Options for Reducing Costs in the United Kingdom's Future Aircraft Carrier (CVF) Programme

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Summary

The United Kingdom's Future Aircraft Carrier (CVF) acquisition project has been designated a 'Beacon' programme by the Ministry of Defence (MOD) because of the opportunity for substantial whole-life savings. To help realise the project's Beacon potential, the MOD called for an independent, objective analysis of new technologies and alternative manufacturing options. The RAND Corporation was asked to perform that analysis and, in particular, to identify and evaluate options for reducing support costs and other whole-life costs (WLCs) and for reducing manpower.

The research was undertaken when the project was in its competitive stage, which included two competing companies. In January 2003, it was announced that an alliance comprising the MOD, BAE Systems, and Thales UK had been selected for the project. Following this announcement, the Thales design was selected to take forward. This design has subsequently been developed and matured.

The precision of the RAND analysis has been limited by the fact that, at the time of the study, the design of the CVF was still evolving; therefore, there was an unavailability of detailed design and manning data. However, we derive qualitative judgements and present some analytic paradigms that should be of value to the MOD.

Cost Analysis Tools

The evaluation of initiatives to reduce CVF WLCs requires a set of analytical tools to understand the trade-offs among various cost elements. We present four such analytic paradigms:

- A total WLC model that examines the interactions among acquisition, operating, maintenance, and personnel costs and permits the quick evaluation of trade-offs and cost-reduction initiatives.
- A method for understanding the cost of each day of carrier operations. We calculate a daily cost exceeding £500,000.
- A means of trading off acquisition and operating costs. This approach suggests that a £1,000 per year savings for each of the two planned carriers would justify a £25,962 up-front investment across both ships.
- A way of making a similar trade-off between initial technology and subsequent manpower costs. Replacing the median crewmember would save £1.2 million.[2]

Acquisition Cost Savings

While the focus of our efforts was on support costs and manpower, we identified several options that might lead to lower CVF construction costs:

- using more advanced outfitting, especially for electrical, piping, and HVAC (heating, ventilation, and air conditioning), than is currently used by most UK shipbuilders
- setting the start of the second ship to minimise total labour costs at the shipyards constructing the large blocks
- centralising the procurement of material and equipment

[2] That is, if the net present values of all individual crewmembers' lifetime compensations were ordered from highest to lowest, the median of that distribution would be £1.2 million.

- considering the use of commercial systems and equipment in place of military standard equipment wherever there is no adverse impact on operations or safety
- ensuring that comprehensive design reviews by all functional parties are complete so that the design of the ship is acceptable to all before construction commences
- minimising changes during ship construction and quickly resolving any that must be made.

Support Cost Savings

To identify ways of reducing support costs, we first consider avenues through which annual costs might be reduced, regardless of who is responsible for doing so. Second, we consider contractor logistics support (CLS), in which the burden for most cost-reduction choices is shifted to the contractor.

Minimising Annual Support Costs

The MOD faces challenges in maintaining the CVFs. The drop in fleet size from three ships to two will end the current arrangement in which there is always one carrier in refit. That arrangement has certain advantages, e.g., a ship off which to cannibalise parts and workload stability at the refit facility. The MOD and its support contractor will also have to maintain the CVFs with vastly less reliance on dry-docking.

The MOD might gain from designing some systems to commercial standards. We infer from studies for the US Navy that the use of certain hotel-related commercial systems in the CVF might save as much as a net £400 million in WLCs across both ships.

Paint is also a major maintenance expense. If higher-quality paint were used, the scheduled sixth-year dry-docking might be eliminated, which could yield substantial savings.

Contractor Logistics Support

We do not think the MOD can have a CLS arrangement in which the contractor is responsible for every aspect of making a carrier available and is paid solely for available vessel days. The ship is too costly and complicated for a contractor to assume full financial risk for not having the ship operate.

Instead, CLS on the CVF will be a modified version in which considerable responsibilities are left to the Defence Logistics Organisation or the weapon system manufacturers. However, such modified CLS might be prone to 'seam' problems in which different participants blame one another for why the ship does not operate correctly.

CLS implementation difficulties aside, there is reason to be optimistic about CVF maintenance costs. Because the MOD has expressed considerable ambition for cost reduction through new maintenance paradigms, long-run advantages may accrue. Furthermore, many of the most problematic aspects of carrier maintenance may well have been addressed in the choice of ship design.

Personnel Cost Savings

As background, we begin with a review of how the Royal Navy and its original design contractor, Thales UK,[3] approached complementing, then suggest some ways of improving the practice. Next, we identify a number of complement-reduction initiatives on other naval platforms. Finally, drawing from these case studies, we identify and evaluate a number of complement-reducing measures and suggest directions for the future.

Estimating the CVF Complement

The Royal Navy's complementing process takes technology as a given and uses inherited assumptions about hours of work and mix of trades and rates. The process may be regarded as a review and assess-

[3] The design is now the responsibility of both Thales and BAE Systems, working together as the Aircraft Carrier Team.

ment by an honest, experienced broker. It does not produce any recommendations for reorganising work or for adding technology, materials, or equipment. With no systematic evaluation of the complement-reducing potential of evolving technologies and work processes, decisions in the current complementing system may be overly influenced by culture and by outdated policies and practices.

Thales UK, in contrast, appears to have taken a zero-based approach to complementing. It has estimated the work to be done and computed the number of manpower slots necessary to accomplish it. Thales' complementing process yielded a distribution of labour that differed substantially from the Royal Navy's breakdown for the CVF.

As further complementing work is done, the following points should be kept in mind:

- A principal, persisting goal must be observed. Minimising WLCs and minimising crew size, for example, will each result in a different complement.
- Some CVF systems will be inherited from the current carrier class. These systems might bring inefficient manning with them.
- Ambitious plans to cut manpower by investing in technology can be impeded by constraints on the up-front funding.
- Operational commanders may be reluctant to accept smaller complements because they would reduce the margin for error in situations threatening ship safety.

Complement-Reducing Initiatives on Other Platforms

To assist in identifying manpower-reduction options potentially relevant to the CVF, we reviewed several efforts by various navies to reduce complements:

- **Transfer of US ships to the Military Sealift Command** (MSC). As sealift ships have been shifted from US Navy manning to MSC manning, largely with civilians, billets have dropped dramatically.

- **US carriers.** Of particular interest is the Smart Carrier programme, a series of innovations implemented chiefly during *Nimitz*-class refits.
- **The US Navy's Smart Ship.** In an experiment aboard the guided-missile cruiser USS *Yorktown,* significant complement reductions were achieved with core/flex manning, e.g., forgoing underway watches in reduced-threat environments, making more manpower available for other duties.
- **The US Navy's Optimal Manning Experiment.** Innovations on the destroyer USS *Milius* and the cruiser USS *Mobile Bay* permitted reductions in crew size without affecting performance.
- **The LPD-17 and other amphibious ships.** Smart Ship principles were applied; e.g., ship system operators were brought into the design process to suggest efficiency improvements.
- **The Royal Netherlands Navy.** The Dutch are constrained by tighter manpower ceilings than apply in the United Kingdom and therefore accept somewhat higher risks while spreading out most predictable tasks to permit accomplishment by small crews.
- **DD(X).** This is a set of technologies that will be used on future US surface combatants.

The more incremental initiatives such as the various Smart Ship programmes have either shown or are intended to show complement reductions of 15 to 20 percent. Much higher reductions are hoped for in the case of DD(X) and certain Dutch ships.

Identifying and Evaluating Complement-Reduction Options

We identified 57 feasible complement-reduction options of potential relevance to the CVF. Of those, we judged 12 to have appreciable potential for complement reduction and to be advantageous in other respects. Six of these twelve emerged as particularly promising:

- Leaving machinery spaces unmanned, a policy change facilitated by technologies such as remote sensing of spaces.
- Consolidating watches.

- Employing a core/flex manning concept.
- Using civilians to augment the ship's crew for nonwarfare responsibilities.
- Emphasising broad skills and a cross-trained workforce, so that a smaller crew could perform the same number of activities.
- Using conveyors to aid crewmembers in loading stores from the shore to the ship.

We do not know what options have been assumed in the planning complement estimate devised for the CVF and thus do not know if the target is optimistic. There are reasons, though, to believe that the target will be reached:

- There is strong fiscal motivation to realise savings.
- Complement reduction is a key CVF design goal.
- The immaturity of the design may allow for further savings.
- Operating and personnel policies will continue evolving towards sailor multifunctionality.
- As new technologies prove their worth, old manpower-intensive approaches to tasks will fall away.

Initial complement targets have historically proved optimistic, however, and progress toward the complement goal could be complicated by some remaining challenges. For example, many complement-reducing options are not technological but procedural, and efforts to implement such changes can encounter institutional resistance.

We conclude by offering some general guidelines towards better defining complement-reduction options and pushing them closer to realisation:

- Consider the implications of a revolutionary CVF complement for the Royal Navy personnel structure.
- As CVF design proceeds, continue the emphasis on complement reduction and human systems integration.
- Focus on manpower-intensive activities for possible reductions.

- Place a premium on designing or selecting systems that do not require highly specialised personnel to operate.