Naval War College Review

Volume 42
Number 2 *Spring*

Article 8

1989

From Technology to Tactics: Finding the Missing Link

Frank C. Mahncke

From Technology to Tactics: Finding the Missing Link

Frank C. Mahncke

Why should those of us in the research and development community be interested in fleet tactics? It is often argued that we only design the weapons, we do not fight them. True, in a narrow sense, but in the modern navy, as well as all previous ones, technology and tactics are, and were, closely coupled and cannot be treated in isolation. What weapon systems we have often determine the battles that we can and cannot fight. What battles we must fight often determine the weapons technology we must have. In his book, *Fleet Tactics*, Wayne Hughes of the Naval Postgraduate School notes "that the foremost intellectual requirement for developing good tactics is a knowledge of how weapons work."[1] The converse to that is just as important for the development of naval technology and weapons.

Hughes' basic argument about the relationship between tactics and technology is that to be able to attack effectively first—one of the cornerstones of fleet tactics—appropriate doctrine and tactics must be developed with the weapons. This is a transition process whose complexities, stresses and upsets are typically underestimated during the development phase. "The question facing the community that understands technological promise is how to transform the technology into combat reality at sea . . . the objective is to solve a monstrous transition problem."[2] That we still have problems with this transition is illustrated by the difficulty we have had developing targeting techniques and employment doctrine for the Harpoon and the Tomahawk cruise missiles.

A bit of naval history may well illustrate the necessity for a strong relation between technology and tactics. First, the unhappy story of the U.S.S.

Mr. Mahncke is Director of the Surface Warfare Analysis office of the Naval Surface Warfare Center in White Oak, Maryland. He is a graduate of Bowdoin College and the Naval War College. Working with the Center for Naval Warfare Studies, he designed several war games involving new technologies which stimulated this paper.

Wampanoag. Designed during the Civil War by Benjamin Isherwood, as a swift commerce raider, she incorporated the most advanced steam power plant of her day. In 1869 she set an absolute speed record for naval vessels of 23 knots, a record which stood for 20 years. As significant a technical achievement as this was, the Navy was not particularly impressed, and most assuredly was not revolutionized. No fleet of *Wampanoags* was built, and no world naval race for speed ensued. The *Wampanoag* became a stationary receiving ship at New London and shortly thereafter was sold off.

In 1906 a typical new battleship was capable of 18 knots or less. Her armament was like a variety store: four 12-inch, eight 8-inch, twelve 7-inch, twenty 3-inch, and so on, to give an American example. Secretly and swiftly—it was done in a year—the British built the *Dreadnought*, a radically new battleship capable of 21 knots and mounting a main battery of ten 12-inch heavy guns with a number of quick fitting 12-pounders for close-in defense. She had no intermediate caliber guns. The product of Sir John Fisher's fertile era, she was a great success and set off a rash of dreadnought fever throughout the major navies of the world. The United States, Germany, Italy, Russia, and Japan followed suit as quickly as budgets and yard space allowed. Within the next few years, capital ships like the *Dreadnought* dominated the world's naval tactics and warfare.

The *Dreadnought's* influence on naval matters was so great that we now refer to all capital ships of her type, built before the First World War, as dreadnoughts. This may be the original and classic case of brand name identification.

Why did the *Wampanoag* become a forgotten bit of naval history while the *Dreadnought* became a memorable benchmark? The question may be a trifle too simple, but the answer lies in the relationship between the technologies used in the two ships and the naval missions of their times.

The *Wampanoag* was built for speed alone. Her premier technological feature was the use of the new long cutoff point steam engines. This gave her the impressive speed for which she is remembered. Her mission was commerce raiding, a mission inspired by the very visible success of the commerce raiders of the Confederacy during the Civil War when she (*Wampanoag*) was designed. While speed may well have been the most influential parameter in the design of ships for commerce raiding, the postwar Navy was not in the business of commerce raiding. In the late 19th century, the Navy's mission was first to protect and defend the shores of the country against attack by heavy naval forces and, second, to maintain a thin presence along and about the worldwide sea lanes wherever the United States had commercial and maritime interests. The *Wampanoag* was too lightly gunned for the first, and far too short-legged for the second. Hers was not a balanced design.

Mauricce: From Technology to Tactics: Finding the Missing Link

Although steam driven vessels had been in the Navy for 30 years, many senior officers in the late 19th century navy were still not comfortable with them. Elting Morison suggests that the board that surveyed the *Wampanoag* did so for reasons of discomfort with steam; the concept of seamen was not sustained by men "lounging through the watches of a steamer."[3] Whether this was the case or not, Hughes notes that the board was essentially right in their assessment that the fast but short-legged *Wampanoag* did not fit into the naval missions and tactics of her day and country.[4]

To the casual naval historian, the *Dreadnought* appears to have been nought but a big fast ship with big guns. That is not a bad combination. But there was more than that which led to the *Dreadnought's* influence on her contemporary navies.

Pre-dreadnought ships depended on local fire control for their gunnery. Each gun fired independently under the control of its gun captain. He could not see targets accurately at any great range and had a limited ability to correct his fire as he could not always spot the fall of his shot separately from that of his colleagues. To win the engagement, ships were thus forced to close their opponents to where they could use rapid fire guns at their short effective ranges. Hence the need for many intermediate caliber guns on capital ships. If heavy gunfire could be laid more accurately, then the capital ship might destroy her opponents at a range beyond their ability to return the favor.

Lautenschlager[5] describes the eight years before the First World War when the dreadnoughts capitalized on technological developments in optics and electrical transmissions of information. New optical technology eventually allowed the dreadnoughts to get accurate range and bearing information on the target, while the electrical transmission technology allowed accurate and simultaneous transmission of this information from the spotting top to all the guns. The electrical transmission technology also allowed the simultaneous firing of all the big guns in the main battery which, when the range was right, vastly increased the lethality of the broadsides.

An additional and crucial development was the technique for shot-fall spotting from the spotting top. This permitted the rapid correction of range by observing the shot-fall accurately, as either over or under, so that a hit might be expected on the third or fourth salvo. Collectively, these technologies and techniques enabled the dreadnoughts to deliver with improved precision a greater weight of explosive at a greater distance than their probable opponents. They were designed to attack effectively first—one of Hughes' cornerstones of fleet tactics.

Technology alone did not give the *Dreadnought* and her sisters their memorable place in naval history. Tactics for the effective utilization of the weapons also had to be developed to enable the dreadnoughts to use these technologies to meet the mission: the control of the seas through the destruction of all who might oppose them. Organized and structured shotfall spotting was the first tactical addition. The second was to reorganize fleet operations to focus on engaging the enemy at the maximum range, a range which would minimize the possibility of counter-damage to the dreadnoughts. Previously, naval engagements had been brutal slugging matches that as often as not ended in grave damage to both parties. The dreadnoughts were designed to survive winning an engagement. The final tactical change was the addition of torpedo-boat destroyers—called destroyers—to the dreadnought fleet to guard against close-in torpedo attacks. This last addition demonstrated that effective utilization of a new weapon system may require the addition of new ancillary weapon systems to the complete fleet.

While all this did not work out at Jutland quite as well as expected, the significance of the dreadnoughts, in contrast to the *Wampanoag*, lies in the successful integration of the several technologies underlaying their design which enable them to meet their mission: to dominate from a safe distance all their then-known opponents. In modern language, they were designed to expand and then to dominate and control the battle space around them. As they evolved, they became an early example of good systems integration.

The different histories of the *Wampanoag* and the dreadnoughts illustrate two important points about the consequences to naval warfare of new technologies. First, a single technology such as the engines on the *Wampanoag*, while elegant in itself, rarely makes a major change in the likely outcome of a war. The real impact comes from the successful integration of several related or complementary technologies, as with the dreadnoughts. Second, technology and tactics must be developed with due regard for the naval mission at hand. The success of the dreadnoughts lay both in their technologies and in the development of appropriate tactics for their employment in meeting their mission.

The same points could be made equally well from a historical look at the troubles navies had with the incorporation of submarines and aircraft into their fleets. When aircraft first appeared, navies used them in an obvious if unforesightful way—as extensions of the spotting tops. Even as unique ships—aircraft carriers—emerged with attack capable aircraft, they were not viewed as capital ships by the naval establishments of the time. The initial role of the carrier was that of scout for the battleships. The strategic requirements of the Pacific theater finally caused the Navy to develop and transition a whole new body of tactical doctrine to capitalize on the new technological capabilities of the aircraft and the carrier.

With the operations of the fast-carrier task forces in the Pacific, the transition from the technology of the aircraft and the carrier to the effective tactics for their utilization was accomplished. The questions for us today are: could the transition have been accomplished before the war; is it necessary to have a war to work out the transitions? Certainly all the pieces were in place before the war. The problem seems to have been the inability of the operational forces to see the full capabilities of those pieces. We might well ask now, what role did the designers of the aircraft and the carriers play before the war in demonstrating to the Navy the capabilities of the technology and the opportunities presented by it?

Hughes speaks of the importance of the transition from technology to tactics and sets as one of his cornerstones of tactics: "To know tactics, you must know weapons." As the contrast between the *Wampanoag* and the dreadnoughts and the struggle to find the best role for carriers illustrated, tactics and technology are inexorably entwined. "The goal of both the tactical commander and the weapons designer is to maximize net delivered offensive firepower."[6] Neither will alter the course of war without the other.

This is easily said and agreed to in principle by all parties. In practice we have come to separate the development of technology from the development of tactics and to place the latter in a secondary position. There is a tendency to assume that technology alone will carry with it the necessary tactical solutions and that little thought for the tactics need be given during the weapon development phase. Hughes notes, "there are officers in peacetime who regard the official statement of a requirement for a new piece of hardware as the end of their responsibility in correcting an operational deficiency."[7] Similarly, there are those in the technology community who regard the delivery of a piece of technology or hardware as the end of their responsibility.

One reason for the common presumption that technology will produce its own tactical solutions without further effort may lie in the remarkably successful American affair with the fruits of technology in the 20th century. The development and use of the atomic bomb was a watershed experience. To many, it appears that the atomic bomb was an exercise in pure technology to meet a clear need and when dropped—the obvious tactical thing to do with it—ended the war with a bang. No specific tactical development was needed to alter the course of the war with the atomic bomb.

The difficulty with the Manhattan Project experience is that it may have conditioned a whole generation of military planners to expect that scientists and engineers can deliver just about any exotic thing that might be wished, that the application and tactics will be easy and obvious, and that when used it will have a dynamite effect and end the war. The atomic bomb may have caused us to expect that new weapons will work as advertised and that they will immediately solve all the tactical problems at hand. Thus we need not plan for the difficulties of the transition from technology to tactics.

This positive experience was repeated with the development and deployment of the ballistic missile firing submarine and its missiles. Although more an exercise in engineering than in pure technology, the effect was the same. The system worked well from the start, simply by being there, and solved a problem in the vulnerability of the land-based ICBM force. Its tactics were obvious and required neither revision of doctrine nor restructuring of the fleet.

Unfortunately, The Gods of War are rarely so kind and cooperative. Most new technologies and weapons require much hard thought and struggle before the tactics are in place in order to make full and best use of them. The key to a successful transition from technology to tactics lies not in the bureaucratic structure (though that might be improved) but in finding the right people. Individuals are needed who have the flexibility of mind and intellect to understand and work with both technology and tactics.

That this has been done well in difficult circumstances is illustrated in the development of fighter interception tactics during World War II in the United Kingdom. During the prewar years there were great debates among the technical advisors to the British government over the appropriate technical and tactical schemes for air defense. The conflict in ideas was most fierce between Lindemann and Tizard as has been described by C.P. Snow.[8] Both were men of considerable scientific stature, although Lindemann had the more public reputation.

Lindemann was an arrogant man who had Churchill's ear initially. He focused his attention on gadgets that appeared to promise a quick and easy solution to the problem of destroying German bombers over the British Isles. Some of the notions he pushed now seem quite bizarre, such as dragging sweep wires behind interceptors or dropping aerial mines on the bombers. Few of his ideas amounted to much for he did not have a systematic grasp of the whole problem, nor did he have the ability to develop one.

Tizard, though an unprepossessing man, recognized early on that radar was the key, but that much difficult work needed to be done in the management and control of the interceptor aircraft before the potential of radar could be realized. Although Lindemann eventually drove Tizard away from the RAF air defense committee, Tizard's concepts for radar as a part of an integrated air defense system prevailed in time for the essential elements—including fighters, radar stations, and most importantly, the command and control system—to be in place for the Battle of Britain.

The conflict between Tizard and Lindemann illustrates two things about the development of a productive relationship between technology and tactics. First, the best combination of technologies and tactics is not always obvious. Men with impressive credentials may disagree passionately. Second, the best solution requires a good grasp of both the technologies and the operational needs. In the real world, finding that best solution is often a matter of understanding the interplay of several technologies and the mission requirements. We now like to call this systems engineering and integration.

Even when the basics of the best solution have been found and put into place, considerable work must still be done to fine-tune the process. This is difficult and can only be done by continuing and trusting work between the technical community and the operational community.

This cooperative tuning of the tactics and the technology is well-illustrated in the operational research done for air defense in the United Kingdom during the early part of the Second World War. P. M. S. Blackett[9] wrote a good description of this after the war. He and other scientists worked directly with the air defense forces throughout the bombing of Britain to adjust and refine both the radar and communication systems and the tactics for using them. At times, during the peak of the battle, they made almost daily changes and improvements in the process. They worked directly with the operational forces in the command centers and at the radar stations. Their most significant achievement was the degree of trust and confidence they built with the operational commanders.

A very similar story of productive working relations that affected the outcome of the mine campaign against Japan has been told by E.A. Johnson.[10] Scientists and engineers from the Naval Ordnance Laboratory worked in the field with the naval forces in the Pacific to improve continuously the mines and the tactics.

The *Wampanoag* story also illustrates a continuing problem for new weapons: how to integrate them into the fleet and its missions? This is especially difficult when the new weapon comes along in small numbers, has radically different performance characteristics, and must be blended into a fleet of long-lived platforms and weapons.

This has been the case with the hydrofoil. The first hydrofoil was flown on the Seine River in 1887 by Comte de Lambert. In 1918, Alexander Graham Bell flew his HD-4 hydrofoil at 60 knots on the Bras d'Or Lake in Nova Scotia. Neither of these demonstrations had any immediate effect on the navies of the world.

Hydrofoils have proven to be impressively fast but very difficult to integrate into the fleet. They are faster than anything else in a task force, but too short-legged for the sort of transoceanic work that the Navy needs. The tactical solution has been to create a unique squadron and tailor its missions to the specific characteristics of the hydrofoil, i.e., fast response, short duration missions in the Caribbean. The Navy's reluctance to buy more hydrofoils may cast some doubt on how well this technology has transitioned to a useful operational capability.

Technology can give us weapons that we may be unable to integrate into the tactics and operations of our fleet in spite of the great hopes raised by them. For a number of years the Navy has wrestled with the question of what to do with more advanced hull forms such as the surface effects ships, the air cushion vehicle and the SWATH. While the surface effects ship has found a special niche as the LCAC in amphibious operations and the SWATH a very special niche towing acoustic detection arrays, the technology has languished because of the transition problem. We have not been able to figure out how to integrate advanced and high performance hull forms into a fleet dominated by less exciting ones. Advanced hulls have yet to make any major impact on the operations and tactics of the Navy.

Perhaps, as Hughes suggests, the introduction of new weapons into the fleet by evolution rather than revolution would allow us to manage better the tactical development problem. Hughes builds a good case for this by looking at the history of the old treaty cruisers. The first of these, the *Pensacola* class, were disappointing. As more of these cruisers were designed, they incorporated incremental changes based on lessons learned from the operations of the first. This evolutionary process led eventually to the *Astoria* class with integrated and effective AAW combat systems for the Pacific war.

By making incremental changes from one to the next as they were designed and built, this initially unpromising type eventually produced some effective ships. Certainly such an approach allows us to experiment with the connection between technology and tactics and to correct our errors before we have bought too many of them.

We should remember that the final class of these ships, the *Des Moines*, *Salem*, and *Newport News*, could empty their magazines in 10 minutes of vigorous combat, reminding us that sustainability is an important consideration in developing tactics for a new technology. It was probably fortunate that none of that trio of ships ever faced so stressful a 10 minutes that their skippers felt compelled to fire away everything they had.

The American lead in technology over the Soviets has become a shibboleth in our defense planning. This technology lead is how we expect to counter the sheer mass of the Soviet military. As we wait for this advantage to be deployed and give us a revolution (typically 15 years), the Soviets appear to have adopted the evolutionary approach to the introduction of new technology into their fleet. They may be gaining an edge in deployed technology and, by so doing, may possibly be gaining an edge in the ability to use the technology. They may have had more opportunity to experiment with and develop suitable tactics. Whether they have done so with their relatively low deployment rate remains an interesting and open question.

Turning to the question of how to manage the transition from new technology to new and appropriate tactics, I suggest that there are three things of which we might make better use: the skills and personnel of the Navy laboratories, war gaming, and fleet exercises.

With its in-house laboratories the Navy has a group of leading technologists who are knowledgeable of, and sensitive to, the missions and operations of the Navy. These men and women are ideally positioned to know and work with technology, with its potential application to naval missions, and to contribute directly to the development of tactics for the new weapons in whose engineering development they have participated. They well meet the requirements of the converse of Hughes' cornerstone—to know weapons technology, you must know something of tactics.

War gaming has long been a part of the Navy's development and evaluation of tactics. This past year, the Naval War College has been developing and supporting a series of technically focused seminar war games at several of the Navy laboratories. Among other objectives, these games have helped to introduce laboratory people to tactical realities. These games have also begun to look at the matter of generating technical requirements based on tactical needs. If further developed, this game series could be used to develop a cadre of Navy technologists who can participate usefully in the transition from technology to tactics.

Full-scale war games can and should be developed which will explore in a realistic environment the various tactical options opened up by new weapons technologies. At the moment, this is not being done for reasons of cost and lack of experience. War games are the ideal place to explore radically new or different tactics and to evaluate their potential place in the next navy. They are also a whole lot less expensive and embarrassing than building and deploying fleets of *Wampanoags*.

Perla[11] has made the point well that war gaming is an integral part of a network or hierarchy of activities, including systems analyses and fleet exercises, which together lead to the development of tactics and strategy.

Technical fleet exercises such as the SHAREM (Surface Ship ASW Readiness Measures) and BGAREM (Battle Group ASW Readiness Measures) ASW series are of course the best way to develop and validate new tactics for new weapons. Regrettably they are expensive, difficult to organize, and often very hard to reconstruct and analyze. We have often saved a few pennies by scrimping on the reconstruction and analysis. Nevertheless, we do not do enough of them; we do not get and use enough good data from them; and we do not involve enough members of the Navy's own technological community (laboratories) in them. We should.

Rather harshly Hughes says that: "Tactical hopes and technological opportunity are separated by an invisible wall, which is a source of friction and frustration. Naval tacticians have been guilty of trying to fit new capabilities into the tactical framework with hidebound lack of imagination. Inventors have been guilty of advocating new capabilities . . . that are too fragile, too narrow in their purpose, or too expensive for tactical application."[12]

There is no natural reason why this should be so, save the problem of two cultures. Now and again we have done better, we have the tools and skills to do so now. Let us begin.

Notes

1. Hughes, Wayne P. Jr., *Fleet Tactics—Theory and Practice* (Annapolis, Md.: Naval Institute Press, 1986), p. 4.
2. *Ibid.*, p. 206.
3. Morison, Elting E., *Men, Machines and Modern Times* (Cambridge, Mass.: The MIT Press, 1966), p. 114.
4. Hughes, pp. 208-211.
5. Lautenschläger, Karl, "The Dreadnought Revolution Reconsidered," *Naval History (The Sixth Symposium of the U.S. Naval Academy* (Wilmington, Del.: Scholarly Resources, 1987).
6. Hughes, p. 207.
7. *Ibid.*, p. 32.
8. Snow, C.P., *Science and Government* (Cambridge, Mass.: The Harvard University Press, 1960).
9. Blackett, P.M.S., *Studies of War* (New York: Hill and Wang, 1962).
10. Johnson, E.A., *Mines Against Japan* (Silver Spring, Md.: Naval Ordnance Laboratory, 1973).
11. Perla, Peter P., "War Games, Analyses and Exercises," *Naval War College Review*, Spring, 1987, pp. 44-52.
12. Hughes, p. 214.

"It is curious how the possession of a blank cheque on the bank of man-power had so analogous an effect in 1807-14 and in 1914-18. And, curious, also, that in each case it was associated with the method of intense artillery bombardments. The explanation may be that lavish expenditure breeds extravagance, the mental antithesis of economy of force—to which surprise and mobility are the means."

B. H. Liddell Hart: *Strategy*
New York, Praeger, 1967, p. 127