

**What price the future submarine?**

by Andrew Davies

99

2 March 2012

Given the current level of discussion on Australia’s future submarine and its potential cost, ASPI thought it timely to put into context the various figures that are being used.

ASPI’s 2009 paper *How to buy a submarine* contained the following table:

**Table 1:** ASPI’s 2009 submarine cost estimates

Submarine	Cost of 12 (2009 A\$ billion)
New build <i>Collins</i>	12.0
4,000 tonne boat at <i>Collins</i> cost/tonne	16.8
4,000 tonne boat at historical trend	36.5
Type 212/214 equivalent in 2020	8.8*

\*assumes exchange rate of A\$1 = US 75c

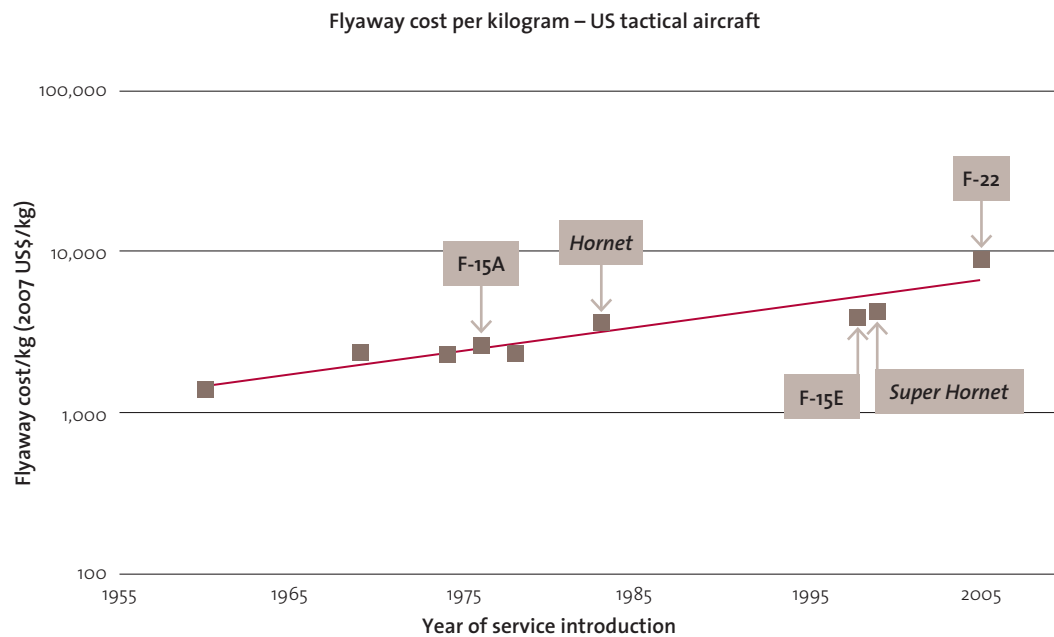
The discussion that followed in the press—and which continues today—focused almost exclusively on the last two figures in the table, with the others being largely ignored. This note is intended to reiterate the significance of the high and low figures, and to explain the circumstances in which the other intermediate figures could be relevant.

**Highs and lows**

To understand the significance of the high and low estimates above, a digression into combat aircraft costs is useful. Figure 1, derived from the ASPI publication *How much will the Joint Strike Fighter cost Australia?*, shows the real cost growth of American tactical aircraft since 1960.

The overall trend is an exponential growth of cost per unit weight over time, reflecting the increased complexity of combat aircraft (which has also resulted in greater capability). This sort of cost growth is well documented.<sup>1</sup>

But the labelled points tell a story within a story. The three most recent tactical aircraft to enter US inventories were the F-15E *Strike Eagle*, an evolution of the F-15A-D *Eagle* series, the F/A-18E/F *Super Hornet*, an evolution of the F/A-18A-D *Hornet* series, and the F-22 *Raptor*, an entirely new design that represented a quantum leap in capability.

**Figure 1:** The real cost growth in American tactical aircraft 1960–2005

By building on existing platform and system designs, the evolutionary aircraft were developed and produced at an overall cost that fell below the historical average. But the revolutionary F-22 was well above the trend line—to the point where it became so expensive the final production run was only 187 units against an original target of 650.

Simply put, the future Australian submarine described in the 2009 Defence White Paper (DWP 2009) is more like the F-22 than the *Super Hornet*. As described, it has a suite of capabilities that have never been combined into a conventionally-powered submarine. In fact, it has most of the characteristics of a nuclear-powered submarine—one of the reasons the nuclear option has been brought back into the discourse by several writers and commentators. The DWP 2009 boat would set a new benchmark for conventional submarine capability—which the RAND Corporation has identified as historically being when the largest jumps in the cost occur. In the absence of more detailed information, the estimate of \$36 billion derived from the trend data remains a credible estimate for the DWP 2009 submarine.

On the other hand, if the future submarine design is subjected to a cost-benefit trade-off study, with an identification of the ‘must have’ and ‘nice to have’ capabilities, there is the potential to bring the overall cost down below the trend line. (This approach was argued in ASPI’s 2011 *The Once and Future Submarine*.) That was the basis for a figure of \$25 billion that appeared in a footnote in ASPI’s recent paper on shipbuilding—which was a deliberately conservative figure.

Similarly, if the *Collins* is used as the starting point for the future submarine, and an evolutionary design adopted, as argued in ASPI’s 2011 paper on the evolution of the *Collins*, an even lower figure is possible—hence the \$16.8 billion figure in table 1. The figure for ‘new build *Collins*’ in table 1 is the least relevant number as no one is suggesting simply building more of the existing design due to known problems and guaranteed obsolescence well before the 2050 date the new boats will be expected to meet. In today’s dollars each *Collins* cost about \$1.5 billion.

The figure of \$12 billion for 12 assumes that existing infrastructure and know-how would reduce the fixed costs and that the marginal cost would be less due to a learning curve effect. Note that each step down in cost also comes with a step down in nominal capability, although reduced program risk may offset that to an extent.

An off-the-shelf purchase of a European submarine is almost certainly the least expensive option. The figure \$8.8 billion in table 1 is based on defence trade press reports and should be interpreted as a lower bound. The reported figures are from sales by French and German manufacturers to other countries. At the current exchange rate of A\$1 = €0.8 the per boat cost is \$500–625 million, or a nominal total of \$6–7.2 billion for twelve. But that price doesn't include the full program cost, or any of the additional costs that would accrue from local assembly. It represents the cost of materials and services provided by the original contractor, but doesn't include any further costs of local inputs. It's not possible to say what the total would be for boats assembled in Australia. But a figure between our earlier \$8.8 billion estimate and the \$12 billion estimate for restarting the *Collins* line might reflect the start-up costs of a local assembly line and the relative inefficiency of at least the first few builds. Like the air warfare destroyer project, there would be a premium for a local build. On top of those costs would need to be added support equipment, training, weapons etc.

The *Virginia* class nuclear submarine currently being produced for the US Navy has entered the debate this year. There are profound political, technical, regulatory and sovereignty difficulties with this proposal, but we include it here for completeness. The *Virginia* class entered full-rate production in 2011, when the USN began buying two ships per year. [This year's Pentagon budget papers](#) show that in 2011 two *Virginia* class submarines were completed at a total procurement cost of US\$5.349 billion or \$2.675 billion each.

According to the US Government Accountability Office [2011 assessment of selected weapon systems](#), the USN's goal is to reduce costs to \$2.24 billion per vessel and the time required to build each ship to about 60 months. Under the US Foreign Military Sales regulations, any submarine purchased by Australia would cost a little more than the cost of production for the USN. A working figure might be US\$2.5 billion, with a lead time of at least five years, although that figure does not include the support systems, infrastructure investment and other costs that would also be incurred. The *Virginia* would almost certainly be the most expensive option—albeit the most capable.

## Note

- 1 Charts showing the historical growth of costs of tactical, bomber and commercial aircraft, helicopters, aircraft carriers and tanks can be found in Norman R Augustine, *Augustine's Laws and Major Systems Development Programs*, American Institute of Aeronautics and Astronautics (2nd edition), New York, 1983, p 47.

The historical cost growth in ships and submarines is discussed in detail in the 2006 RAND Corporation report *Why has the cost of Navy ships risen?* They observe the 'stairstep' rise of costs, with a sharp rise when there is a significant change in capability—as would be the case for the 2009 Defence White Paper's boat.

## About the author

**Dr Andrew Davies** is ASPI's Operations and Capability Program director.

## About Policy Analysis

Generally written by ASPI experts, the **POLICY ANALYSIS** series is provided online to give readers timely, insightful opinion pieces on current strategic issues, with clear policy recommendations when appropriate. They reflect the personal views of the author and do not in any way express or reflect the views of the Australian Government or represent the formal position of ASPI on any particular issue.

ASPI

**Tel + 61 2 6270 5100**

Fax + 61 2 6273 9566

Email [enquiries@aspi.org.au](mailto:enquiries@aspi.org.au)

Web [www.aspi.org.au](http://www.aspi.org.au)

© The Australian Strategic Policy Institute Limited 2012

This publication is subject to copyright. Except as permitted under the *Copyright Act 1968*, no part of it may in any form or by any means (electronic, mechanical, microcopying, photocopying, recording or otherwise) be reproduced, stored in a retrieval system or transmitted without prior written permission. Enquiries should be addressed to the publishers.

Notwithstanding the above, Educational Institutions (including Schools, Independent Colleges, Universities, and TAFEs) are granted permission to make copies of copyrighted works strictly for educational purposes without explicit permission from ASPI and free of charge.