# Sticker Shock:

# Estimating the Real Cost of Modern Fighter Aircraft

***An occasional report by defense-aerospace.com***

***Highlights:***

***- Average unit costs exceed $100 million***
***- Longer production runs do not always equate to lower unit costs***
***- International cooperation does not necessarily lead to savings***
***- One fighter is worth its weight in gold, three are worth their weight in caviar***

**Revised version**
This version, posted on July 12, corrects minor editing errors primarily pertaining to the Joint Strike Fighter.

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# Sticker Shock:
# **Estimating the Real Cost of Modern Fighter Aircraft**

The average unit procurement cost of fighter aircraft produced in the NATO area is $112.43 million, and varies in a ratio of almost 3 to 1 from $62.1 million for a Dassault Rafale C to $177.6 million for a Lockheed F-22A. Three aircraft have a unit procurement cost of around $70 million, and another three cost around $110 million.

When total research and development costs are added, however, the picture is very different, as the average program unit cost rises to $148.7 million. On this basis, only two aircraft cost less than $100 million, another costs $112 million, and two (Eurofighter and Rafale) cost around $140 million. Again, the F-22A is the most expensive, with a unit program cost of $338.8 million.

These figures can appear surprising, especially as they indicate that the Rafale costs less than the Gripen, yet they reflect the actual price paid for these fighters by domestic customers. We opted to disregard other prices, such as those offered on export competitions, on the grounds that they are slewed by commercial considerations, while prices paid by domestic customers more accurately reflect the real cost of developing and procuring combat aircraft. The methodology followed is described on page 14.

Most intriguing is the tentative conclusion that aircraft prices (or costs to governments), like those of other manufactured goods, are determined as much by how much the market can bear as by their actual development and production costs (see Tables 2, 3)

This report is intended to provide an objective basis for estimating the true costs of combat aircraft for their domestic buyers, at a time when manufacturers, locked in increasingly bitter competition on the export market, routinely inflate the cost of competitors' aircraft while making demonstrably misleading claims about their own.

**Table 1: Combat Aircraft Ranked by Unit Production Costs**
*(in millions of currency units) (prices first in local currency, then converted to $ at current exchange rates)*

| Aircraft Type | Unit Procurement Costs | Program Unit Costs | Comments |
|---|---|---|---|
| Rafale C | (EUR 51.8) $ 62.1 | (EUR 113.2) $ 135.8 | Air force single-seat (inc VAT) |
| Rafale M | (EUR 56.6) $ 67.9 | (EUR 121.4) $ 145.7 | Naval version (inc VAT) |
| JAS-39C Gripen | (Poland bid) $ 68.9 | (SEK 552.9) $ 76.07 | Swedish version (inc VAT) |
| F-18E Super Hornet | $ 78.4 | $ 95.3 | MYP II contract |
| Eurofighter (Germany) | (EUR 85.7) $ 102.8 | (EUR 118.3) $ 141.9 | Tranche 2, Dec. 2003 prices |
| F-15E Strike Eagle | $ 108.2 | Not significant | FY06 order |
| F-35 Joint Strike Fighter | $ 115.0 | $ 112.5 | LRIP aircraft (estimates) |
| Eurofighter Typhoon (UK) | (GBP 64.8) $ 118.6 | (GBP 78.6) $ 143.8 | Tranche 2, July 2004 prices |
| Eurofighter (Spain) | Not available | (EUR 105.6) $ 126.7 | Tranche 2, mid 2005 prices |
| F-22A Raptor | $ 177.6 | $ 338.8 | FY06 contract |

*(Sources: GAO, CBO, NAO, DoD, UK MoD, French Parliament for data; defense-aerospace.com for analysis. Figures are latest available)*

Our ambition is not to accurately peg actual aircraft prices, but rather to provide general estimates and a mass of data and sources that readers can use to compute their own price, depending on their requirements, by building on the elements provided in this study.

These costs may differ substantially from the ones publicly quoted by the various manufacturers. In some cases, this is due to different definitions of what a given price includes, to different rates of value-added tax, or to how R&D costs are accounted for.

In many cases, however, the differences are due to "creative accounting" intended to distort true prices to gain a public relations competitive advantage, while the complexity of the issue makes it unlikely that the media will devote sufficient time and energy to confirm or infirm prices publicly quoted by manufacturers. This is another reason for which we opted to compare prices paid by national customers.

The study also compares aircraft prices using various benchmarks:

- exchange rates at Purchasing Power Parity;
- prices per kilo, compared to luxury goods;
- prices as a multiple of Gross Domestic Product per head.

This study makes no claim to absolute accuracy, or to perfect methodology. Indeed, as one manufacturer noted, "we know all cost estimates are wrong because they never include the same things, sometimes purposely." For example, some aircraft costs include EW systems and weapons integration, while others do not. Currency exchange fluctuations, and the random use of then-year - as opposed to current - prices, and of fly-away as opposed to unit production prices, further complicate the issue. Finally, European prices include value-added tax on domestic sales, while US domestic prices do not.

To obtain the most objective price data available, we opted to only use prices quoted to the domestic customer (including, as applicable, value-added tax). We also examined two benchmark prices:

- **Program Unit Cost**, obtained by dividing the total program cost by the number of aircraft produced. This is possibly the most significant benchmark, as it includes research and development costs as well as all related ancillary costs (support equipment, spare parts, documentation etc.);

- **Unit Procurement Cost**, obtained by dividing the cost of the latest production contract (thus excluding most R&D and support costs) by the number of aircraft contracted. In some respects, this can also be defined as the marginal cost of additional aircraft, and provides a benchmark for comparisons.

To avoid any possible bias, manufacturers were not initially consulted (except for Gripen, see note p. 8), but were offered the opportunity to comment the study's findings and to offer their own price figures. When provided, these are included in the relevant notes below. Lockheed is the only company that did not respond to our requests for information.

We also opted (except for Gripen) to disregard export contracts, as their costs depend on the requirements of each customer (size of spares inventory; number of operating bases; payments terms; R&D recoupment charged or not, etc.), and often have no direct link to the actual cost of the aircraft themselves.

Despite these obstacles, this analysis summarizes the most recent cost figures and clearly sets out what information was provided by which source. It should thus contribute to a better understanding of these costs, and provide a credible basis for future cost and price comparisons.

We believe it provides the most accurate information currently available of the price of Western combat aircraft to their domestic buyers.

To allow readers to refine these price estimates, we have listed all of our sources of aircraft financial data, and added hypertext links. Readers will thus also be able to confirm the origin of data used as the basis of this study.

## II. HIGHLIGHTS AND CONCLUSIONS

The first and most obvious conclusion from this study (see Table 1) is that, in practice, it is virtually impossible to compare aircraft costs with a meaningful degree of accuracy.

Even government auditors, with access to classified data, are unable to agree on actual costs. For example, the officially quoted prices for the Eurofighter Typhoon vary by as much as 10% between Britain and Germany, while price estimates by the GAO, the Department of Defense and the US Air Force for both the JSF and the F-22 vary by as much as 50%.

That being said, comparisons of even estimated costs provide useful information, not only on the relative costs of competing aircraft, but also as the basis for generic conclusions about the economics of the industry.

Thus, Table 1 points to some interesting conclusions about the economics of combat aircraft production, and appears to contradict conventional wisdom as to the benefits of international cooperation, long production runs and other truisms:

**1. Aircraft designed by a single country are not necessarily more expensive** than those developed through international cooperation.
Gripen and Rafale were both developed by single countries, but end up costing substantially less than Eurofighter, which is produced by a four-nation consortium.

**2. But single-nation development does not guarantee lower costs**, as the three US fighters all cost substantially more than the two European "national" fighters, and are comparable to those of Eurofighter, a four-nation cooperative program.
Conversely, the projected unit cost of the only (partly) cooperative US aircraft, the Joint Strike Fighter, already exceeds that of Gripen and Rafale and of two other US aircraft, F-18E and F-15E, all of which are single-nation designs.

**3. Long production runs do not always lead to less expensive aircraft**.
The F-18E, with a production run of 462 aircraft, costs half as much again as the Rafale, which has a much smaller production run of 294 aircraft. JSF will cost twice as much as Rafale, despite having a production run almost ten times as large, and half as much again as the F-18E, whose production run is five times smaller. All three are modern, multirole combat aircraft.

**4.** While charges for major program stoppages and restructurings add to program costs, **the increase is not proportional** to the length of the hiatus. Both Eurofighter and Rafale programs were halted and restructured, adding eight or ten years to their development cycle, while F-15E, F-18E and Gripen were not, yet this is not demonstrably reflected by the difference in their respective cost.

**5. Continuity in development is the best way to avoid cost overruns**. Gripen and F-18E (the F-15E is not significant in this respect) are the only programs to have avoided lengthy "freezes" and large-scale re-designs, and their production costs are notably lower than competitors'.
Program unit costs of Rafale, Eurofighter and F-22 exploded after they were "suspended" for several years for major re-designs or funding shortfalls.

**6.** Although these aircraft were all developed beginning in the late 1980s, and for broadly similar missions, there is **no common ratio between R&D and acquisition costs**. Indeed, there seems to be no correlation whatsoever between these costs, reflecting each aircraft's unique R&D itinerary and development history.
In other words, development costs are influenced not by so much be an aircraft's actual capabilities as by a "smooth" management and development history.

## II. BENCHMARK COMPARISONS

Having arrived at credible cost estimates, we then looked at how fighter aircraft costs compare with other widely used economic benchmarks.

The first approach is to compare aircraft on a "cost per kilogram" basis, a rule of thumb approach that is often used in the industry as a rough guide to relative aircraft costs. We then compared these costs with those of gold and caviar, which are widely traded commodities.

**Table 2: Worth their weight in gold?**
*(Aircraft ranked by cost per kilo (program unit cost divided by empty weight.)*

| Aircraft | Weight (kg) | Cost ($ million) | Cost per kg ($) | |
|---|---|---|---|---|
| F-15E | 20,400 | 108.2 | 5,303 | (unit procur. cost) |
| ***caviar*** | | | ***6,000*** | Paris, May 2006 |
| F-18E | 13,400 | 95.3 | 7,111 | |
| JSF | 12,000 | 112.5 | 9,375 | |
| Gripen | 5,700 | 76.07 | 13,345 | |
| Rafale C | 9,400 | 135.8 | 14,446 | |
| Typhoon | 9,750 | 143.8 | 14,748 | |
| ***gold*** | | | ***18,700*** | Paris, May 2006 |
| F-22 | 14,400 | 338.8 | 23,472 | |

As shown above in Table 2, combat aircraft costs vary by a factor of 4:1 on a cost per kilogram basis, slightly less than the 5:1 range for unit costs.

The comparison with luxury goods shows that, on a kilo-per-kilo basis, the F-22A is the only one of the seven aircraft examined in this study to cost more than its weight in gold, while five of the six others cost more than their weight in caviar.

**7.** Different costs of materials and labor in various countries can distort direct cost comparisons. **To even out the playing field**, we converted Unit Procurement Costs from national currencies into US dollars at Purchasing Power Parity. We used the PPP exchange rates provided by The Economist's Big Mac Index" (January 12, 2006) http://www.economist.com/markets/bigmac/

**Table 3: Worth their weight in hamburgers?**
*(Aircraft ranked by unit procurement costs at purchasing power parity)*

| Aircraft | Cost in $ (actual rate) | Local Big Mac price | Weighted cost in $ | |
|---|---|---|---|---|
| Rafale C | $ 62.1 | $ 3.51 | $ 55.7 million | |
| Rafale M | $ 67.9 | $ 3.51 | $ 60.9 million | |
| F-18E | $ 78.4 | $ 3.15 | $ 78.4 million | |
| Gripen | $ 68.9 | $ 4.28 | $ 84.0 million | |
| F-15 E | $ 108.2 | $ 3.15 | $ 108.2 million | |
| Typhoon (UK) | $ 118.6 | $ 3.32 | $ 112.5 million | |
| JSF | $ 115 | $ 3.15 | $ 115.0 million | |
| F-22A | $ 177.6 | $ 3.15 | $ 177.6 million | |
| | | | | |

The result is shown in table 3 (above): while prices of non-US aircraft increase when converted into dollars at PPP, the overall ranking is not substantially changed despite generally higher labor and material costs in Europe.

**8.** A final comparison **compensates for differences in national wealth**, to see how much of a nation's economic resources are consumed by the acquisition of a modern fighter aircraft. To arrive at the ranking below, we divided the Unit Procurement Cost of each fighter by the national pro-capita gross domestic product in its home country, using data for 2005 provided in the CIA's World Factbook.

**Table 4: Cost ranking as a bite of GDP**
*(Unit procurement costs divided by national GDP per head; 2005 estimated GDP at purchasing power parity, CIA World Factbook)*

| **Aircraft** | **Aircraft Unit Production Price** | **GDP per head *(estimated 2005)*** | **Cost as multiple of GDP per head** | **Notes** |
|---|---|---|---|---|
| | | | | |
| F-18 E | $ 78,400,000 | $ 42,000 | 1,866 times GDP/head | |
| Rafale C | $ 62,100,000 | $ 30,000 | 2,070 | |
| Gripen | $ 68,900,000 | $ 29,800 | 2,312 | |
| F-15 E | $ 108,200,000 | $ 42,000 | 2,570 | estimate |
| JSF | $ 115,000,000 | $ 42,000 | 2,738 | (UK GDP) |
| Typhoon | $ 118,600,000 | $ 30,900 | 3,640 | |
| F-22 | $ 177,000,000 | $ 42,000 | 4,228 | |
| | | | | |

Table 4 (above) compares costs after correcting them for national economic conditions. This ranking shows that, in terms of cost to the national economy, the F-18E is most affordable while the F-22, which costs four times as much in terms of GDP per head, is the least affordable. Interestingly, the ranking of non-US aircraft does not change significantly in this comparison.

It is worth noting that the price range, excluding the F-22, is remarkably homogenous, with a ratio of 1:2 (from 1.8 to 3.6 times GDP/head), and remains practically invariable whatever benchmark is used.

This tentatively points to a correlation between economic conditions in the customer country and the cost of the aircraft it buys.

## III. AIRCRAFT COSTS BY PROGRAM

*(see following pages)*

This section examines cost information available for each aircraft, lists the most recent cost estimates by source, and selects for each the most credible Program Unit Costs (total program cost divided by the number of production aircraft) and Unit Procurement Cost (value of latest production contract divided by the number of aircraft).

Those figures are used in the comparative tables (above), and are marked **in bold** typeface in the following pages.

# 1. Dassault Aviation RAFALE

**Program Unit Cost** : **$ 135.8 million** (Rafale C air force single-seat aircraft)
**Unit Procurement Cost** : **$ 62.1 million**

**Manufacturer's comment:**
Dassault noted that prices quoted in French defense budget documents are inclusive of value-added tax (VAT) at 19.6%. If VAT, which is not applicable on export contracts, is excluded, the total cost of the Rafale program drops to 27.82 billion euros, and the average program unit cost is reduced to 94.63 million euros.
Again excluding VAT, the prices of the various versions are 47.3 million euros for the Rafale M, 41.5 million euros for the Rafale C and 43.3 million euros for the Rafale B.
These figures are all at January 2005 prices, Dassault says.

**Cost data and sources:**
- Total cost (R&D plus production) of the Rafale program was estimated in October 2005 by a French Parliamentary report at 33.27 billion euros for 294 aircraft (234 for the French air force and 60 Rafale Ms for the French navy. This implies an average program unit price of **113.17 million euros**. (see note 1)

- Total program cost for the Rafale M naval program are estimated at 7.27 billion euros, or 121.4 million euros per aircraft. (2)

- Unit procurement costs were estimated by the French Parliament during the debate on the 2006 defense budget at 56.6 million euros for the naval Rafale M, 49.6 million euros for the single-seat and **51.8 million euros** for the two-seat Rafale C air force versions (at January 2005 prices). (3)

- The most recent production contract, awarded in 2004, covers 59 Rafale F3 aircraft and was valued at 3.11 billion euros, or approximately 52.77 euros par aircraft. (1)

- The latest figures published in June 2006 by French MoD put the total cost of the program, including development, pre-production, production and integrated logistical support, at 33,273 million euros for 294 aircraft (including value-added tax, at 2003 prices).
Unit procurement prices vary between 45 million euros and 50 million euros (excluding VAT), depending on the versions.

**Sources:**

(1) Commission de la Défense Nationale et des Forces Armées, Rapport sur le Projet de loi de finances pour 2006 ; N° 2572, Tome VIII : Défense : Equipement des Forces,
By Jerome Rivière; dated October 12, 2005, see page 11 et sq.
http://www.defense.gouv.fr/portal_repository/206537047__0001/fichier/getData

(2) Commission de la Défense Nationale et des Forces Armées, Rapport sur le Projet de loi de finances pour 2006 ; N° 2572, Tome V: Défense: Préparation des Forces: Marine
By Philippe Vitel, dated October 12, 2005, see page 22
http://www.defense.gouv.fr/portal_repository/1536638127__0001/fichier/getData

(3) Commission des Finances, de l'Economie Générale et du Plan, Rapport sur le Projet de Loi de finances pour 2006 (n° 2540), By Gilles Carrez, Rapporteur Général ; See page 131 et sq.
http://www.defense.gouv.fr/portal_repository/1898695565__0001/fichier/getData

## 2. Saab-BAE Systems JAS-39 GRIPEN

**Program Unit Cost : $ 76.07 million**
**Unit Procurement Cost: $ 68.90 million** ($55.1 million excluding VAT)

**Manufacturer's comment:**
Gripen International AB says "the fly-away cost of a Gripen in the market is between $35 million and $40 million."

**Background to cost data and sources:**
- Gripen is now in advanced production, and the only available program cost estimates, including a 1996 Court of Audit report, are outdated, while the Swedish Parliament has not publicly debated the program's cost for several years. Consequently, another approach was needed. This demonstrated the limits of Sweden's much-vaunted transparency in government affairs.

**Estimating Gripen costs:**

**(a)** The Swedish defence material agency, FMV, says the total cost of the Gripen program between 1982 and 2009 is 99 billion Swedish krona (worth $ 13.54 billion at current exchange rates), including weapons and simulators but excluding Value-Added Tax, for 204 aircraft.
We converted this 99 billion krona figure to 2006 prices based on the 14% increase in Sweden's Consumer Price Index between 1994, the program's mid-point, and 2006. (CPI Index increased from 245 points in January 1994 to 279 points in January 2006, see Swedish Statistics agency, http://www.scb.se/templates/tableOrChart____33848.asp)
This brings the program's estimated total cost to 112.8 billion krona at 2006 prices.
We then deducted the cost of simulators and weapons by applying a 20% discount to the 112.8 billion krona program cost, and added 25% value-added tax.

The resulting **Program Unit Cost** is **$ 76.07 million** per aircraft.

**(b)** Both FMV and the office of the Swedish Minister of Defence declined to provide the value of the latest Gripen production contract (awarded in June 1997), covering the 64 aircraft of Batch 3, claiming commercial confidence.

Consequently, we extrapolated Gripen's Unit Acquisition Price from the Swedish offer to Poland (November 2002), which was made public at the time and remains the most recent price figure available.
This offer was worth 3,150 million euros ($ 3,780 million) for 48 aircraft, from which we deducted 30% for the cost of spare parts and support equipment, and added 25% value-added tax to bring it in line with our tax-inclusive benchmark.

The resulting estimate of Gripen's **Unit Procurement Cost** is $68.9 million.

## 3. Boeing F/A-18E SUPER HORNET

**Program Unit Cost : $ 95.3 million**
**Unit Procurement Cost: $ 78.4 million**

**Manufacturer's comment:**
In response to our query, Boeing said that "the fly-away cost of the Super Hornet, under the current, second multi-year procurement contract with the U.S. Navy, is $53.8 million."

**Cost data and sources:**
- Unit fly-away cost of the F-18E, as included in the US Navy FY07 budget request, is **$78.4 million** per aircraft. (4)

- In the latest DOD Selected Acquisition Reports (Dec. 31, 2005), the total program cost for the 462 planned F-18E Super Hornets is set at $44.03 billion, putting the Program Unit Cost at **$95.3 million** per aircraft. (5)

**Sources:**
(4) US Navy FY07 budget request, F-18E page
http://public.secnav.navy.mil/FY07.nsf/($reload)/8525711F000FDA09852570F200669A35/$FILE/145+FA-18EF.pdf

(5) SAR Program Acquisition Cost Summary (Dec. 31, 2005)
http://www.defenselink.mil/news/Apr2006/d20060407sars.pdf

## 4. Boeing F-15E STRIKE EAGLE:

**Program Unit Cost : not significant**
**Unit Procurement Cost: $ 108.2 million (atypical)**

**Manufacturer's comment:**
Boeing provided no comment on the cost of the F-15E.

**Cost data and sources:**
The F-15E Strike Eagle is no longer in production for the US Air Force, so no current production prices are available, while total program costs are now outdated and not significant.
However, at the direction of Congress, the Pentagon included **$108.2 million** in the Air Force's FY07 budget request to fund a single attrition reserve aircraft, and this is the most recent price available for the aircraft.

**Source:**

(6) US Air Force FY07 budget request:
https://www.saffm.hq.af.mil/FMB/pb/2007/afprocurement/3010_Aircraft_Procurement_v1_FY07_PB.pdf
See page 77

## 5. Eurofighter TYPHOON:

**Program Unit Cost** : **$ 143.8 million** (Royal Air Force)
**Unit Procurement Cost** : **$ 118.6 million** (Royal Air Force)

**Manufacturer's comment:**
According to figures provided to the German Bundestag on June 15, 2004 by the German Ministry of Defence, total cost to Germany of the Eurofighter program is 21.3 billion euros, of which 5.87 billion euros for development and 15.4 billion euros for procurement of 180 aircraft.

*Editor's note: These figures work out to a unit program cost of 118.3 million euros per aircraft, and a unit procurement cost of 85.7 million euros (including subsystems) per aircraft for Germany.*

**Cost data and sources:**
- The UK House of Commons Defence Committee, in July 2004, estimated the cost to Britain of the Eurofighter Typhoon program at £ 19.018 billion for 242 aircraft, or a program unit cost of **£78.6 million** per aircraft. (7)

- In 2005, the UK National Audit Office estimated the unit production cost of Typhoon aircraft for the Royal Air Force at **£ 64.8 million**, based on the Tranche 1 and Tranche 2 contracts that have already been awarded. (8)

- On July 22, 2005, the Spanish government cabinet estimated the cost of its share of the Eurofighter program at 9.19 billion euros for 87 aircraft, equivalent to a program unit cost of 105.6 million euros per aircraft including the cost of the future Tranche 3 contract (9).

- UK MoD statement, Dec. 17, 2004:
"In addition Typhoon represents one of the largest, if not the largest, European defence investment to date. Certainly it is the largest for the RAF, providing 89 Tranche 2 aircraft, in addition to the 55 Tranche 1 aircraft already on order, and represents a future investment of £4.3 billion" This implies a unit procurement cost of £ 48.3 million per aircraft, without engines and certain subsystems.

- Eurofighter GmbH statement, Dec. 17, 2004:
"Production of the 236 Tranche 2 aircraft ….the overall value of the contract is in the region of Euro 13 billion," but this figure is not significant as it excludes the cost of the engines and of some subsystems, which are procured separately.

**Sources:**

(7) House of Commons Defence Committee: Sixth Report: Defence Procurement
28 July 2004
http://www.publications.parliament.uk/pa/cm200304/cmselect/cmdfence/572/57202.htm

(8) Ministry of Defence: Major Projects Report 2005, by the National Audit Office
See Project Summary Sheets, page 113
http://www.nao.org.uk/publications/nao_reports/05-06/0506595_II.pdf

(9) Spanish government cabinet statement on cabinet decision on Eurofighter Tranche 2 contract, July 22, 2005.

## 6. Lockheed F-35 JOINT STRIKE FIGHTER

**Program Unit Cost : $ 112.5 million**
**Unit Procurement Cost : $ 115 million** (LRIP aircraft)

**Manufacturer's comment:**
Lockheed Martin did not respond to repeated requests for comment.

**Cost data and sources:**
- The Government Accountability Office (GAO), in its March 31 report on "Defense Acquisitions: Assessments of Selected Major Weapon Programs" estimates the Joint Strike Fighter's cost at $257 billion for 2,443 aircraft, i.e. a unit program cost of $105.2 million per aircraft in FY2006 dollars. (16)

- Another GAO report, also published in March 2006, estimates the cost of 424 Low Rate Initial Production aircraft at $ 49 billion, i.e. $ 115 million per aircraft (see note 15).

- However, is its April 2006 Selected Acquisition Report, the Pentagon said total JSF program costs had increased to $276.5 billion for the 2,458 aircraft planned by the US (see note 17), meaning unit procurement cost increased in proportion to **$112.5 million**. This is the latest figure available, and is the one used for comparison purposes.

- As the JSF program is still in early development, no figures are available for its unit procurement cost once full-rate production gets underway. Much higher cost estimates have been made public than those used in this study; for example the US Air Force, in documents accompanying its FY07 budget request, estimates the JSF's future "recurring fly-away cost at $154.6 million (see note 13)

- On June 9, the Congressional Research Service (CRS) estimated the average procurement unit cost (APUC, which does not include R&D or other "sunk" costs) at $94.8 million per aircraft in then-year dollars. (see note 18)

- The LRIP contract price was used to compute JSF's unit procurement costs because this is the only contractual figure to have been made public. It is however not a satisfactory basis.

**Sources:**

(18) CRS: F-35 Joint Strike Fighter (JSF) Program: Background, Status, and Issues (June 9, 2006)
http://www.fas.org/sgp/crs/weapons/RL30563.pdf (see page 6)

(16) GAO: Tactical Aircraft: Recapitalization Goals Are Not Supported by F-22A and JSF Business Cases (Testimony, March 2006)
http://www.gao.gov/cgi-bin/getrpt?GAO-06-487T

(13) US Air Force, FY07 budget request
https://www.saffm.hq.af.mil/FMB/pb/2007/afprocurement/3010_Aircraft_Procurement_v1_FY07_PB.pdf

(14) Department of Defense, Program Acquisition Costs by Weapon System, FY07
http://www.dod.mil/comptroller/defbudget/fy2007/fy2007_weabook.pdf

(15) GAO: Joint Strike Fighter: DOD Plans to Enter Production before Testing Demonstrates Acceptable Performance, see Appendix II
http://www.gao.gov/cgi-bin/getrpt?GAO-06-356

(17) Pentagon: Selected Acquisition Report, April 2006
http://www.defenselink.mil/news/Apr2006/d20060407sars.pdf

# 7. Lockheed Martin F-22A RAPTOR

**Program Unit Cost : $ 361.3 million**
**Unit Procurement Cost : $ 177.6 million**

**Manufacturer's comment:**
Lockheed Martin did not respond to repeated requests for comment.

**Cost data and sources:**
The number of F-22s to be produced, and the total program cost, has undergone many changes since the program was first launched. In February 1992, the program was estimated to cost $81.1 billion for 624 aircraft, that is to say a program unit cost of $125.1 million (in FY 2006 dollars) but has escalated since then.

-Given the wildly differing prices quoted for the F-22, we opted to use figures published by the Government Accountability Office (GAO) March 31 report on "Defense Acquisitions: Assessments of Selected Major Weapon Programs," while quoting other official sources for the sake of comprehensiveness.
GAO estimates the F-22 program's cost at $65.4 billion for 181 aircraft (in FY 2006 dollars), that is to say a program unit cost of **$361.3 million** per aircraft. (12)

- GAO also estimates procurement costs at $32.14 billion for the same 1841 aircraft, implying a unit procurement cost of **$177.6 million** per aircraft.

- In its latest Selected Acquisition Report, released on April 10, 2006, the Pentagon estimates the program's total cost at $62.6 billion for 184 aircraft, implying a program unit cost of $338.8 million per aircraft. (10)

- In its FY07 budget request, the US Air Force sets the F-22A's fly-away unit cost at $141.5 million. (11)

- No F-22s are procured in the FY07 budget. However, the 24 aircraft funded in the FY06 budget cost $3,766.8 million, or a unit production cost (excluding R&D amortization) of $156.9 million per aircraft (see 14, page 18).

**Sources:**

(10): Pentagon SAR, April 2006:
http://www.defenselink.mil/news/Apr2006/d20060407sars.pdf

(11) US Air Force FY07 budget request, page 53
https://www.saffm.hq.af.mil/FMB/pb/2007/afprocurement/3010_Aircraft_Procurement_v1_FY07_PB.pdf

(12) Government Accountability Office (GAO), Defense Acquisitions: Assessments of Selected Major Weapon Programs (page 59)
http://www.gao.gov/new.items/d06391.pdf

## NOTE ON METHODOLOGY

These cost/price estimates are based on cost data published by government auditors, such as the US Government Accountability Office (GAO), Congressional Budget Office (CBO) and Congressional Research Service (CRS), or Britain's National Audit Office (NAO). Other cost data was obtained from government press releases or reports, parliamentary budget reports or testimony in official hearings. Sources are identified, and links provided.

To ensure that figures are as objective as possible, manufacturers were not consulted for the study but were subsequently asked to comment its findings. Comments are included as provided.

Price figures are provided both in terms of "program unit cost," i.e. the total cost of a program divided by the number of aircraft produced, and of "unit procurement cost," that is to say the value of the most recent production contract divided by the number of aircraft it financed.

While these figures are not directly comparable because of differing national accounting and budgeting standards, they offer the best available indication of real aircraft prices.

Export contract prices are useful benchmarks and provide realistic figures in terms of how much it actually costs to buy and operate a given aircraft. However, they were not used in this study as they include the cost of ancillary equipment, training, spares and weapons that vary according to the customer, making it impossible to extrapolate actual aircraft prices.

For the same reasons, fly-away prices and life-cycle costs were not considered for this study.

Unless otherwise indicated, prices refer to complete aircraft (i.e. including engines, flight and mission avionics) without their weapons except, when fitted, for fixed cannon.

### TAXES: VAT rates and export prices

Prices used in this study are inclusive of value-added tax (VAT), where applicable, as the basis we used is the cost billed to national customers.

Consequently, the export prices of European aircraft should be reduced by the amount of national VAT, which is not applicable on export contracts. Thus, the basic export price of a single-seat Rafale C drops to 41.5 million euros ($ 49.8 million) after deduction of France's VAT of 19.6%, while that of Eurofighter would be reduced by the VAT rate in the partner country which invoices the customer (16% in Germany, 20% in Italy and 17.5 in the United Kingdom). Gripen's export price should be reduced by the Swedish VAT rate of 25%.

### Prices and Exchange Rates

For the purposes of this study, all price figures are in current values, except as otherwise noted.

US dollars have been used as the benchmark for price comparisons. The currency exchange rates used in this study are as follows:
-- 1 euro = $ 1.2
-- 1 pound sterling: $1.83 (approximate average exchange rate from 4/04 to 4/06)

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