

# NAVAL REVIEW

## DESIGN TO FIGHT

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### Introduction

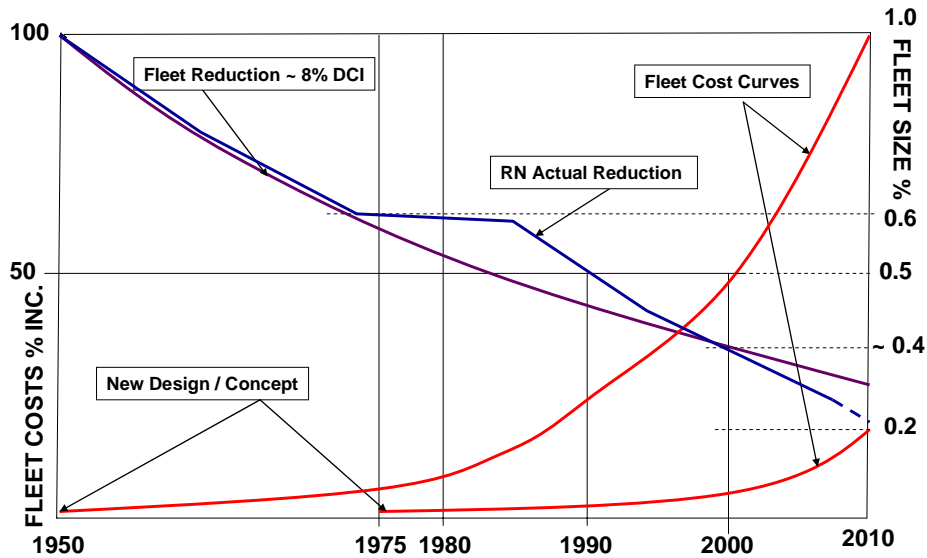
I was struck recently by the fact that the debate regarding the future of the Royal Navy appears to have increasingly been displaced from the UK and the NR – off-shored – and is being undertaken, amongst other places, in *Proceedings*, noting Sir Jeremy Blackham's and Professor Gwyn Prins article, *Storm Warning for the Royal Navy*, (Oct 07) and Professor Eric Grove's response (Dec 07). These might also be set against Professor Norman Friedman's analysis of the *New Maritime Strategy*, also in the *Proceedings* December 2007 issue. This to me raises two pivotal questions: the first is 'why has this debate apparently become off-shored' and 'what are "we", within the Royal Navy (and so the Naval Review), doing to bring the debate back?' This short article explores some of these issues but essentially maintains that the Royal Navy will only begin to re-emerge if it can re-design its fleet to the requirements today, for tomorrow. In this regard, neither Professor Grove nor Admiral Blackham or Professor Prins may be wrong in what they have to say. However, nailing my colours firmly to the mast, I sympathise more with the Blackham-Prins analysis 'that the cup is indeed less than half full'. This links to Friedman's piece, suggesting that a capability, rather than a strategy driven navy, is a clear indication of a lack of strategic and so design thinking. Indeed, it is the worst predicament that one can face because, in such a situation, one allows capabilities to determine choice and, ultimately, that means one's capabilities will no longer be designed to fight. Moreover, recent (Sunday Times, Dec 07) press speculation that the future carriers have been 'deferred indefinitely' and of more FF / DD cuts and of the RN being 'stuck alongside the wall for most of [2008]' suggest this may no longer be a storm warning: the storm is on us.

### Pugh-Augustine

'Philip Pugh [1986] and Norman Augustine [1997] are the fathers of the concept of Defence Cost Inflation (DCI). In both their studies, they concluded that all military equipment is subject to year on year compound inflation in the region of 8%. The impact of their statistical analysis (which was done in relation to the British Navy) meant that (on the assumption of compound UK defence budget increases of 2-3% per year) the navy would shrink by a compound interest figure of 2-3% a year. If one projects these figures out over 50 years, the navy becomes so diminished that it ceases to have any meaningful utility. The real-life inflationary costs of notable defence procurement projects – like the proposed aircraft carriers, and Eurofighter Typhoon – have come in at higher figures than presented by Pugh and Augustine. If we couple the inflation of these headline projects to the replacement of the nuclear deterrent and to other core costs such as the recruitment and retention of services personnel, fuel, ammunition and the like, then the pressure on the defence budget begins to look daunting. The same is the case across the whole of the European Union; for the disappointing reason that the majority of EU member governments used the Cold War to offset their defence costs against the American security guarantee. The off balance-sheet cost of this upward economic cycle and downward capabilities cycle is to limit the range and scope of activities that EU can prosecute in its own name and its member states can do in support of NATO. The political effects of these trends are therefore large [Dover].' Dr Dover, in his evidence to the House of Commons Defence Select Committee, perfectly sets out the dilemma facing all fleets of any size – from the Wright Flyer to the F-35, irrespective.

If we take the Pugh-Augustine Law and apply it to the Royal Navy from 1950 through to the present day, it confirms that, with a Defence Cost Inflation of 8% per annum, the Fleet has been reducing in size at a rate of about 2% per annum:

# PUGH-AUGUSTINE LAWS

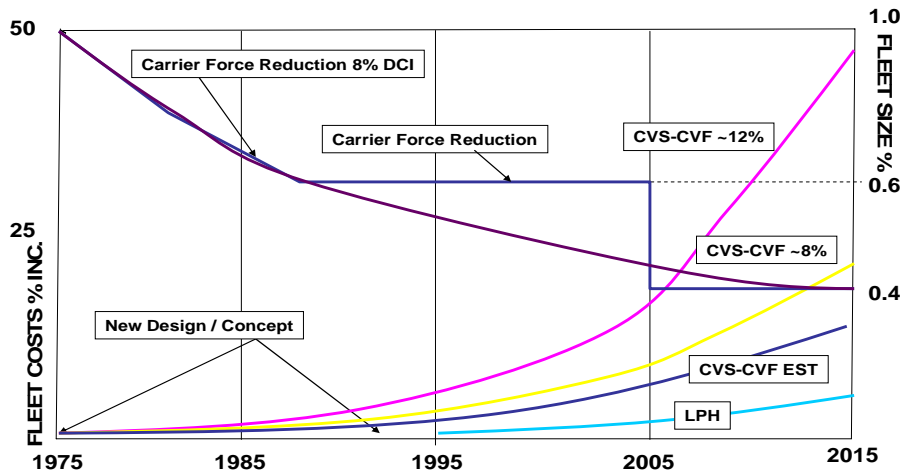


**Figure 1: Pugh-Augustine Laws as applied to the Royal Navy, 1950 -**

From Figure 1, the RN fleet size ran parallel to the Pugh-Augustine prediction until the late 1970s. Then a combination of three significant factors began to apply: primarily, that new designs and concepts (including the Through Deck Cruisers that became the Invincible class of Aircraft Carriers) were introduced in the mid 1970s; increased defence spending under the Callaghan and Thatcher governments, boosted by the 1982 Falklands Conflict, and the NATO (essentially Reagan-Thatcher) commitment in the early 1980s to increase defence spending year on year. This all led to a ‘blip’ in the predicted RN Fleet size; having the overall effect of slowing the rate of decline but not reversing it. Indeed from the mid 1990s, as various peace dividends were taken, the fleet overshot predictions; reducing at almost twice the predicted rate. It is this decline that Blackham and Prins are pointing towards; rightly raising the question of ‘reversibility’. Figure 1 also shows the ‘new design curves’. Arguably, the last full re-design of the Royal Navy took place in the mid 1970s – itself largely in response to the abandoning of the CVA01 carrier programme in 1966. The subsequent ‘blip’ largely confirms the ‘Pugh-Augustine Law’: ‘that to maintain capacity, one has to create and build to new designs’, rather than symmetrically buying the next generation of the same capability. Essentially, this is what is meant by ‘strategy and design driven capability’; rather than ‘like-for-like’ capability driven strategy.

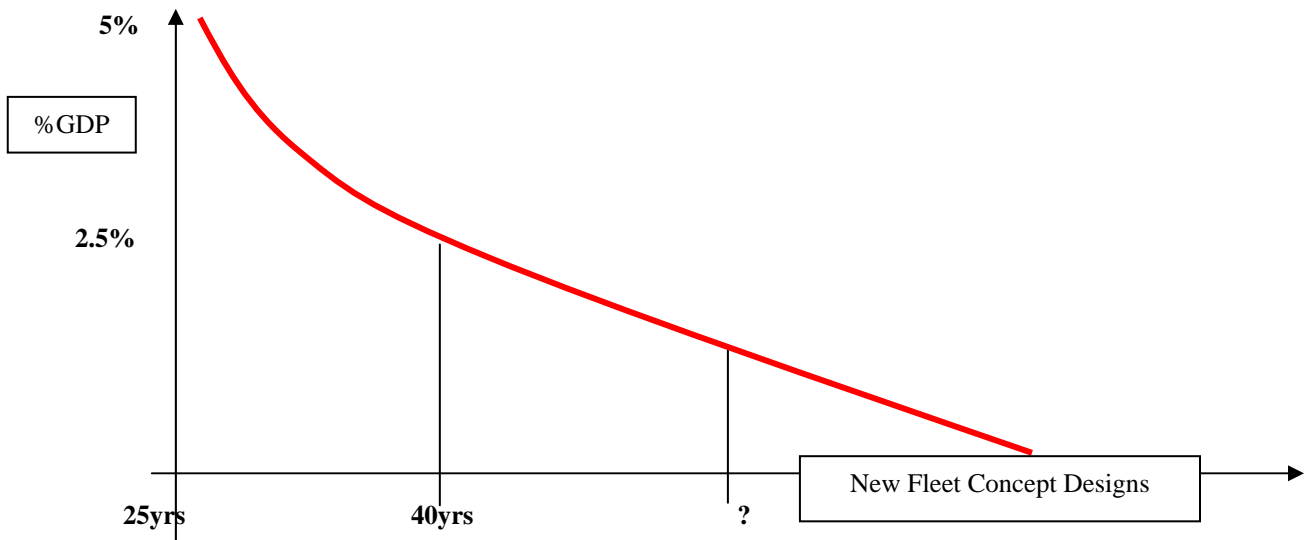
The RN carrier fleet, Figure 2, reduces in accordance with the ‘Pugh-Augustine Law’ to 2015 when there were planned to be two carriers (CVFs). Three cost curves are shown: the upper one uses the cost projection from the first CVS (Invincible) to the last (Ark Royal) and the lower two use the average cost of building the three existing carriers (CVS) as the unit of measurement, to estimate a ‘like-for-like’ based on the Pugh-Augustine model (DCI 8%) and the announced CVF costs. However one looks, it is going to be expensive; ranging from 45 to 15 times the original replacement costs. The announced CVF costs actually suggest a DCI of 7%, which may, if anything, be an underestimation. An alternative design model is suggested by the Landing Platform Helicopter (LPH – HMS Ocean). This was a new-design concept based on the hull of a CVS, and applying the minimum of Lloyds Register and [Royal] Naval Engineering Standards. Confirming the Pugh-Augustine Design Law, by constructing to these new design criteria, it was possible to build the LPH in the late 1990s at three-quarters the mean cost of building a CVS, two decades previously. Moreover, its cost projection to 2015 suggests an alternative ‘carrier’ design may be possible – and one that could also preserve numbers, almost at a ratio of ‘three for the price of one’. In the networked world, ‘quantity has a quality all of its own’.

# PUGH-AUGUSTINE LAWS



**Figure 2: Pugh-Augustine Laws as applied to the Royal Navy Carrier Fleet, 1975 -**

The above graphs were based upon full fleet redesigns occurring every twenty five years. This, itself, was based upon a UK Defence Budget in the region of 5% of GDP in the mid 1980s. Since then, the Defence Budget has fallen and continues to fall in real terms and has now halved to about 2.3% GDP. Even accounting for the fact that the UK Defence Budget has just had a 1.5% uplift, this essentially translates into a decline when adjusted for Defence Cost Inflation. Inevitably, this has resulted in full fleet redesigns being pushed further and further out, to 40 years or more – with major capabilities, such as the CVF for example, expected to have in-service lives of fifty years or more. Clearly this is impracticable; further complicated by the fact that the communities involved, today, will be different again from their predecessors and successors. Meanwhile, time and costs are dominating the processes; making it increasingly difficult to ‘design ahead’



**Figure 3: UK Defence Spending as % of GDP versus Full Fleet Redesigns**

## Design or Die

These facts and figures are staring the Royal Navy in the face, right now. This is not a healthy position to be in; yet it will affect all fleets at some time, irrespective of current budgets and commitments. As Blackham and Prins note, ‘the Royal Navy is already over committed and under-resourced’. This means that the fleet is ‘running out’ even faster as its hulls and air-frames are being used at rates never designed for. More worryingly, it is uncertain if this impact has yet to filter down – for example, there has been minimal change in design-thinking. The RN is essentially living on borrowed time; almost seven years beyond the point at which it should have completed its last full re-design. This needs to be set against the fact that there is little incentive to come to a conclusion, with manufacturers’ profit often coming more from development than

production. Equally, we have examples of when we did this, as in WWII, when we – particularly the US – rapidly moved on to new concepts and designs and then the design teams moved on to the next project. Increasingly we appear set against large production runs and, as a result, procurement cycles are spiralling ever outwards.

We appear, therefore, to be in danger of ‘doubly enveloping’ ourselves – we do not have the funds necessary to maintain realistic ‘like-for-like’ replacement rates; and our industrial base sees little incentive to change the system. Few rewards go to ‘designing for production’ something, I understand, that the recent US Quadrennial Defense Review (QDR) was originally going to examine. The other dilemma we face is that we need to kill off ‘symmetric’ production legacies properly if we are to get at the new. This means that we will need to couple our procurement processes asymmetrically, not just to the front line but, also, to the sharp edges of principles, philosophy, creation, design, acquisition and delivery. The problem is that this is hard and many of our institutions looking at these things look out 0-3 years and have increasingly limited design experience – ‘you cannot teach experience’. Underlying all of this is that our institutional systems beget big systems and if you do not kill them off, the symmetries simply perpetuate and replicates themselves. The unwritten Pugh-Augustine Law therefore becomes:

‘If you can kill off the old symmetries, a new system can come in at numbers and cost.’

## The Big Question

The big question facing the Royal Navy is that of its strategy for the 21<sup>st</sup> Century. If it can get its strategy right, it can get its designs right and so match, over-time, its capabilities to its commitments. Symmetrically building more weapons systems or spending more on Defence is not a recipe for victory. In fact, optimisation and good strategic thinking, planning and designing are polar opposites [Goodman]. During World War II, if the Allies had wanted to optimise, they would never have implemented operation Overlord. Equally, both the RN and USN have been here before, as in Cromwell’s ‘New Model Navy’ of the 1650s and the US Navy that emerged from the Revolution, 150 years later [Toll]: both designed to fight and win. The real essence of strategy, which leads to new designs, is tailoring ‘means to ends’; not ‘ends to means’. It is about first asymmetrically defining the terms of our engagement [Goodman]; not about defining the weapons, measurements or tactics of engagement.

This all sounds very simple on paper but, as we all know, is very much harder to deliver in practice. Everything in my mind points to the need for a blue-water Royal Navy capable of delivering global strategic effect, over the horizon. This is not a military wish but a political, security and economic imperative as we look at a rapidly changing international reality. This will take ‘boots on the ground’ and ‘ships across the seas’. It will also require us to asymmetrically match our capabilities to our strategies along the lines of the old adage of ‘better equipping the man; rather than better manning the equipment’. Can it be done? Does the UK have the will to do this and, even if the UK commits to such a ‘sea change’, does the UK have the people, serving and non-serving, to design, engineer and build a sustainable Royal Navy for the future? These are worrying questions for which, I believe, we do not yet have answers. It would be wrong, though, to write off the Royal Navy or the UK – they have both been around a long time – and from the ashes a new and vibrant Royal Navy may well emerge, designed to fight for the 21<sup>st</sup> Century. That is my earnest hope. As an engineer, I am tired of forever cutting – I want to start designing and building the Royal Navy again. We have to start somewhere.

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