to dropping cruise missiles.**
- 8. Push the JORN coverage northwards to cover the South China Sea.**



# Fighter Aircraft Design

## Last four books

