

Advanced Naval Vehicles: Who Needs Them?

William D. O'Neil¹

A broad, informal review is provided of the problems involved in justifying heavy expenditures for development of new types of Naval vehicles. It is argued that questions of need and worth are commonly treated too shallowly. A number of frequently urged simple justifications are examined and dismissed. The author closes by urging that vehicle proponents attempt to justify their proposals in terms of specific impact on the results of realistic Naval scenarios.

Introduction

NOT LONG AGO I learned of an interesting advanced vehicle program. It seems that New York's Museum of Modern Art decided that today's technology ought to be able to produce something better than warmed-over Detroit iron for service as taxicabs. Prototypes were furnished, gratis, by three European auto manufacturers, while two enterprising U. S. firms, eager to get in at the start of this newest of the high technologies, built prototypes for the nominal consideration of a million dollars apiece of the taxpayers' money.

As always happens, some of the prototypes were better than others, but all in all it was a great success—technically. The advanced vehicles offered much improved utilization of space, better maneuverability, more accessible and flexible passenger accommodations, a more comfortable and secure working environment for the cabbie, reduced energy consumption, and a host of other advantages. Everyone was very impressed with what advanced technology could offer the taxicab—except for the people who would have to pay for it. It seems that advanced technology is expensive, at least when applied to taxicabs. And somehow all those improvements do not appear to have done much for the cab's basic money-earning capacity. And so the taxi owners shake their heads in wonder and disgust and go on buying Dodges and Fords and the like.

Everyone will draw his own moral from a story like this. One acquaintance of mine sputtered on for some time about the irresponsibility of taxi owners in refusing to face up to "societal and technological imperatives" out of excessive and short-sighted concern for profit. Mine is more homely: It seems to be a lot easier to find engineer-marketeers who are willing and able to conjure up some "advanced technology" than it is to find people who are willing and able to pay for the privilege of putting it into service.

Undoubtedly, like those of most of us, my perceptions are shaped by my environment. I am continually besieged by people who want to apply their own particular brand of "advanced technology" to the solution of the Navy's problems. Great corporations, struggling enterprises perched on the verge of bankruptcy (some of which are also "great corporations"), private citizens, congressmen, and admirals—all have pressed one "advanced vehicle" or another on me, from surface effect ships to solid concrete aircraft carriers.

There is a great range of sophistication in such proposals, but

¹ Staff Specialist for Naval Vehicles and Mines, Office of the Director of Defense Research and Engineering, Washington, D. C.

The views presented herein are those of the author and do not necessarily represent the views or policies of the Department of Defense or of the Director of Defense Research and Engineering.

Presented at the January 13, 1977 meeting of the Chesapeake Section of THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

the fundamentals do not vary. Each proponent has a long and impressive list of advantages which his concept will bring and each makes essentially the same plea: "If we can afford to spend billions on System X, why can't we afford the paltry sums which will be needed to bring my system to glorious fruition?"

Occasionally it is possible to dispose of these proposals rather easily; a little simple engineering analysis will show that the advantages depend on repeal of the Second Law of Thermodynamics or something of the sort. But things are not often so easy.

The usual thing is that there are some plausible advantages to the concept, but that it will take some development effort to find out whether the thing can really be made to work. "Development effort," in this case, is a cryptonym for "money."

Contrary to the impression held in some quarters, neither I nor anyone else in the Department of Defense is provided with sufficient discretionary funds to undertake any serious development effort. My boss, the Director of Defense Research and Engineering, is empowered, under certain circumstances, to ask Congress for development funds. But Congress, on the whole, tends to be rather flinty-eyed, and Dr. Currie at least has never shown much enthusiasm for asking them for money without some pretty clear justification.

Typical proposals

There are three questions to be answered in assessing any advanced naval vehicle proposal:

- Can it be done?
- If it can be done, how much will it cost?
- How much would it be worth?

Unfortunately, it is usually impossible to get very usable answers to the first two questions without first spending a fair amount of money on exploratory and advanced development.

Nevertheless it is the first two questions, technical feasibility and cost, which normally receive most of the attention. My own theory is that this is because feasibility and cost can be considered in relative isolation: a thing either works or it does not, and everyone knows (or thinks he knows) how to measure costs.

The taxi owners have a well-defined (if perhaps somewhat Philistine) measure of worth, too, but that is not available in dealing with defense. (I speculate that this circumstance has something to do with the fact that peddlers of "advanced technology" usually knock first on the doors of the Pentagon.)

So I try to get at the question of worth by asking vehicle proponents, "What is it for?" About 95 percent of the time I get one or more of the following five answers (perhaps embellished a little—I know some people who can spend two hours at a stretch saying, "It goes fast"):

1. Carrying helicopters (or V/STOL aircraft)
2. ASW
3. It goes fast
4. Replacing the conventional surface ship
5. There is a firm military requirement

In view of the frequency with which they are advanced, I think each of these deserves separate treatment.

Carrying helicopters (or V/STOL aircraft). I am encountering more and more people who think that the only thing surface ships are good for, militarily, is to carry aircraft. Helicopters are currently the "in" aircraft to carry, although they are clearly being supplanted (in popular imagination) by V/STOL aircraft.

Aircraft can do a lot of things that ships cannot. (More on this later.) Thus, the idea of sticking aircraft on ships, to extend their capabilities, is a very natural one. It works out pretty well, too—up to a point. A helicopter or two can give a frigate or destroyer the speed and weapon reach advantage over the submarine it lost when subs went nuclear and took up missiley. You add maybe \$5 million to the cost of the ship (*excluding* the cost of the helo itself, which will run about \$7 million a copy for LAMPS MK III and correspondingly less for less capable birds) but this is a pretty small proportion of the total.

When one gets more ambitious, however, the price rises sharply. A large conventional carrier, built today, would involve an investment cost of about \$15 million per aircraft carried. (Again, this excludes the cost of the aircraft themselves.) For smaller ships, or for ships with nuclear power, the average cost per aircraft carried will be higher than this and it does not make much difference, to first order, whether the ship is exclusively an aircraft carrier or whether it carries catapults and arresting gear. [Of course the figure must be scaled down if the aircraft are small; the average carrier aircraft has a maximum gross weight of about 50 000 lb (22 500 kg).]

With this sort of price tag, one encounters embarrassing questions, like, "Why don't we base them on land?" or, "Do we really need to do that mission at all?"

The point of all this is that the principal need, in carrying aircraft, is to do it more cheaply. And this is the one virtue most advanced vehicles do not even aspire to. Of course they claim other, supposedly compensating advantages, such as high speed or low vulnerability to this or that threat.

This is all very nice, but such considerations by no means establish the value of the vehicles for which they are claimed. After all, if one's principal objective is to go fast and keep safe from torpedoes and anti-ship missiles then the natural thing to do is to stay in the air. Aeronautical technology has now reached the point where it is perfectly possible to design aircraft which, flying from politically and militarily secure land bases, can maintain patrols above virtually any ocean area of interest. By operating the aircraft in relays such patrols can be maintained virtually indefinitely.

Long-range aircraft need not be particularly large and unwieldy simply because they are long ranged. (The scaling laws for aircraft do not discriminate against smaller vehicles to the extent those for ships do.) With present technology, however, they cannot very well be supersonic or really agile. Boeing, under Air Force sponsorship, has been attacking this problem by investigating the possibility of carrying small fighter or attack aircraft within a Boeing 747 which would launch and recover them in flight. The idea seems quite feasible—at least as feasible as the average "advanced naval vehicle."

Clearly the airborne aircraft carrier represents an extreme of speed and invulnerability to anti-ship weapons which it is difficult to imagine any surface vehicle can ever approach. To say that such a thing can be done is not to say that it is worth doing. But it nicely illustrates the futility of claiming that this or that advanced naval vehicle is of transcendent value to the Republic

simply because it carries aircraft and has sundry other reputedly valuable attributes.

ASW. It is the conventional wisdom of those who follow naval matters that the Russians are not only coming but coming by submarine. This makes ASW everybody's favorite mission application; when in doubt, tell them it is for ASW. Actually, we have every reason to believe that if it came to a shooting war with the Soviets they would run out of submarines before we (and our NATO allies) ran out of merchant ships—or aircraft carriers, although there is perhaps more room for doubt on that point. This is not all that we might desire but it does suggest that we can afford to be a little selective in choosing what to invest in for ASW.

In fact, since the ASW situation seems to be viewed as being reasonably well under control, there is very little prospect that the Department of Defense or Congress could be persuaded to devote substantially more money to it than is presently allotted. That means that advanced vehicles will be bought for ASW only if they can efficiently replace one or more of the current types of ASW vehicles. "Efficiently," in this context, means that an equal sum spent on the advanced vehicle must produce fewer total ship losses or more or quicker sub kills than if it were devoted to buying updated versions of the vehicle in question.

In case anyone has forgotten, the vehicles in question are airplanes, submarines, mines (we are using "vehicle" in a very broad sense), and—Oh yes,—displacement monohull surface ships. Now most of the airplanes spend most of their time chasing down contacts far at sea, where speed is important to reduce time late. If there are any "advanced vehicles" with the speed or range to challenge airplanes in these missions, I have not heard of them.

Most of the submarines and mines spend most of their time lurking in places which would be distinctly insalubrious for any vehicle which was not very nearly invisible. Again I know of no candidates.

This pretty well leaves the surface ships and those airplanes and submarines committed to local defense of convoys and carriers as candidates for replacement. It happens that sneering at our ASW ships—particularly the FFG 7 class—is one of the most popular games in Washington these days. But whatever you may think of the design of this ship (I happen to think it is pretty good, in most ways that make any difference), the truth of the matter is that in surface ASW the towed array and helicopter are the big equalizers—and the FFG 7 can tow arrays and launch helos with the best of them.

Arrays will not work if towed fast and, while a higher speed for sprinting ahead between arrays tows would be nice, the advantage will have to be weighed against the cost. The FFG 7's may not be exactly cheap, but it seems unlikely that any "advanced vehicle" with similar capabilities would cost less than two or three times as much.

All this is not to say that advanced vehicles will not or should not be considered for ASW missions. But the mere fact that a given advanced vehicle *can* perform ASW functions—even the fact that it can do them well—is not by itself compelling reason to rush out to buy it.

It goes fast. Most people who want to sell me an advanced vehicle start by telling me it is wonderful because it goes fast—two, three, or even four times as fast as a displacement monohull. Those who have managed to stay awake this far will have no difficulty in guessing my answer to that: if two, three, or four is good, why isn't twelve or eighteen that much better? "Advanced vehicles" twelve to eighteen times as fast as fast displacement monohulls exist today; they are known as subsonic airplanes. If I wanted to rub it in I could make it sixty times as fast—the Lockheed SR-71 being a case in point.

Replacing the conventional surface ship. After learning that the fact that their pet can (a) carry helos or V/STOL aircraft, (b) can do ASW, and/or (c) goes fast does not automatically make

it of overwhelming interest, those who are promoting vehicles which happen to operate on or anywhere near the air-water interface commonly draw themselves to full height and announce loftily that comparisons with airplanes and their like are irrelevant; *their* vehicle is intended to replace the conventional (that is, displacement monohull) surface warship. Obviously, nothing but another ship can do that!

Alas, the sad truth is that, in a very real sense, airplanes and submarines, together, have been progressively replacing ships for three-quarters of a century. By this I mean simply that navies in general and the U. S. Navy in particular have been devoting steadily greater proportions of their procurement and operating budgets to airplanes and submarines at the expense (necessarily) of surface ships.

It is also true that in another sense neither airplanes nor submarines can possibly replace ships; they simply do not *do* the same things. They do not carry heavy guns or launch amphibious assaults. Current types of aircraft do not operate on the water surface and current submarines do not shoot down airplanes. Neither looks so splendid, to the eye of the connoisseur, as a well designed man-of-war.

And of course no one ever said, back when the whole process began, that this squadron of airplanes or that submarine was going to take over the functions of some particular antiquated protected cruiser, instead of buying a new DD or CL for the same job. But the airplanes and subs did take over many functions which would otherwise have been performed by ships; they simply employed different means to the same ultimate ends. It was the difference in means that made it so difficult for most contemporaries to understand how these newfangled gadgets could possibly play any very important role in naval war, and led them to say things which sound so silly today.

Consider the case of the automobile and the passenger train as an illustration of indirect replacement. The automobile clearly cannot directly substitute for the passenger train in many ways. It cannot offer anything like such comfortable accommodations, will not burn steam coal or No. 6 fuel oil, and needs a much wider right of way for a given level of passenger traffic. Nevertheless, despite these and a whole host of other incompatibilities, the automobile did dispossess the railroads of the greater portion of their passenger revenues.

Passenger trains do still run (even if their economics are doubtful in most cases); it is not intended to suggest that we should or will stop building surface ships altogether in favor of airplanes or submarines any time soon. What is suggested is that the most attractive competitor to a particular vehicle may not be one which is "the-same-as-but-better." It is not a theorem of logic or a law of nature that surface warships, to the extent they ought to be supplanted at all, must be replaced by other surface or near-surface vehicles.

There is a firm military requirement. The heart's desire, the holy grail of every true enthusiast is an official, signed Operational Requirement for his own system. Never mind that ORs usually come out sounding as if they had been drafted by a council of bishops after sitting seven years in continuous session. With a bona fide Requirement there can be no question about the need for a vehicle it names. Can there? There are at least two serpents in this particular garden, one bureaucratic and one logical. The bureaucratic one takes precedence, as any bureaucrat can tell you, so I will deal with it first.

Once upon a time it was an accepted article of faith, subscribed to by all the righteous and right-thinking, that the Chief of Naval Operations, and those authorized to act in his name, had plenary powers over the design of naval vehicles. (The more aged of us can remember an earlier day when the CNO's powers were much circumscribed by the "Bureau System," but that is another story.) The CNO is a bureaucrat, however, if a very exalted bureaucrat, and his writ is good only where it will run. For some years now, upstart Secretaries of Defense and even Congressmen

have taken it upon themselves to challenge the CNO on at least some vehicle design issues, with some success, at least in a bureaucratic sense.

A much more fundamental obstacle has now arisen. The Commission on Government Procurement inveighed rather strongly against "premature" selection of system characteristics in major system acquisition programs. Office of Management and Budget Circular A-109, issued 5 April 1976 in an effort to correct the problems identified by the Commission in major systems acquisition procedures, directs that acquisition programs begin with a hardware-independent statement of mission needs. This statement, which must be approved by the agency head (that is, the Secretary of Defense), becomes the basis for an open solicitation in which offerors are to propose system design concepts to meet the mission need, without constraint as to technical approach.

If A-109 means what it says and if there is anyone who is both able and willing to enforce it (neither of which is to be taken for granted) then the CNO would no longer be free to direct that plans be laid for procurement of half a gross of Vehicle X. Instead he would have to write down what it was that he wanted the vehicle to accomplish, get the statement approved by the Secretary of Defense, and let industry decide which vehicles it thinks best for the job. Whether it will ever really work this way is anybody's guess but it does make it impossible for anyone to say that there is an authoritative capital-R Requirement for a specific kind of vehicle.

The logical problem is that there is no sensible way for the CNO or any other human to decide that there is a requirement for a particular vehicle without first answering all three questions:

- Can it be done?
- How much will it cost?
- How much would it be worth?

Thus anyone who has a "Requirement" but cannot answer the question about worth is a mountebank or a fool.

Assessing a vehicle's "worth"

It will surprise no one at this point to learn that I do indeed have my own suggestions as to how one ought to go about assessing "How much would it be worth?" One ought to begin, in my view, by thinking seriously about the kinds of conflicts one's country might become involved in and the objective to be sought therein. A sample conflict would be a NATO/Warsaw-Pact war starting with a non-nuclear Warsaw Pact armored thrust on the Central Front and the NATO objective might be to achieve a negotiated restoration of the status quo without anyone having let the nuclear genie out.

Next one thinks about the other guy's objectives and how he would go about pursuing them. For instance, an interest in land-grabbing might go with a Soviet decision not to employ "tacnucs" at the outset. And in such a conflict one can confidently predict that they would throw all their attack subs and naval Backfire strike aircraft into attempts to sink our carriers and cut off supplies to Europe. (It does not take any mind reading to know this; it is what they say they plan to do.) So then the question is: What do we do to him to further our objectives?

Maybe one thing is to cut the Soviet Northern Sea Route to impede transportation of supplies and material to the war front. (This is a *purely hypothetical example*.) Voila! It just so happens that my favorite vehicle, the aerodynaydrostat, can do that!

Wonderful. Now go on in that fashion until you have toted up all the more promising things your vehicle can do in that conflict. Add up the forces required and estimate the costs. And finally go around and look for some other things of equal cost in our current or planned force which do not seem able to make an equal contribution to achieving our objectives. If you find some, then you have not only made a plausible case for the worth of your

vehicle but have gone some way toward identifying where the money for it should come from. Simple, isn't it?

Note that this process is not at all the same thing as that of looking around for a vehicle your favorite can replace, even though in one sense the end result is indistinguishable. "Replacing Vehicle X," as it is usually thought of, involves doing the same job X does in pretty much the same way, only better or cheaper. That does happen sometimes, but historically the usual way that vehicles get elbowed aside is that someone finds a way to do the job in an entirely different fashion, or finds some entirely different job which is worth more.

It may seem that it is really easier to shoot for a direct replacement on the basis that your vehicle can do the job both better and cheaper than to get all wrapped up in squishy questions of grand strategy. It is a nice trick if you can do it but I think that one is bound to get hung up on at least one detail. For a long time there was serious (and effective) opposition to the introduction of steam cruisers on the grounds that they could not keep to sea for two years without touching land, the way a well-found sailing frigate could.

The uncertainties involved in what I have suggested are not to be gainsayed. When you get all through, someone will surely come along to say you have picked the wrong war or wars, misjudged the capabilities or intentions of our assumed opponents, incorrectly analyzed the effectiveness of the sensors you assumed opponents, incorrectly analyzed the effectiveness of the sensors you assume your vehicles to be carrying, or simply jiggered your costs. It is all very frustrating, but then that is war.

If wars were subject to precise, neat calculation, it is likely no one could be found to fight them.

Closing remarks

I should deal here with one final point, that of vehicles for what used to be called "gunboat diplomacy" and is now more politely if less vividly referred to as "naval presence." The idea, as I understand it, is that for such purposes the vehicle's appearance is more important than its capabilities since it is only there to impress people with how powerful we are, not to fight. My own view is that effective presence can only be based on effective warfighting capability because (a) the people who can so readily be fooled are only rarely worth impressing and (b) anyone who makes even the most veiled threats of this sort without being prepared for an aggressive reaction is acting very foolishly.

It has been observed by many people I know that selling a new vehicle is a great deal harder than selling a new radar or missile. In my view this is precisely as it should be. For one thing, vehicles are what principally determine the cost of navies. For another, far from being the mere platforms for firepower that they are often made out to be, it is vehicles which principally determine the shape of naval war. Naval war, with its low ratio of force to space is (or at least should be) very largely a matter of maneuver, and it is vehicles which form the units of maneuver. It is thus impossible to separate the question of what kinds of vehicles should be procured from the questions of what we want our Navy to be capable of doing and how we would employ it to pursue those ends.