From Concepts to Capabilities through Learning: The Case of *Stiletto* Today and the Case of the Combat Information Center (CIC) in World War II

by

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Introduction

"Informed risk-taking"—that's what this paper is about. The Secretary of Defense knows that the ability of organizations in the Department of Defense (DoD) to take informed risks is one key to transformation. Without risk-taking, there can be no learning, and without learning, there can be no transformation. But there have to be ways to hold risks in check.[1]

This paper will briefly describe a method developed by the Office of Force Transformation (OFT) to take "informed" risks, using the example of the recently launched *Stiletto* watercraft. This method is neither as radical nor as new as you might think. OFT found a forerunner of it in Navy records from World War II—in the development of the very successful Combat Information Center (CIC).

What matters to you, whether you're a warfighter or a developer, is OFT's demonstration that the existing acquisition process can be *complemented* by OFT's related but different method—one that creates new capabilities, places them quickly in the hands of warfighters, and then reacts to how those warfighters learn to use those capabilities. Acquisition is about equipping the joint force. OFT's approach—called "concept-technology pairing"—is about *helping the joint force learn*.

The Problem

The regulations that govern the existing acquisition process are based on a linear sequence of activities: requirements generation, development, initial testing, preparation for production, production, operational testing, and fielding. This step-by-step process is designed to identify risks, highlight the critical risks as far ahead of time as possible, and then apply time-tested ways of mitigating them.

However, in partnership with other elements of DoD, OFT has developed a "feedback" model, which places selected prototypes in the hands of warfighters so that they and the developers can use these prototypes and learn from them, plowing the learning back into a new cycle of rapid development, testing, and fielding. The goal of this circular process is not to bypass the linear acquisition process, but to learn quickly about how to use new systems and how to develop new warfighting concepts.

It is true that the linear model of acquisition allows for block upgrades and step-by-step improvements of existing systems. There are many examples of this; the cases of the block upgrades of the F-15, F-16 and F/A-18 combat aircraft are just a few illustrations of successful efforts to steadily improve an already fielded system. But what OFT and its DoD partners have done is to create a process that emphasizes learning

through the operational use of a rapidly developed system. In this case, the emphasis is not on improving an already fielded system. Instead, it is on using systems to learn how to deal with the asymmetric challenges that the enemies of the United States are turning to in their efforts to blunt or deflect the overwhelming conventional force that U.S. military units can bring to bear on opposing regular armies.

There are many existing processes for placing new capabilities in the hands of warfighters: (a) the Joint Capabilities Integration and Development System (JCIDS), (b) the Joint Rapid Acquisition Cell (JRAC), (c) Advanced Concept Technology Demonstrators (ACTDs), (d) Joint Urgent Operational Needs, and (e) a collection of what might be called "niche" processes, such as those used by the Combating Terrorism Technical Support Office.[2] But these processes tend to be modifications of the basic linear acquisition process. They quicken its pace, or create means to insert new technology into ongoing programs, but *they are not fundamental departures from the linear model* of acquisition. Fortunately, there is another model for simultaneously acquiring, developing and learning from rapidly fielded prototype systems. It's not really new, as the next section will show.

The Development of the CIC in World War II

The Combat Information Center (CIC) was a tool of "information warfare" developed during World War II to assist the Navy's surface forces in their struggle with trained and professional squadrons of warships of the Imperial Navy of Japan, especially the latter's cruisers and destroyers. The CIC combined and displayed the information from a warship's air and surface search radars, fire control radars, visual sightings, and meteorological sensors with intelligence and contact reports sent to the ship by other friendly ships and aircraft. In effect, the CIC was a "Grand Central Station" of information, where raw data were filtered, processed and then turned into displays— into what today we would call the "relevant operating picture."

The Navy's surface ships did not go to war in December 1941 with most of this equipment or with the knowledge of how to use it. But the Navy's destroyers and cruisers did go to war with a doctrine that stressed the aggressive use of destroyers and cruisers to repel and defeat night attacks by enemy destroyers and cruisers on the American battle fleet.[3] The naval arms limitation agreements had left the Imperial Japanese Navy (IJN) inferior in battleship strength to the Navy, and the IJN's surface forces planned to compensate for this inferiority by attacking aggressively with torpedoes at night, when the primary prewar sensor—the human eye—was at a disadvantage.[4] Torpedo-armed ships that could break through the screen surrounding the Navy's battleships could cripple or sink them, giving the IJN's battleships equality or even an advantage once the expected daylight gunnery action began.

Before World War II, the Navy had made impressive strides in developing optical range finders and in using the analog computers attached to those rangefinders to aim the dual-purpose guns of destroyers and the 6 and 8-inch guns of light and heavy cruisers. As the official history of the Navy's Bureau of Ordnance noted, "By the time of the

Japanese attack on Pearl Harbor, surface fire control was almost completely automatic."[5] Moreover, radar—especially the microwave sets produced after 1941—promised to make control of the guns at night as precise as it was during the day. In consequence, radars were attached to the existing fire control rangefinders as quickly as the radar sets were manufactured and ships became available for their upgrades.[6]

Yet the existence of radar-equipped ships did not give the Navy the upper hand in night surface engagements against the Japanese around Guadalcanal in the summer and fall of 1942. In five desperate battles, Allied and Navy formations lost 6 of 18 cruisers engaged and 9 of 27 destroyers. The Japanese lost only one cruiser of 15 engaged and 5 of 34 destroyers. The Japanese also lost two fast battleships, as well as the overall naval campaign, but the magnitude of the losses suffered by U.S. forces came as a shock and a surprise.[7] There were a number of reasons why the U.S. forces did not do better, including a lack of training (many formations were scratch teams) and the fact that the cruisers and destroyers engaged usually had dissimilar radars that produced different "pictures" for their commanders. But the fact remained that a U.S. advantage in sensor technology had not led to a decisive advantage in battle.

The problem was that the new radars had produced a lot of relevant data, but the individual ships lacked a process for turning that data into essential information that their captains could act on. There was one exception, however. The executive officer of new destroyer *Fletcher*, Lt. Commander J. C. Wylie, Jr., had rigged a radar control room "just off the chart house" where he could monitor in real time the information from *Fletcher*'s radars and the reports sent *Fletcher* by other ships. Wylie spoke directly to *Fletcher*'s captain, who stood in his traditional post on the bridge, informing the captain of friendly and hostile ship movements that the captain could not see. Wylie did not create any new equipment. Instead, he organized that equipment in such a way that he could draw useful information from all the data that the equipment produced.

As *Fletcher*'s captain noted in a 19 November 1942 report, "the officer [Wylie] in Radar [sic] control was able to keep the Captain constantly informed of the tactical situation, which was often visually obscured; was able to select and then designate gun targets; and was able to coordinate the fire-control tracking and torpedo-director pointing for torpedo fire."[8] In short, Wylie provided his commander with "situational awareness," with the result that *Fletcher* came through two very severe engagements in November essentially unscathed.[9]

Fletcher's successful performance was documented in reports to the Pacific Fleet Destroyer Type Commander in Hawaii, Rear Admiral M. S. Tisdale, and in reports to the senior Navy commands in the Pacific and in Washington.[10] Early in 1943, Tisdale transferred Wylie to his staff and directed him to produce a short handbook on how to use the available equipment and new data evaluation procedures to create a CIC. Wylie and his colleagues produced the "CIC Handbook for Destroyers" in two months. The "first run of about five hundred copies… was an immediate success and within a short time was widely reprinted and distributed throughout the navy."[11] Tisdale then sent Wylie to Washington to gain the support of the Bureau of Ships (responsible for search radars and

plotting equipment), the Bureau of Ordnance (responsible for fire control radars), and the Atlantic Fleet destroyer type commander.[12]

The next step was to *institutionalize* the CIC concept—that is, to build on Wylie's *operational* innovation to make it both the standard operating procedure *and* a stimulus for further advances in technology. Making the CIC a Navy-wide standard was done by issuing handbooks and tactical bulletins. The Pacific Fleet staff also began publishing a special journal (*CIC*) in 1944, and fleet tactical doctrine was formally changed that same year.[13] New military occupational specialties were created, CIC schools were set up, and newer ships were altered so that they had sufficient space for the equipment needed by a working CIC. Facilitating this rapid institutionalization of the CIC concept in surface warships was the effort already expended in the Pacific to create effective air defense (or "fighter direction") centers on board aircraft carriers.[14]

In about 18 months, the Navy moved from its first operational installed microwave radar and Plan Position Indicator (PPI) scope to the institutionalization of the CIC concept.[15] For this to happen, multiple streams of development—in radars, plotters, and communications equipment—had to be combined and applied to the needs of the combat forces. This combining was done *by the combat forces*, which had to deal with a resilient and adaptive enemy, and it placed a great strain on part of the Navy's acquisition community. As the official history of the Navy's Bureau of Ordnance pointed out, "The rate of equipment obsolescence was greater than production rates." The Bureau responded to this challenge by producing "the first workable design at hand, rather than wait for a potentially superior design at a later date."[16] But this approach worked because of "the ability of the men in the fleet to get better than predicted performance out of whatever equipments were available."[17]

This dramatic incidence of revolutionary innovation was a response to the deadly pressure of combat. The success of the initial CIC-equipped ships silenced any critics of the process of user-driven acquisition, and the special rules that governed acquisition in wartime opened possibilities for procurement, testing and funding that would not have been possible in peacetime. However, the size and weight of the equipment in a CIC prohibited Navy officers from extending the successful CIC operational concept to smaller combatant craft.

In 1945, the famous Hollywood director John Ford made a movie called "They Were Expendable," which was based on the book of the same title written by William L. White. The book and the movie described the exploits of PT boats that fought in the defense of the Philippines in the opening months of World War II. The movie opened with the PT boats maneuvering in Manila Bay just before the beginning of the war. They demonstrated their high-speed maneuverability to the Admiral in command in an effort to prove that they were an important and integral element of his forces. After their maneuvers, the Admiral inspected the crews of the PT boats. Just as he left for his headquarters, he turned to the commander of the PT boat squadron and said something like, "Your small craft are very impressive, but I prefer something with more punch." For the rest of the movie, the PT boat crews, disappointed but full of fight, fought

courageously to prove that they had that punch. Because Hollywood provides us with myth more often than reality, they proved their point.

But if you examine the actual records, you find something very different. PT boats were not ineffective in World War II, but their contribution to the fight was much less than advertised.[18] The reason for that was because they could not carry many weapons, they did not have great range, and they lacked the radars, fire control devices, and CICs that were installed on destroyers and cruisers. Toward the end of the war, newer PT boats were equipped with radar, but the actor portraying the admiral in the movie "They Were Expendable" had it right—the PT boats always lacked stamina, sensors, and systems to link them to aircraft and more powerful ships. The wartime myth was that PT boats were "killer bees." The truth was that they were more like mosquitoes when they went up against a powerful, competent enemy.

The key point is that certain kinds of equipment—especially lightweight and reliable microwave radar and the Plan Position Indicator radar scope—were necessary preconditions for the development of the CIC, but it took officers such as Lt. Commander Wylie to figure out how to use that equipment to solve the operational problems they faced. Wylie and his contemporaries drew on technological innovations to create a dramatic and effective operational innovation.

The development of OFT's *Stiletto* today is similar to the creation of the CIC during World War II in the sense that *Stiletto* is the analog to radar, and providing *Stiletto* to the Navy and to the Special Operations Command (SOCOM) makes possible the sort of operational innovation that led to the CIC. Before discussing *Stiletto*'s potential, however, it's necessary to explain where this very unusual technology came from.

The Development of *Stiletto*

Stiletto is an innovative "hydrodynamic lift" ship developed recently with funds from OFT and the Special Operations Command (SOCOM). To find the origins of this very innovative design, we must go back to the years right after the end of the Cold War. Once the Soviet Union broke apart at the end of 1991, the Navy reconsidered its role as a combat service. The result of many months of discussion and analysis was a commitment to littoral warfare, or war *from* the sea against the land. The waters near a coast, however, can be extremely dangerous to ocean-going warships. Ships such as missile destroyers can be ambushed by high-speed anti-ship cruise missiles, damaged by mines, and even assaulted by terrorists in small boats bent on a suicide mission. In many cases, the depth of *the water that matters* is not sufficient for existing deep-draft warships such as the DDG-51 type with its large bow-mounted sonar dome.

What sort of ships were best suited to the new littoral mission? Using the standard linear acquisition process, the Navy developed several designs for the "littoral combat ship" and went through the standard procedures for acquiring the new designs. In the meantime, VADM Arthur K. Cebrowski was appointed President of the Naval War College and Commander, Naval Warfare Development Command (NWDC). VADM

Cebrowski was convinced that the Navy needed some unconventional alternatives to the littoral combat ship to facilitate war from the sea against objectives on land.

The first one that he focused on was a wave-piercing catamaran designed as a commercial ferry but used by the Australian government as a high-speed naval transport. Using NWDC funds, the Admiral leased one of these ships (dubbed the HSV, or "high speed vessel") for testing. Could it serve as an effective intra-theater transport? Could it be equipped with a helicopter landing platform? The answer to both questions turned out to be yes, and the success of the HSV led other designers of atypical ships to beat a path to the Admiral's door once he became the director of OFT.

Could unorthodox designs fill other operational needs? SOCOM needed a shallow-water transport to carry Special Operations teams and their standard rigid-inflatable boats (RIBs) close to shore, and whatever SOCOM chose had to "ride" better than the RIBs, which subjected the personnel in them to physically punishing rides as they plowed through high seas just offshore. So many SOCOM personnel were suffering shock-related injuries from the poundings they were experiencing in getting to and from the shore that SOCOM was ready to examine an unusual design.

OFT and SOCOM decided to experiment with an innovative, patented hull design constructed from composite carbon fiber. With a length of over 80 feet and a width of 40 feet, the odd looking design had enough internal space for a standard 11-meter RIB and the men who would man it.[19] It also channeled what would have been the wake generated by a conventional hull into spaces under its M-shaped hull to create a "cushion" of air and water that lifted it above wave action in most sea states, thereby saving SOCOM's warriors from the stress and strain of jarring rides in their RIBs.[20]

To demonstrate that the new design could be fielded quickly and at a relatively low cost, OFT and SOCOM organized a team of commercial firms and Navy test and field organizations. OFT's Lloyd Feldman and CDR Greg Glaros, USN, selected the

Naval Undersea Warfare Center (NUWC) as the contracting agent. The vessel's hull was built by a yacht manufacturer that had never produced any hulls for the Navy. The Combatant Craft Division of the Naval Surface Warfare Center-Carderock was recruited to test the new design once it was finished. The new ship went from concept design to finished product in just 15 months, and its cost was quite small for a ship with so important a mission—just over $6 million before outfitting.

But *Stiletto* was not constructed only to show that DoD could turn to a neglected part of the industrial base to rapidly produce an unorthodox design at a relatively low cost. Instead, and more importantly, *Stiletto* was deliberately designed with an innovative "electronic keel" to serve as a learning tool—as one critical element of a digitally networked force meant to trade mass for the advantages offered by accurate, real-time information. OFT supplied a majority of the funding for *Stiletto* in order to test the potential of network-centric warfare—a potential that relies on shared tactical "pictures" to avoid a more powerful enemy where he's strong while taking him by surprise where's he's weak or not paying attention.

It is this potential—the potential inherent in networked joint forces—that *Stiletto* will test starting this year. *Stiletto* is *not* a more powerful version of the PT boat or other small combatants. Instead, she is one node in a network, and the Navy will begin soon to test the potential of a network of small platforms supported and sustained at a distance by larger, more seaworthy ships and by various kinds of aircraft—all of them linked together digitally. *Stiletto* is also not a rival to the Navy's littoral combat ship. *She's not an acquisition in the usual sense.* She's a learning tool that doubles as a useful and safe transport for SOCOM personnel. Warfighters will find out soon if *Stiletto*, with the concepts built into her, is a piece of a larger transformation of littoral warfare.

Conclusion

In wartime, the desperate pressure of intense combat aids those with innovative ideas. In the winter of 1942-43, senior Navy officers in the Pacific were determined to find a means to use the technical advantage of radar to give them a decided tactical advantage over the Japanese. When the Pacific Fleet's destroyer type commander read Lt. Cdr. Wylie's report of his innovative use of data from his ship's and other ships' radars to give his captain a clear operating picture in what was otherwise a chaotic battle, the type commander recognized a potential transformation. He recruited Wylie and other young officers to turn that potential into reality. Superiors up the chain of command—all the way to the Commander-in-Chief of the fleet—were ready and eager to gamble that Wylie's innovation could be institutionalized. To make sure that it would be done to support combat, they put the power to institutionalize it in the hands of younger combat officers. The result was a "transformation" that lasted for over a generation.

Stiletto was also a gamble. To hedge against the chance that she would not serve as a useful element in a larger network of sensors and platforms, she was built as a here-and-now transport for SOCOM. In effect, OFT served as a "venture capitalist" in sponsoring and financing *Stiletto*. Without the pressure of combat, there has to be some

office ready to take the kinds of risks that warfighters under stress are willing to take—and would, if put to the test. Put another way, innovations with transformational potential will probably not be developed in peacetime unless DoD has a process that mimics what happens in wartime.

OFT's "concept-technology pairing" is a surrogate for the intense pressure that combat exerts on warfighters and that they pass on to developers. In wartime, the culture of innovation can trump accepted ways of "doing business," whether those are methods of contracting, or legal and technical reviews, or even the process of developing and refining requirements. Being able to learn quickly—to adapt and innovate faster than the enemy—is the key to victory in war. If you can learn just as fast and effectively in peacetime, then you improve your competitive advantage over your current enemy and potential foes.

In the Global War on Terror, the pressure of combat has been intermittent for the Navy because the enemy spends most of his time avoiding contact with heavily armed U.S. forces. It's not like World War II, when the pressure was intense all the time and the need for rapid learning was obvious. It's also not like World War II because the Navy's (and the joint force's) claim on the nation's resources is limited. In effect, the future joint force has the worst of both war and peace—the pressure is on to be innovative, but the limited resources available for innovation place a premium on doing innovation in a cost-effective way.

That's why *Stiletto* is more about learning than about prototyping. What we have done in DoD is refine the acquisition process with such energy and diligence that we've forgotten what has happened in earlier wars. We've forgotten that there's always a need to complement the "normal" acquisition process with a learning process. It's true that the learning process is high risk because those doing the learning have to have tools to work with and such tools cost money. But the overall "cost" is less if you pay it in peacetime. That's when you can find out if what the warfighters rig up in the field is supportable and maintainable. If the innovation takes place in wartime, you're more liable to end up with equipment that is a logistician's nightmare.

In helping to create *Stiletto* as an instrument of learning, OFT took a risk. To successfully take that risk—to maximize the chance of success—OFT did *not* enter the Joint Concept Integration and Development System (JCIDS) process. But neither did OFT subvert JCIDS. OFT's success in developing *Stiletto* through its alliance of private firms and DoD agencies simply shows that the regular acquisition process is not well suited to taking some kinds of risk and developing systems, like *Stiletto*, that are meant to promote learning. It's like the car you want your teen-agers to learn to drive in. It should be safe, not too complicated, and cheap. If they break it, you want to be able to write it off. If they want to take it apart to learn how a car works, you don't want it to be either expensive or overly complex. If they learn how to drive well and also learn about how a car works and how to keep it running, then you've achieved success at a reasonable risk.

What OFT offers the rest of DoD is a new approach to change—one that depends on learning through the use by warfighters of items developed through unorthodox but not extra-legal means. What distinguishes OFT's approach is the linking of concepts to experiments through the use of tools that OFT and its partners can rapidly and inexpensively put into the hands of the warfighter. It's the focus on aiding and abetting learning to reduce the inevitable risks of war that makes OFT different than other DoD organizations. Put another way, OFT can and does sponsor what the existing sponsoring offices in the Services consider too risky.

Stiletto is only one case of taking the smaller risk *outside* the conventional process in order to cut down on larger risks that inevitably arise when there is just one developmental process. OFT has led other, similar projects with powerful implications for how DoD develops systems. Had OFT followed the regular acquisition process in each case—whether through JCIDS or ACTDs—*Stiletto* would still be on the drawing boards and not in the hands of warfighters, and there would be no new learning.

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[1] A number of colleagues read and commented on the draft of this paper. I particularly want to thank Dr. Joseph Mait of the Army Research Laboratory, Dr. Mark Mandeles and Scott Craig of OFT, Dr. Henry Gaffney of the Center for Naval Analyses, and CAPT John Byron, USN (Ret.). However, I am completely responsible for the paper's content.

[2] See, for example, USAF Instruction 63-114, "Rapid Response Process"; SECNAVINST 5000.2C, Part 2.8; Dept. of the Army Pamphlet 70-3, Sections 5.2.2 through 5.2.4. The Joint Rapid Acquisition Cell was established in a memo from DepSecDef Paul Wolfowitz, "Meeting Immediate Warfighter Needs," 15 Nov. 2004. The relevant CJCSI is 3470.01 (15 July 2005), "Rapid Validation and Resourcing of Joint Urgent Operational Needs (JUONS) in the Year of Execution."

[3] "The Evolution of Fleet Tactical Doctrine in the U.S. Navy, 1922-1941," by Trent Hone, *The Journal of Military History* 67 (October 2003), pp. 1107-1148.

[4] *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy, 1887-1941*, by David C. Evans and Mark R. Peattie (Annapolis, MD: Naval Institute Press, 1997).

[5] *U.S. Navy Bureau of Ordnance in World War II*, by Buford Rowland and William Boyd (Washington, DC: Dept. of the Navy, Bureau of Ordnance, 1953), p. 373.

[6] The sequences of development and installation are described in *Naval Radar*, by Norman Friedman (Annapolis, MD: Naval Institute Press, 1981), pp. 145-150.

[7] "The Similarity of Past and Present Standoff Threats," by Thomas C. Hone, *U.S. Naval Institute Proceedings* (September 1981), pp. 113-116.

[8] Report, from The Commanding Officer, to the Commander in Chief United States Fleet, via the Commander, South Pacific Force and the Commander in Chief, Pacific Fleet, subject: "Use of type SG Radar during night action," November 19, 1942, Serial No. (S)-2, page 1, in Record Group 38, World War Two Action and Operational Reports, U.S.S. Fletcher, Box 984, National Archives.

[9] See John B. Hattendorf's "Introduction" to Rear Admiral J. C. Wylie, Jr.'s *Military Strategy: A General Theory of Power Control* (Annapolis, MD: Naval Institute Press, 1989), p.xv.

[10] Initially, LCDR Wylie's reports, as well as those of his Captain, CDR W. M. Cole, went to the commander of Task Force 67, but CDR Cole's report of 19 November 1942 was endorsed by the Commander South Pacific Area and South Pacific Force on 21 December 1942 and endorsed again on 19 January 1943 by the Commander in Chief, U. S. Pacific Fleet, and sent to the Commander in Chief, U.S. Fleet. Box 984, Record Group 38, National Archives.

[11] Hattendorf's "Introduction" to Rear Admiral Wylie's *Military Strategy*, p. xvi.

[12] See "Tentative Destroyer Escort Combat Information Center Handbook," December 1943, Box 614, Record group 38 (Records of the Chief of Naval Operations, HQ COMINCH), National Archives.

[13] *Current Tactical Orders and Doctrine, U.S. Fleet* (USF 10A).

[14] *When Computers Went to Sea*, David L. Boslaugh (Los Alamitos, CA: Institute of Electrical and Electronics Engineers, 1999), pp. 20-21 and 38-45. See also *Angel on the Yardarm: The Beginnings of*

Fleet Radar Defense and the Kamikaze Threat, by John Monsarrat (Newport, RI: Naval War College Press, 1985), especially pages 53-55.

[15] *Naval Radar*, Norman Friedman (Annapolis, MD: Naval Institute Press, 1981), especially pp. 147-48.

[16] *U.S. Navy Bureau of Ordnance in World War II*, Buford Rowland and William Boyd (Washington, DC: Bureau of Ordnance, Navy Department, 1953), p. 420.

[17] *ibid.*

[18] See *U.S. Small Combatants, Including PT Boats, Subchasers, and the Brown-Water Navy: An Illustrated Design History*, by Norman Friedman (Annapolis, MD: Naval Institute Press, 1987).

[19] See "M Ship Co. Succeeds in Taking Stiletto from Concept to Trials in a Year," by Geoff Fein, *Defense Daily*, Vol. 229, No. 49 (March 14, 2006), Article 1.

[20] In technical terms, what *Stiletto*'s unusual hull form does is to channel conventional wake energy into "tunnels" at the bottom of the hull. This energy is then available to lift the hull. In a conventional v-form hull, the wake energy is pushed aside and lost, and the wake itself is just an indicator of the amount of energy needed to push the ship through the water