

# SOME RETHINKING ON THE DESIGN PHILOSOPHY OF WARSHIPS

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## ABSTRACT

Indigenous know how in design of war ship is a great national asset, particularly for the Royal Navy and the U.S. Navy who have been looked upon as pioneers in the design field of warships. With a diminishing defence budget the task of a war ship designer has become more challenging in delivering a cost effective ship, a distinct departure from the old traditional concept of producing a best ship.

The author in this article examines various factors leading to a re-thinking in the design philosophy of warships with particular reference to the Royal Navy.

## Introduction

Changes in the Navy often come at a distressingly slow pace. It may be worth mentioning that it took two-thirds of a century for the US Navy to change from sail to steam. When steam did become a reality, there was yet a period of stagnation in changing from coal to oil. Inertia seems to be endemic to naval development. Change for sake of change is not desirable and generally not welcomed, but any change that is likely to improve the cost effectiveness of a warship needs to be pursued with courage and determination. The primary assets of any Navy (besides, men of course) are the ships, submarines and aircraft (floating assets). Therefore, it is logical to state that any re-thinking in the design philosophy of such assets for the betterment of a Navy is a must. The Government in turn must respond with expediency to the demands of the Navy in view of the fast changing global scenario. The primary aim should be to break the moulds and attitudes that risk becoming so firmly established that they inhibit progress. This implies that there has to be re-thinking in approaching the subject of design philosophy of warships that shall indicate a departure from the old traditional path.

## Some factors on which re-thinking regarding design of warship have progressed

It is often said that a designing of warship is engineering greatest compromise. The aim of a designer has changed from producing the best ship to the most cost effective in view of the end of cold war with the disintegration of the Soviet Union. It must however be noted that there will always be a conflict between Cost and Effectiveness.

Some of the factors that has drawn the attention of a designer towards re-thinking in the design philosophy of warship are:

- a) Diminishing Defence Budget.
- b) 'Small but better' slogan (alternatively 'Do more with less').
- c) Economy in direct procurement vis-à-vis manufacture of equipment.
- d) Through Life Cost (TLC).
- e) Manpower cost.
- f) Indigenous marine industrial base support.
- g) Habitability standards.
- h) Ship safety.

- i) Technological advances.

### **Diminishing Defence Budget**

With the end of the Cold War era most of the Governments, implemented reduction in the defence budget. This decision compelled designers to do some hard re-thinking in the design of warships.

### **‘Small but better’ slogan (alternatively ‘Do more with less’)**

This slogan was initiated by the Royal Navy in 1982 due to considerable reduction in the defence budget. This in a way, indirectly implied the designer to ‘do more with less’. The first casualty to fall a prey to this slogan was the Type 23 frigate project as the number of ships had to be reduced.

In reality, on a closure examination of the slogan, the ‘Smaller’ will invariably precede the achievement of ‘Better’ – not a very healthy situation.

### **Economy in direct procurement vis-à-vis manufacture of equipment**

Most marine equipment fitted in warships are similar to those available commercially on the shelf. Therefore, there is a lot of sense in resorting to procurement of equipment from the commercial markets unless compelled to undertake manufacture due to very stringent naval specifications. This commercial approach can result in considerable saving both in cost and time. Major navies of the world like the United States, UK, France, Australia and India have a separate Controllorate dealing with direct procurement for warship building projects.

There is considerable efforts exercised to reduce unit procurement cost of warships during the construction phase by resorting to a contracting policy through competitive tendering. The overall aim being to derive maximum value for money during the service phase of a warship. The essence of any procurement policy should be based on the three C’s namely:

- Contractization.
- Competition.
- Collaboration.

Whereby:

- **Contractisation** shall attract industrial houses.
- **Competition** shall ensure good value for money.
- **Collaboration** will enable sharing of developmental cost and thereafter derive profit from large scale production.

Further, there is a pressing need to create an environment of trust between contractor and the Navy (customer) thereby permitting the Navy to take a certain percentage of risk. This is justifiable in view of the savings in time and cost which otherwise would have been taken up by developmental cost.

### **TLC**

It can take 13-15 years for a ship to enter service from the commencement of the go-ahead signal for conceptual studies. With the expected average service life of twenty years, a ships life time from cradle to the grave can work out to  $15 + 20 = 35$  years.

The greatest cost is the cost of ownership, which is very large, and normally the TLC of a warship is three times the acquisition cost. Much attention has been focused on reducing unit procurement cost of warships during the ship building phase, but unfortunately, the ship does not receive the same focused attention to get a good value for the money spent during its service life once commissioned.

Some of the areas warranting attention from the designer are in the field of:

- i. Reliability – when executing a contract with an acceptable risk factor.
- ii. Logistics support – i.e. reduction in inventory of spares required during service period life.
- iii. Reduction of through life cycle cost - greater stress to be laid.

### **Manpower Cost**

A large slice of the cost of ownership is consumed by the manpower bill and it is for this reason that the manning of the warship has been a subject of much debate. One way to reduce the manpower bill is to reduce the watch-keeping load but this is in no way an easy matter. This is because a warship does not only need watch-keeping personnel but also personnel to look after running maintenance, action damage, ship safety and other general ship duties. It must however be admitted that sophisticated machinery controls and surveillance have to some extent reduced the watch-keeping bill.

### **Indigenous marine industrial base support**

One of the major factors for a successful warship construction industry is the need of a well established and sound industrial marine base support. In this regard, both the US and Royal Navy have been fortunate to inherit a very sound infrastructural base as proved during the Second World War. The Indian Navy is yet to establish a sound ancillary marine industry to support its ship building industry, though admittedly, some progress has been made ever since the advent of the LEANDER frigate construction project completed a decade ago.

However, one of the major pitfalls of the Indian warship construction programme, particularly, the submarines construction has been the utter lack of timely Government support to fund it and has remained woefully stagnant for the last twelve years. This has resulted in a loss of skilled workers as well as experienced staff due to the unduly long stagnation period, which is likely to affect the 'Think Tank' capacity to undertake future design of warships.

### **Habitability standards**

The last two World Wars confirmed that the habitability of warship left much to be desired. The poor ventilation coupled with improper diet adversely affected the health and morale of the ship's company which in turn had an impact on the combat efficiency. Habitability basically concerns the living and working conditions of men onboard. It must be made amply clear that good living and working conditions onboard can only come at an 'extra cost'. The ship designer has to very carefully balance these two conflicting requirements, namely 'extra cost' and 'Habitability'. This tug of war between Cost and Habitability will always prevail and remain a challenging task for the warship designer.

Historically, men and equipment have been added to ships without much consideration for personal comfort. Further, as the standard of living ashore continue to improve the demands for a better life afloat will persist. This is the price that has to be paid for relying on personnel to operate ships thereby justifying the recent growing demand to reduce complement of board. A word of

caution is necessary in this regard. Decision will have to be made with great care if the Navy is not to experience serious design related personnel problems in the future which will affect combat readiness vis-à-vis the diminishing trend to attract suitable youth as being experienced by some countries. Time alone will tell.

### **Ship safety**

Ship safety is defined as the design and construction of the vessel, operation and maintenance of its material state such that the peacetime likelihood of death or injury due to its loss, damage, malfunction or maloperation is acceptably small as is the associated risk to the general public or property in the vicinity of the environment

The ship safety management system was formally introduced in 1992. The motto being:

- To make ships safe.
- To sail them safe.
- To keep them safe.

Some of the critical ships safety hazards focusing the concern and care of the ship designer are:

- i. Loss of stability.
- ii. Structural failure.
- iii. Explosion.
- iv. Loss of watertight integrity.
- v. Fire.
- vi. Toxicity.
- vii. Escape and Survival.

The consideration of the above factors play a great role in influencing the scope of design and the procurement process of marine equipment and systems for warships.

### **Technological advances**

Increased machinery automation, surveillance, control and simulator training facilities ashore have contributed towards reduced complement and better value for money. But it must be said that irrespective of advances made in technology, the inescapable need to have personnel (the most prime asset of a navy) will continue as long as there are ships to operate. It therefore becomes incumbent for a designer and more so for a decision maker to give habitability its proper due in order to ensure combat efficiency.

### **Future trends in ship designing**

Some of the factors affecting future trends in ship design are:

- i *Availability, Reliability and Maintenance (ARM) factors*

The ARM factor have played a significant role in equipment design and shall continue to do in years to come. But extending this concept from equipment to a whole ship is fraught with uncertainty and shall not be an easy task because it is not a straightforward linear function. To illustrate this reasoning, take for example, a weapon system, which can fail to deliver, its rated performance due to a breakdown of a chiller unit in the A/C system. It is therefore seen that the extension of ARM factor to a whole ship though necessary is likely to take some more time for achieving it.

ii *Sequential vis-à-vis concurrent engineering in the design process of management of warship*

Most navies practise sequential engineering concepts in the design management philosophy of a warship. The US Navy on the other hand follows concurrent engineering concept resulting in saving of valuable time.

iii *Ability to walk-through the entire design*

Modern Technology allows the designer to view the whole warship deck by deck, compartment by compartment forward to aft so as to give the feel of the 'Space' available and review the entire lay out of the equipment fitted.

### **Existing Constraints**

Design is inevitably a matter of compromise between cost and effectiveness and also quality vis-à-vis quantity. The warship is seen as the centralized collection of disparate technologies confined in a steel box with personnel operating in a hostile and corrosive environment. Thus the teaching of design and management of design is not an easy task under the above circumstances.

In the earlier years, experience was gained on the job as new designs were quite frequent. Today, lengthy intervals between new design have greatly reduced this wealth of design experience as a result there is less opportunity for a young designer to learn. Teaching by tutorials using historical examples is the only substitute provided the teacher understands both history and design. The designer (teacher) needs to be aware of the historical development of his subject in order to confront the current design problems in its proper perspective to his students. Another important feature of design is the innovation, an aspect of engineering which is so vital in pursuing the design project of a warship and more so, as the same cannot be thought during the formal engineering courses. Such a quality can only be acquired by a designer through sheer creativity.

### **Way ahead**

A way ahead lies in investigating how to increase overhaul periods of diesels and gas turbines, the interval between dry docking. The increase in automation, micro-miniaturisation of circuits and micro-filming of documents onboard. Stealth design features shall continue to be pursued more vigorously, making ships less susceptible to detection. Full electric propulsion is another area, which needs to be pursued for application to future warships as the same has been successfully proven in merchant ships.

### **Conclusion**

The development of design of warships has been mostly evolutionary, e.g. the evolution of WHITBY class to LEANDER frigates in the Royal Navy and also later adopted by the Indian Navy.

Both cost and change have been two fundamental factors for a warship designer to plan and workout his design. 'Design to cost' is an economic consideration and 'Design to change' is a strategic consideration. Both are beacons that throw light on future ships to come. It is, however, opined that the above two beacons can only be two legs of a three legged policy stool and Stability, Strength and Balance must be part of the third leg. This third leg of the policy stool is called 'design for continuity' which shall be a watchword for future designers of warships.

Finally, only a Navy with a fund of in-house design experience duly backed up by a solid R & D and a sound ship building industry (both naval and mercantile) shall be able to sustain in any future conflict.