Naval Transformation and the Littoral Combat Ship

by

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EXECUTIVE SUMMARY

A thorough review of the forces impelling current naval transformation efforts, the arguments for and against small combatants made during the *Streetfighter* debates, the Navy's broader transformation plans, the potential role of small combatants in the 21st century "Assured Access Navy," as well as the design goals for the Navy's new Littoral Combat Ship leads to the following proposition: ***small network combatants have an important role to play in 21st century naval warfare, and the reconfigurable Littoral Combat Ship may make important warfighting contributions as part of the Navy's 21st century "Total Force Battle Network" (TFBN).***

SMALL COMBATANTS IN THE 21ST CENTURY TOTAL FORCE BATTLE NETWORK

A small combatant is any warship with a displacement of 3,000 tons or less. Small combatants have consistently performed ten broad missions vital to battle fleet operations: *battle force screening; mine warfare; protection of shipping*; *battle fleet scouting; anti-surface warfare/offensive maritime interdiction; amphibious/sea base support; close-in fire support; riverine warfare; support of naval special operations forces; and maritime domain awareness and maritime patrol and security*. A special variant of this last mission is *US maritime domain awareness and defensive maritime interdiction*, a key responsibility of the US Coast Guard. An eleventh mission, highlighted repeatedly during the *Streetfighter* concept development process, must be added: *battle network sensor emplacement.*

When considering whether or not it should include the small Littoral Combat Ship in its 21st century TFBN, the two key questions confronting Navy planners are: *Is there any evidence to suggest that any of the aforementioned small combatant missions will be less important in the 21stcentury, or that intermediate and large combatants would better perform them?* The answers to both these questions would seem to be no, for three key reasons:

- First, precedence. Whenever a fleet battle network or enhanced networked sea base closes on a defended enemy coastline, its intermediate and large combatants focus on enemy threats to the landward side of the littoral. While doing so, they rely upon smaller combatants to protect them from mines and attacks mounted by the enemy's littoral screening forces, and to conduct offensive interdiction of enemy coastal traffic. These roles are among the oldest missions assigned to US small combatants, and they assume increasing importance whenever the fleet operates close to shore. As in the past, when performing this role, future small network combatants would themselves rely on the larger combatants for protection against over-matching threats.

- Second, utility. For the foreseeable future, the Navy will likely operate most often in unimpeded and guarded access scenarios. In these conditions, small combatants capable of conducting the missions of offensive maritime interdiction; protection of shipping; battle force scouting; amphibious/sea base support; support to naval special operations; and maritime domain awareness and maritime patrol and security tasks (e.g., sanctions enforcement, patrolling choke points, conducting anti-piracy, drug, and terrorism patrols, and participating in humanitarian assistance and disaster relief operations) will be in extremely high demand. Since small combatants can be afforded in much greater numbers than larger and more capable combatants, they also allow the Navy to expand its global battle network coverage, even if defense budgets remain flat.

- Third, efficiency. Because so many traditional small combatant missions will be performed in unimpeded and guarded scenarios, a force of small warships should allow the Navy to free up its fewer, more expensive and more capable combatants for more pressing duties without appreciably increasing either overall operational risk or individual ship risk—provided the small combatants built are capable of sensing over-matching threats and carry a capable self-defense suite.

Although small crewed combatants themselves appear to be ill-suited for missions where access is vigorously contested, should they be capable of employing unmanned systems, they may be able to make a valuable contribution in such contingencies by operating from stand-off ranges. This is the preliminary conclusion reached by naval planners; it must be proven through fleet experimentation.

LCS AS A POTENTIALLY TRANSFORMATIONAL SYSTEM

The Navy appears to be on solid ground in its pursuit of new small battle network combatants. Indeed, the LCS has the potential to help transform the way the Navy assembles and operates future battle networks.

While the LCS's high top speed has attracted much attention, its high sustained speed will have a bigger impact on fleet operations. Because the LCS will have the speed to keep pace with distributed fleet battle networks surging forward from US home waters, it will be fully battle force capable (or more appropriately, *battle network capable*). As such, it will be the first small combatant capable of operating with high speed naval battle forces since World War II.

However, the LCS's real potential as a transformational network system lies in its modular design and its ability to quickly reconfigure to perform different missions. Its payload volume will be divided among twenty different mission module stations designed to accommodate either manned or unmanned off-board systems, onboard weapons and sensors, or mission pack-up kits (i.e., supply packages). Moreover, the LCS crew will be separated into a permanent core crew that operates and maintains the basic "sea frame," and a mission crew that comes aboard with a new mission package. By designing the ship around modular mission stations and by separating the ship's mission capability from its hull form, the Navy is aiming to achieve rapid mission reconfiguration with minimal facilities support.

Said another way, the LCS is less of a ship, and more of a battle network component system, consisting of a sea frame, a core crew, assorted mission modules, assembled mission packages, mission package crews, and a reconfiguration support structure. The total system aims for a level of ***battle modularity*** that will allow for a LCS's complete mission reconfiguration—including operational testing of its combat systems ***and*** crew readiness for follow-on mission tasking—in less than four days. If successfully demonstrated, the LCS's high degree of modularity would be without precedent in naval history, and would afford the 21st century Total Force Battle Network a unique ability to adapt itself to confront any existing or evolving access challenge.

If the LCS and the similarly designed High Speed Vessel (HSV) successfully demonstrate the demanding degree of modularity and mission adaptability just outlined, the 21st century "Assured Access Navy" will accrue several additional and powerful benefits:

- First, because small combatant missions typically demand different ship design attributes and characteristics, past naval architects have routinely been forced to focus any combatant with a displacement less than 3,000 tons on a single primary role or function. As a result, past small combatants have been typified by a very large number of different ship types, classes, hull forms, and combat systems. In sharp contrast, the Navy's planned family of 21st century small network combatants should be able to effectively accomplish the key elements of all but one of the eleven traditional or emerging small combatant missions (riverine warfare being the exception) *with only two different basic hull forms,* augmented by existing special purpose ship-to-shore landing craft (and perhaps, over time, with stealthy variants).

- Second, based on empirical evidence developed by the Royal Danish Navy, the Navy's planned force of 56 multi-role LCSs with 112 to 134 mission packages (reflecting a 2.0-2.4:1 mission package to hull ratio) would be equivalent to a mixed force of 77 to 88 small single-mission ships that cannot be reconfigured. However, by improving on the Dutch model, the Navy should expect a higher "modularity factor." As a result, 56 US LCSs may prove to be functionally equivalent to a mixed force of single-mission ships that is substantially higher than the gains suggested by the Dutch experience.

- Third, weight gain in small combatants has been a consistent problem since 1889, leading to the continual degradation of their designed performance in operational service. By having an aggregate payload weight limitation for its modular mission stations, the LCS should be able to maintain its key design performance characteristics—speed, draft, endurance—throughout its operational life.

- And fourth, since World War II, small combatants have generally not lasted more than 15 years service because their designed systems were too limited in capability and their small hulls were generally unsuitable for modernization. Because the LCS is designed to easily accommodate new manned and unmanned *off-board* systems, the LCS should be able to continually expand its mission set and make important battle network contributions for the duration of its expected 20-30 year service life.

The combination of high sustained battle force speeds and battle modularity could potentially transform the role of small combatants, making them a complete and effective contributor in the Navy's 21st century Total Force Battle Network.

SQUADRON OPERATIONAL TESTING: THE WAY AHEAD

Despite its promise, the LCS represents the first small US battle force capable combatant to be designed and built by the Navy and the US shipbuilding industry in over 60 years. Moreover, the LCS battle network system will introduce an entirely new concept of battle modularity that has no US or foreign naval precedent. There are therefore a number of unresolved issues about this ship and its associated organizational and support structure. Many of these issues appear to be irreducible through paper analysis. Therefore, a second proposition is that *the LCS program must undergo thorough operational experimentation in addition to any continued analytical study.*

Current Navy LCS production plans appear to be overly ambitious. Accordingly, the Navy should consider a modification to its current plans to allow more thorough testing of the ship as a battle network component system.

- Given the many degrees of design freedom in meeting the Flight 0 LCS requirements (six initial designs and three remaining designs, including a steel semi-planing monohull, a trimaran, and a surface effects ship), the Navy would be advised to build at least two different operational prototypes. However, choosing two different prototypes will not completely resolve many of the operational issues. It seems clear that only by testing *squadron* prototypes will the Navy be able to fully resolve some of the outstanding issues surrounding the LCS and its support structure.

- The currently approved shipbuilding profile for the LCS could be modified to build two operational squadrons and to reduce the risk associated with the current, significantly compressed, LCS program. Assuming the Navy down-selects to two different designs, it should award one competitor a Research and Development (R&D) contract for a ship in FY05 and a follow-on version in FY06 paid for by ship construction money. Similarly, it should then award a second competitor a R&D ship contract in FY06 and a follow-on version in FY07. In this way, the Navy could have two different 2-ship squadrons by FY08, which would seem to be the minimum size needed to conduct comparative squadron operational tests. The Navy could also opt for slightly larger squadrons by dividing the planned ships in FY08 and FY09 among the builders. Once the squadrons were organized, however, the Navy should then delay the final production decision for at least one year to conduct meaningful operational testing.

A counter argument is made by those who believe the fleet is too small for its current global commitments, particularly those associated with the global war on terror. They argue that the LCS is needed *now*, in numbers. However, the Chief of Naval Operations undercut this position when he recently elected to retire some older ships early, and to accept a smaller fleet in the near term in order to free up the resources required to build up the fleet over the long term. Moreover, current strategic circumstances indicate the Navy appears to have some time before having to confront a serious naval competitor in the littorals. As a result, delaying the final LCS production run for a short period while squadron prototypes are tested would appear to appreciably lower the program's developmental risk without appreciably raising the fleet's overall operational risk

I. Ramming Speed: The Littoral Combat Ship Bursts into Existence

A Skeptical Reception

On November 1, 2001, the Navy announced that it would issue a revised Request for Proposal (RFP) for its future surface combatant program. Formerly known as DD-21 (for 21st Century Destroyer), the new program would be known as "DD(X)", and it would comprise a family of three new ships: a large multi-mission destroyer from which the family took its name (DD(X)); a large multi-mission guided missile cruiser (CG(X)); and a small "focused mission" Littoral Combat Ship, or LCS.[1] For the next several decades, these three new "advanced technology surface combatants" would operate alongside a large "legacy" force of over 80 multi-mission combatants designed during the Cold War for open-ocean warfare against the Soviet Navy.[2]

The inclusion of the small focused mission LCS in the new DD(X) family of ships represented an abrupt reversal in the Navy's plans for its 21st century fleet.[3] In a report forwarded to Congress in March 2000 which outlined the Navy's 30-year plan for shipbuilding, the Navy had pointedly rejected the potential contribution of small combatants in its future battle force. Indeed, the report indicated that the *smallest* combatant in the 21st century Navy would have a displacement on the order of about 9,000 tons—over three times the size of current LCS designs.[4] Moreover, throughout the 2001 Quadrennial Defense Review (QDR), Navy officials repeatedly denigrated the potential capabilities of small combatants.[5]

In sharp contrast, Navy planning documents after the announcement of the DD(X) family of ships suggested that the LCS might ultimately comprise 33 percent of future surface combatant fleet, and 15 percent of the entire Navy battle force.[6] The inclusion of the small LCS in the

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[1] Department of Defense, "Navy Announces DD(X) Program," Department of Defense News Release 559-01, dated November 1, 2001.

[2] "Navy Announces DD(X) Program." For the official Navy history leading up to the announcement of the DD(X) family of ships, see DD(X) Program History, found at http://peoships.crane.navy.mil/ddx/history.htm. For another good history of events, see Ronald O'Rourke, *Navy DD(X) Future Surface Combatant Program: Background and Issues for Congress* (Washington, DC: Congressional Research Service (CRS) Report RS21059, updated January 27, 2003).

[3] See for example the reporting of Andrew Koch, in "Littoral Combat Ship Programme Accelerated," *Jane's Defence Weekly*, June 12, 2002, p. 6.

[4] Christopher J. Castelli, "Navy Sends 30-Year Shipbuilding Plan to Defense Secretary," *Inside the Navy*, March 6, 2000, p. 1.

[5] Ronald O'Rourke, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress*, (Washington, DC: Congressional Research Service (CRS) Report RS21305, updated January 28, 2003), p. CRS-1.

[6] Current planning figures are for 56 LCSs in a surface combatant force of 168 ships, and a fleet of 375 ships. These figures were provided to the author by the Assessment Division (N81), under the Deputy Chief of Naval Operations for Resources, Requirements, and Assessments (N8), Office of the Chief of Naval Operations (OpNav).

DD(X) family of ships and assigning them such a prominent place in the Navy's future fleet operational architecture was thus a stunning repudiation of the Navy's former position on small combatants. The Navy's complete reversal of its long-held, strong preference for large combatants—regardless of the merits of the underlying logic—ensured that its decision would be greeted with a high degree of skepticism by many both inside and outside the Navy.

Skepticism over the program only increased when it became evident that the LCS was announced before the Navy had conducted a formal "analysis of multiple concepts" or an "analysis of alternatives" for the new ship, generally the first step toward any new defense program. This caused some critics to question the analytical basis for the new ship.[7] In fact, it was not until May 2002 that the Office of the Secretary of Defense directed the Navy to pursue a new class of small stealthy ships, and it wasn't until February 2003 that the Navy had an approved concept of operations for the LCS.[8]

On balance, beyond labeling the LCS as being a "transformational" system, Navy leaders made little early effort to explain the reasoning behind their decision to embrace small combatants so soon after rejecting them, or to prepare for the inevitable questions that would arise because of it. Indeed, because a large part of the surface combatant community had already dismissed the idea of small combatants in a debate seemingly just closed, there was no broad supporting constituency for the LCS within the Navy itself. As a result, the Navy's leadership was forced to test out arguments for the new ship on the fly. Sometimes the LCS was labeled transformational because of its high speed and the new associated hull forms; other times it was because the ship was designed to defeat "asymmetric" littoral threats such as submarines, mines, and "swarming boats;" other times it was because of the ship's modular combat system, new technology, and automation; and still other times the Navy trumpeted the ship's transformational impact on the American shipbuilding industry.[9] The constantly changing rationale for the new ship helped to confuse both the Navy's internal and external audiences.

Throughout 2002, the Navy struggled to make a cogent, compelling, and consistent public argument for the new small combatant. Although Admiral Clark, the Chief of Naval Operations, had declared the LCS to be his number one transformational program and budget priority,[10] Congress remained troubled over the way the program was initiated. After giving new start

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[7] O'Rourke, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress*, p. CRS-4.

[8] The Navy's first official direction to pursue a new class of small combatants is found in the ***Defense Planning Guidance: Fiscal Years 2003-2007***, published by the Office of the Secretary of Defense in May 2002. See Jim Wilson, "Stealth Strike Force," ***Popular Mechanics***, November 2003, p. 90. The ***Littoral Combat Ship Concept of Operations*** was recommended by N76, Navy Surface Warfare Division, on February 12, 2003, and approved by the Deputy Chief of naval Operations for Requirements and Programs, N7, on February 13, 2003.

[9] See for example Hunter Keeter, "Navy Explores Exotic Shapes, Materials for LCS," ***Sea Power,*** May 2003, pp. 16-20; Anne Marie Squeo, "New Ships Mean New Bidding," ***Wall Street Journal***, August 25, 2003; Vice Admiral Henry Mustin , USN (Ret.), and Vice Admiral Douglas Katz, USN (Ret.), "All Ahead Flank for the LCS," ***Proceedings,*** February 2003, pp. 30-33.

[10] Scott C. Truver, "Navy Plans to Develop LCS Fleet with 'Lightning Speed'," ***Sea Power***, May 2003, p. 15.

authority for the LCS program in the FY 2003 Defense Authorization Act, Congress expressed concern that "(t)here is no definition of the (LCS) requirement and no 'road map' of how the Navy will achieve the system required."[11] Accordingly, Congress directed the Secretary of the Navy to submit a report on the LCS which would address "in detail the analytical process to examine alternatives (to the LCS), and establish relative priorities to meet valid requirements."[12]

THE LCS MOVES OUT

If Congress harbored misgivings over the merits of the LCS, the Navy—having finally committed to the smaller ship—had none. Naval planners moved at "lightning speed" to better explain the intended role of the LCS and to better define the requirements for the ship itself.[13] With regard to the former, in March 2002, an internal Navy mission capabilities analysis "confirmed" the need for a small combatant to "bridge critical warfighting gaps in the littoral."[14] With regard to the latter, the Navy Warfare Development Command (NWDC) worked hard throughout 2002 to get a LCS concept of operations approved, and in September 2002 the Navy established a LCS Program Office under the Program Executive Officer for Ships. Two months later, the Program Office awarded six, $500,000, 90-day contracts to six industry teams to carry out concept studies for a "Focused Mission High-Speed Ship."[15]

The six industry studies were delivered to the Navy early in 2003, and were ostensibly used to develop the Preliminary Design-Interim Requirements Document (PD-IRD) for the LCS and to form the basis for formal Requests for Proposals from the shipbuilding industry.[16] However, the very short time window between the delivery of these concepts studies and the publishing of the PD-IRD and the RFPs made plain that the Navy had generally prepared its LCS design requirements with little regard to the industry submissions.[17] In any event, the LCS PD-IRD and

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[11] Dan Morgan, "Proposed Ship Speeds Into Gathering Storm," ***Washington Post***, July 6, 2005, p. 5.

[12] Section 218 of the National Defense Authorization Act for Fiscal Year 2003 (Public Law 107-314), as cited in "Littoral Combat Ship," Title II (RDT&E), Other Matters of Interest, Navy, in the Senate Armed Services Committee Report , 108-046, for the Fiscal Year 2004 Defense Authorization, S 1050, pp. 179-180.

[13] Truver, "Navy Plans to Develop LCS Fleet with 'Lightning Speed';" see also "US Navy Pursues Aggressive Schedule for Littoral Combat Ship," ***Jane's International Defense Review***, March 2003.

[14] Scott C. Truver, "USN LCS Program Moves Out," ***Jane's Navy International***, August/September 2003.

[15] David Nagle, "Focused Mission Ship Studies to Help Chart Course for Navy Future," story number NNS021206-14 dated December 6, 2002, found at Navy Newsstand at http://www.news.navy.mil. For an example of a contractor team report on these awards, see "General Dynamics Bath Iron Works wins contract to study new high-speed Navy ship capability," General Dynamics News Release, published November 12, 2002.

[16] For a concise recapitulation of the six different design concepts, see Jason Sherman, "US Navy Eyes LCS Plans," ***Defense News***, April 28, 2003, p. 6. See also Jason Sherman, "US Navy Shapes Plans for Small, Fast Warship," ***Defense News***, February 10, 2003, p. 8.

[17] The author is indebted to Adam B. Siegel, Senior Analyst with the Northrop Grumman Analysis Center, for explaining this key point. This and subsequent cites that refer to insights provided by Adam reflect his personal views.

the associated RFPs were published in February 2003, along with the approved version of NWDC's LCS concept of operation.[18] Together, these documents provided the needed momentum within the Navy and industry to move the LCS program into high gear.

The program then hit a slight bump in the road in April 2003 when a senior Navy leader admitted in testimony before the Congress that "rigorous (supporting mission) analysis of the need for the LCS came mainly after the Navy decided to press for the program."[19] Soon thereafter, the Senate Armed Services Committee (SASC) noted its displeasure with Navy officials, noting that the Navy's recent report on the LCS "which was delivered pursuant to last year's requirement, did not provide the necessary analysis."[20] The House Armed Service Committee (HASC) was also displeased. In their Committee Report, the HASC pointed out that, prior to 2001, "the Navy had no plans to acquire a smaller combatant like the LCS," and that the February 2003 report on the LCS delivered to Congress "was a brief, summary document that provided little detail with regard to the analysis performed by the Navy in developing the requirement and concept for LCS." The committee went on to say that it expected the Secretary of the Navy "to more completely address the concerns of Congress."[21]

The Navy responded to this explicit Congressional tasking by initiating a three-phase "tailored" analysis of alternatives that would "fill in analysis gaps that previous studies had not covered." [22] This analysis began early in 2003 and should be completed in spring 2004.[23] In the meantime, in July 2003, the Navy awarded separate fixed-price contracts to three of the six design teams that had responded to the Navy's LCS RFP to develop preliminary designs for the first "Flight 0" ships. These design teams were led by General Dynamics, Lockheed Martin, and Raytheon. Their advanced designs are to be delivered to the Navy for review in late January 2004.[24]

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[18] *Littoral Combat Ship: Concept of Operations,* version 3.1 (Newport, RI: Navy Warfare Development Command, February 2003), and *Preliminary Design Interim Requirements Document, serial number N763F-S03-026, for Littoral Combat Ship (LCS) Flight 0, Pre-ACAT* (Washington, DC: Office of the Chief of Naval Operations, N76, February 13, 2003).

[19] Morgan, "Proposed Ship Speeds Into Gathering Storm," p. 5.

[20] "Littoral Combat Ship," Senate Armed Services Committee Report 108-046 for the Fiscal Year 2004 Defense Authorization, S 1050, pp. 179-180.

[21] "Littoral Combat Ship," Title II (RDT&E), Other Matters of Interest, Navy, in the House Armed Services Committee Report , 108-106, for the Fiscal Year 2004 Defense Authorization, HR1588, pp. 181-182.

[22] "Tailored Analysis of Alternatives Under Way for Littoral Vessel," *Inside the Navy,* September 2, 2003.

[23] Jason Sherman, "US Navy Fine-Tunes LCS Requirement," *Defense News,* August 21, 2003.

[24] "Navy Announces Contract Award For Design Of Ship," DoD News Release No. 517-03, dated July 17, 2003; "Navy Issues LCS Contracts," *Sea Power*, August 2003, p. 38; "US Navy Selects Three Finalists for Littoral Combat Ship," *Jane's International Defense Review,* September 2003, p. 3; and David Foxwell, "Hullforms Key to Speed for Littoral Combat Ship," *Jane's Defence Weekly,* November 19, 2003, pp. 28-29.

Armed with the results of the aforementioned tailored analysis of alternatives, the Navy intends to award one or two of the surviving design teams a production contract for the first Flight 0 ships in May or June 2004. If everything goes according to plan, these ships will be in the water in 2007, with a production decision on the winning class design or designs scheduled to follow soon thereafter.[25] Although the precise number of ships in the class production run has not yet been set, a requirement for 45-60 ships has been consistently mentioned by Navy officials, and current notional planning figures are for 56 LCSs in a battle fleet of 375 ships.[26]

LINGERING DOUBTS

The Navy appears increasingly confident that it has finally gotten the LCS "over the hump" with its skeptics. However, doubts about the program continue to surface. For example, in the recently released 106th edition (2003-2004) of the prestigious ***Jane's Fighting Ships***, the LCS was described in this way:

> …with construction of the first class planned to start in 2005, it is surprising that so many options remain open at this stage. Indeed, it is hard to avoid the impression that this is a ship in search of a capability rather than a capability in search of a ship. Lack of clarity is not the best basis for a new class of ship with which the [US Navy] will have to live for a long time.[27]

Ronald O'Rourke, a naval analyst at the Congressional Research Service, is more blunt, commenting that the LCS is the result of an "analytical virgin birth…(t)hat is going to be a problem for this program down the road."[28] He is in a position to know. Soon after the aforementioned hearing where Navy officials admitted that rigorous analysis for the LCS had come ***after*** the program's announcement, Representative Roscoe G. Bartlett, Chairman of the Projection Forces Subcommittee on the House Armed Services Committee, commented that "We're concerned that the cart has been put before the horse in terms of procurement decisions, before there's an analytical justification….Before we commit any big amounts of money, we'll know where we're going."[29]

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[25] The Office of the Secretary of Defense and Office of Management of Budget have approved that the first two ships of the LCS program be paid for with research and development funding, provided they have different designs. The Navy has not yet decided if it will down select to two designs or just one. Christopher J. Castelli, "Wolfowitz Approves Navy Shipbuilding Changes for FY-05 Budget," ***Inside the Navy***, January 5, 2004, p. 1.

[26] See for example "Admiral Says Navy Needs 45 to 50 Littoral Combat Ships," Sea Power September 2003, p. 34. See also Andrew Koch, "DD(X) Moves Ahead," ***Jane's Defence Weekly***, May 8, 2002, p. 2." The Navy's plans for 56 LCSs in a fleet of 375 ships is confirmed in Jason Sherman, "US Navy Eyes Uses for LCS," ***Defense News***, October 6, 2003, p. 54.

[27] Commodore Stephen Saunders, RN, editor, ***Jane's Fighting Ships 2003-2004***, 106th edition (Alexandria, VA: Jane's Information Group, Inc., 2003), p. 78.

[28] Hunter Keeter: "O'Rourke: Lack of Pedigree May Haunt LCS Program," ***Defense Daily***, January 16, 2003.

[29] Dan Morgan, "Proposed Ship Speeds Into Gathering Storm," ***Washington Post***, July 6, 2003, p. 5.

The Navy, in its "tailored analysis of alternatives," is striving to satisfy Chairman Bartlett's concerns about "putting the cart before the horse." However, as O'Rourke notes, a danger still remains that the results of that study will be of "questionable credibility because it is being performed well after the fact, in the knowledge that the Navy has already announced that the LCS is the preferred approach for performing these missions."[30] O'Rourke believes the Navy could help to quiet some of the ship's skeptics if it could better explain the place that LCS has within its overall naval force transformation plans, and better explain the ship's own transformational contributions.[31]

CSBA AND THE LCS

The Center for Strategic and Budgetary Assessments (CSBA) has periodically considered the potential role of small combatants—including the Littoral Combat Ship—in the 21st century Navy. For example, in a January 2001 report entitled *Strategy for a Long Peace*, CSBA recommended that greater emphasis should be devoted to exploring the potential of the ***Streetfighter*** concept then being debated within the Navy, which among other capabilities included a small, fast, and stealthy combatant. Accordingly, the report recommended that the Navy "should experiment with prototype *Streetfighter* combatants."[32]

In a 2002 CSBA report entitled *The Challenge of Maritime Transformation: Is Bigger Better?*, this author concluded that the Navy "should get out of the small combatant [frigate] business only after careful debate." At the same time, although the report acknowledged the potential high value of "inshore warfare squadrons," it was skeptical about the emphasis then being placed on ship expendability in the *Streetfighter* concept, and argued that operations against anti-access networks likely would be best conducted using long-range unmanned systems.[33]

Then, in a more thorough analysis of Navy plans for meeting future anti-access and area-denial challenges completed in May 2003, this author again evoked skepticism about using small crewed combatants during early break-in operations in a hotly contested littoral. After reviewing the Navy's conflicting public statements about the LCS, the report concluded that the "LCS component of the [Department of the Navy] transformation plan appears to be its weakest operational link, and one that needs to be more fully considered before embarking on a 56-ship

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[30] Jason Sherman, "Report: Holes in USN's Future-Ship Rationale," *Defense News,* October 20, 2003, p. 6.

[31] Keeter, "O'Rourke: Lack of Pedigree May Haunt LCS Program." However, Mr. O'Rourke is increasingly uneasy about attempts to justify programs because of their contributions to "transformation." He believes that the term is now used so liberally in support of defense programs that it is losing its discriminating effect. From conversations with Mr. O'Rourke on December 11, 2003.

[32] See Steven Kosiak, Andrew Krepinevich, and Michael Vickers, *A Strategy for a Long Peace* (Washington, DC: Center for Strategic and Budgetary Assessments, January 2001), pp. 36-37.

[33] Robert Work, *The Challenge of Maritime Transformation: Is Bigger Better?* (Washington, DC: Center for Strategic and Budgetary Assessments, 2002), pp. 64-65; pp. 115-20.

class production run." It therefore recommended that the Navy consider creating two experimental LCS squadrons to more fully explore its operational and design requirements.[34]

This paper attempts to "more fully consider" the arguments for and against the Littoral Combat Ship. It is written in two parts. Part One, comprising Chapters II through IV, outlines the three broad forces impelling current Navy transformation efforts; reviews the Navy's sharp debate over small combatants and the events leading up to the Navy's decision to pursue small combatants for its 21st century battle force; and explains the LCS's place within the Navy's current transformational plans. By so doing, the broad scope of the Navy's transformation efforts is better revealed, as well as the prominent role that small combatants promise to play within them.

Part Two, consisting of Chapters V through VIII, explores issues directly related to the LCS. It discusses traditional small combatant missions; explores the requirements for small warships in a 21st century "Assured Access Navy"; examines the conceptual and design characteristics of the LCS; and highlights outstanding issues surrounding the ship. It ends by recommending potential next steps for the LCS program.

Those readers familiar with or not interested in the history or forces that led to the impassioned debate over small combatants that occurred inside the Navy between 1999 and 2001, or an explanation of the debate's outcome within the context of the Navy's overall transformation plans, may want to move directly to Chapter V.

The paper concludes that small network combatants have an important role to play in 21st century naval warfare, and that the reconfigurable Littoral Combat Ship may make important warfighting contributions as part of the Navy's 21st century "Total Force Battle Network." It also finds that the operational contributions of the LCS will likely be best illuminated through a vigorous fleet operational experimentation program. It thus validates previous CSBA recommendations that the LCS program should first aim to build several operational prototype squadrons to help resolve remaining issues surrounding the ship's future design and operational employment.

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[34] Andrew Krepinevich, Barry Watts, and Robert Work, *Meeting the Anti-Access and Area-Denial Challenge* (Washington, DC: Center for Strategic and Budgetary Assessments, 2003), pp. 57-61.

II. THE IMPETUS FOR NAVAL TRANSFORMATION

By law, the US Navy is "organized, trained, and equipped primarily for prompt and sustained combat incident to operations at sea."[35] As such, it consists of ships, submarines, aircraft—and, increasingly, unmanned systems—and the men and women who wield them as an instrument of diplomacy and war on, over, and under the world's oceans and "narrow seas."

The strongest image of any navy is one of ships. The US Navy operates a wide array of them:

- Huge 100,000-ton aircraft carriers that carry up to 75 combat and support aircraft;

- Surface combatants such as cruisers, destroyers, and frigates that escort carriers and convoys, augment carrier firepower with long-range missile and guns, and conduct a variety of independent missions;

- Strategic ballistic missile submarines that underpin the nation's strategic nuclear deterrent; nuclear-powered attack and (soon) guided missile submarines used to conduct covert intelligence missions, hunt enemy ships and submarines, and strike land targets;

- Amphibious ships that carry and support Marines and other joint land and special operations forces;

- Mine warfare vessels that sweep floating, moored, and bottom mines;

- Combat logistics force ships that refuel and resupply ships at sea; and

- Other auxiliary and support craft such as command ships and ocean surveillance vessels.[36]

Together, these ships and the weapons and systems they carry make up the Navy's *Total Ship Battle Force (TSBF)*—the reservoir of Navy combat power. Since the birth of the Republic, the exact nature and character of the TSBF has changed time and again as old threats recede, new threats are perceived or reveal themselves, and the Navy adjusts to the evolving realities of "sustained combat incident to operations at sea."[37]

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[35] "United States Navy: composition; functions," Section 5062, Chapter 507, Part I, Subtitle C, Title 10, US Code, found at http://www4.law.cornell.edu/uscode/10/5062.html.

[36] Among the most consistent and best depictions of US Navy ships, vessels, craft, aircraft and weapon systems is Norman Polmar's superb *Naval Institute Guide to the Ships and Aircraft of the US Fleet* (referred to hereafter as *Ships and Aircraft of the US Fleet*). The 17th edition is the most recent, published by the Naval Institute Press, Annapolis, Maryland, in 2001.

[37] The Total Ship Battle Force represents the "countable" ships among the Navy's Total Operating Forces. The counting methods for the TSBF are relatively arcane, and often change from one Administration to the next. For a

Since the fall of the Soviet Union, the Navy has been involved in a long-running debate over how it should adapt or "transform" its TSBF in light of the perceived challenges associated with 21st century naval warfare. The stakes of the debate—both in terms of operational change and in dollars—are enormous. As a result, it has been a contentious one, both inside and outside the Navy. Indeed, since its outcome may well alter equities within the Navy in ways not felt since carriers replaced battleships six decades ago, it perhaps has been more contentious than most.

On the surface, the debate centers over whether the Navy should introduce the small Littoral Combat Ship into its battle force. However, the debate over the LCS is only one component of a much broader and important debate over the most appropriate battle fleet model—and its associated fleet operational architecture—for naval warfare in an age of information and globalization.[38] This broader debate occurred at the nexus of three important forces: the Navy's transition into a new era in which distributed naval "battle networks" define the fleet's preferred operational model; the Navy's shift in mission focus from open-ocean "sea control" toward projecting joint combat power from the world's narrow seas, or littorals;[39] and the Navy's increasingly pressing requirement to introduce a new generation of surface combatants into its 21st century TSBF. Each of these powerful forces will be discussed in turn.

TOWARD A DISTRIBUTED, NETWORKED BATTLE FLEET

> Over the course of history the central problem of naval tactics has been to attack effectively, that is to say, to *bring the firepower of the whole force into battle simultaneously*. A second and subordinate objective of naval tactics has been to try to concentrate one's whole force on a portion of the enemy's in order to defeat him in detail. (emphasis added)[40]

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thorough discussion about the TSBF see Norman Polmar, *Ships and Aircraft of the US Fleet,* 13h edition (Annapolis, MD: Naval Institute Press, 1984), pp. 1-8. See also Work, *The Challenge of Maritime Transformation: Is Bigger Better?,* pp. 4-7.

[38] A wonderful compilation of essays about the effect globalization is having on maritime power can be found in Sam J Tangredi, editor, *Globalization and Maritime Power* (Washington, DC: National Defense University Press, 2002). A more focused view of the effects of globalization on the US Navy is found in H.H. Gaffney, *Globalization and Naval Forces* (Alexandria, VA: Center for Naval Analysis, July 2002).

[39] The term "littoral" is defined in the dictionary as "a shore or coastal region." However, in naval usage it is much broader term, describing the complex interface between the operational domains of sea, sub-sea, air and land that occurs in naval and joint warfare. As such, the littoral has both a seaward extension, generally defined as that area of the ocean from the continental shelf shoreward, and a landward extension. Naval planners have an expansive view of the landward extension of the littoral, defining it as the area under the direct control of fire and maneuver from the sea.

[40] Captain Wayne P. Hughes, Jr., USN (Ret.), *Fleet Tactics and Coastal Combat,* second edition (Annapolis, MD: Naval Institute Press, 2000), p. 43.

During its first century of existence, the United States Navy performed three broad and enduring missions.[41] During peacetime, it was tasked with the protection of US overseas trade and interests. During wartime, it both defended the US coast from attack and conducted commerce raiding. These three missions gradually led to a bifurcated fleet architecture consisting of relatively short-range coastal defense ships and monitors operating in home waters, and long-range combatants dispersed among station squadrons located overseas. During times of peace the station squadrons protected US trade and interests. During time of war, the squadrons were trained to scatter and wage *guerre de course*—literally, the "war of the chase"—against enemy merchant shipping.[42]

In other words, the Navy's first fleet operational model emphasized the operations of dispersed and independent warships. Except during the Mexican and Civil Wars when the Navy supported land and river operations, the fleet seldom concentrated its forces. Instead, it organized, trained and equipped itself for independent operations against enemy sea lines of communication. The "capital ship" of this dispersed and independent commerce raiding Navy was at first the powerful sailing frigate, and later the steam-powered cruiser.[43]

In 1883, Congress approved the first of a new class of steel steam-powered cruisers, beginning a nationally endorsed naval transformation program that was to eventually result in a "New Navy." However, the New Navy would no longer be defined by steel cruisers. In 1889, then-Secretary of the Navy Benjamin Tracy endorsed the recommendation of the Naval Policy Board that the Navy adopt an entirely new battle fleet model espoused by Alfred Thayer Mahan. This model rejected *guerre de course* in favor of *guerre d'escadre,* a strategy that required the fleet to be organized, trained and equipped to destroy any opposing enemy battle fleet, and to thereby establish "control of the seas."[44]

The results were dramatic. The old coastal monitor-cruiser fleet structure was gradually replaced by a "battle line" consisting of large battleships and armored cruisers; an intermediate class of cruisers and gunboats that scouted for the battle line and continued to protect US trade and interests overseas; and a new class of small "torpedo boat destroyers" (later, just "destroyers") that defended the battle line from torpedo attack. By 1897, "for the first time in American history, the battleship sat at the core of the United States Navy."[45] And by 1907, the United

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[41] There are many superb histories of the US Navy. The two primary sources used for this paper were Kenneth J. Hagan, *This People's Navy: The Making of American Sea Power* (New York, NY: The Free Press, 1991), and Captain Edward L. Beach, *The United States Navy: 200 Years* (New York, NY: Henry Holt and Company, 1986).

[42] Hagan, *This People's Navy,* p. xi, pp. 1-192, and p. 389.

[43] The Navy toyed with building "ships of the line" after the War of 1812, and actually built several superb examples, among them the 74-gun *Ohio* and the huge, 120-gun *Pennsylvania.* However, they proved to be colossal wastes of money; the *Ohio* had only six years of sea time and the *Pennsylvania* a single week! Throughout the period the Navy emphasized and built powerful "frigates" which were widely regarded as among the best of their types in the world, and ideally designed for independent action. See Beach, *The United States Navy,* pp. 142-43.

[44] Hagan, *This People's Navy,* p. xi, pp. 193-95; Beach, *The United States Navy,* pp. 330-36.

[45] Hagan, *This People's Navy,* p. 209.

States Navy had moved to second place among the world's navies (from twelfth place in 1883).[46] Soon thereafter it proudly conducted a two-year long worldwide cruise of 16 battleships to flex its new maritime muscle. Although the gleaming white battleships that made this cruise had been rendered obsolete by the commissioning of the all-big gun British *Dreadnought* in 1906, the signal was clear: the US Navy aimed to compete on the high seas against any fleet, in any ocean.[47] By World War II, it had surpassed the British Royal Navy as the world's premier naval power, a position it has not relinquished.

Since 1889, the battle fleet model has seen two distinct eras, one in which the killing power of the fleet was dominated by large naval cannon optimized for fleet-on-fleet engagements, and one in which the fleet's killing power was delivered over long range by aircraft. In the first era the capital ship was the heavily armed and armored battleship; in the second, it was the aircraft carrier.

The shift from the battleship to the carrier era occurred abruptly and emphatically between November 11, 1940 and December 10, 1941. On the first date, British carrier torpedo bombers attacked three Italian battleships anchored in the harbor of Taranto, sinking one and putting the other two out of action. On the second, Japanese bombers sank the British battleships *Prince of Wales* and *Repulse* as they maneuvered at sea. In between, the Japanese devastated the US battle line at anchor in Pearl Harbor.[48] After December 1941, the aircraft carrier took its pride of place as the preeminent ship in the Navy's Total Ship Battle Force.[49]

The battleship and carrier eras differed greatly in the way the fleet was to be employed in battle. During the battleship era, the Navy generally trained to fight as a *single* warfighting entity: the fleet battle line, or fighting column.[50] Just prior to Pearl Harbor, the US naval order of battle included 17 battleships—eight in the Atlantic fleet, eight in the Pacific fleet, and one in West Coast overhaul. An additional two were in pre-commissioning status.[51] While this combined force could theoretically assemble two smaller battle lines in each ocean, naval war plans assumed a single decisive fleet engagement involving all of the fleet's first-rate (most modern)

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[46] Samuel P. Huntington correctly tied the transformation of the Navy in terms of a broader shift in national policy, arguing that during this time the United States shifted from its "Continental Phase" to it "Oceanic Phase." See Samuel P. Huntington, "National Policy and the Transoceanic Navy," *Proceedings,* May 1954, p. 487.

[47] Beach, *The United States Navy,* pp. 407-10.

[48] Wayne P. Hughes, Jr., "LCS Isn't Right Yet. That's A Good Reason to Build It," a presentation to the 71st Military Operational Research Society, June 10, 2003.

[49] Even after the carrier had supplanted the battleship as the new capital ship, battleships proved useful. They ended their World War II careers as either powerful anti-aircraft and anti-surface escorts for fast carrier forces, or as powerful shore bombardment platforms. Although all US battleships were decommissioned or laid up by 1958, four were kept in reserve. See Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, pp. 125-29.

[50] For a thorough discussion of battleship era tactics, see Hughes, *Fleet Tactics and Coastal Combat,* pp. 67-89.

[51] "US Battleships of World War II," found at http://www.ww2pacific.com/battleships.html.

battleships. For example, the Washington and London Naval Treaties established a battleship ratio of 5:3 between the US and Japanese fleets. Accordingly, the 1936 version of War Plan Orange ultimately anticipated a climatic fleet duel between 15 US battleships and 9 Japanese battleships.[52] The Panama Canal enabled the Navy to operate battleships in both oceans during peacetime but to rapidly concentrate the single fleet battle line when needed. Indeed, the Canal allowed the Navy to promptly make up for Pearl Harbor battleship losses by quickly shifting five battleships from the Atlantic to the Pacific Fleet.[53]

In comparison, during the carrier era—especially as the number of carriers grew and the range and striking power of their air wings improved—the battle fleet operated in wide-ranging, dispersed carrier task groups. For example, by 1944, toward the end of the Pacific Campaign, Task Force (TF) 58 could call upon 15 large fleet carriers and 9 light carriers in its Pacific naval inventory. TF 58 generally operated as four or five dispersed, individually concentrated task groups normally comprised of four carriers (preferably three fleet carriers and one light carrier) and their escorts (including at least one fast battleship)—although there was much variation in this basic model from one operation to the next.[54] These dispersed groups would concentrate their long-range firepower when possible.[55]

Fifty-five years later, toward the end of the Cold War, the Navy again operated 15 large fleet carriers. However, because of the increased striking power of their carrier air wings, fleet war plans called for seven independent carrier battle forces consisting of two carriers and their escorts, and one carrier battle group with one carrier and its escorts. These eight carrier strike groups were augmented in lower threat environments by four "surface action groups" (SAGs), built around four re-commissioned and modernized World War II battleships armed with anti-ship and land attack cruise missiles.[56]

In other words, the shift to the carrier era saw a new fleet operational architecture evolve. Instead of viewing the fleet as a single concentrated battle line, naval planners saw the fleet in terms of

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[52] Norman Friedman, *US Destroyers: An Illustrated Design History* (Annapolis, MD: Naval Institute Press, 1982), p. 92.

[53] "US Battleships of World War II," found at http://www.ww2pacific.com/battleships.html.

[54] One of the best descriptions of US battle fleet organization in the Pacific War can be found in Clark G. Reynolds, *The Fast Carriers: The Forging of an Air Navy* (Annapolis, MD: Naval Institute Press, 1992).

[55] The need for radio silence more often than not prevented the tactical concentration of dispersed task group firepower until late in the war. Hughes, *Fleet Tactics and Coastal Combat,* p. 96.

[56] Norman Polmar, *Ships and Aircraft of the US Fleet,* 13th edition, p. 110. The aforementioned decision to keep a small number of World War II battleships as a hedging strategy proved to be a wise one. One battleship was re-commissioned for shore bombardment duties in Vietnam. Based on this experience, during the 1980s the Navy modernized four battleships and armed each with 32 Tomahawk land-attack and 16 anti-ship cruise missiles. These formed the centerpieces for four battleship surface action groups, or "BB SAGs." However, with the end of the Cold War, the battleships' age and large crew sizes made them extraordinarily expensive to maintain, especially with the adoption of the All-Volunteer Force. Six decades after the shift to the carrier era, only two battleships remain on the naval register in reserve; all others have been donated as museums or broken up.

multiple independent strike groups. By the end of the Pacific Campaign, the Navy could assemble four or five powerful independent striking groups, and by the end of the Cold War, it could assemble a maximum of 12. These groups could, in turn, be combined with one another in different ways, making the battle fleet much more flexible and capable of exerting influence over a much wider geographic area than it could in the battleship era. Said another way, between the battleship and carrier eras, the battle fleet transformed itself from ***a concentrated striking force to a dispersed striking force capable of concentration***.

As one might expect, the change in preferred wartime employment models between the battleship and carrier eras also led to different peacetime fleet deployment patterns. As opposed to the dispersed squadron operations characteristic through 1889, during the battleship era the fleet gradually was concentrated in US home waters, prepared to sail out and meet any advancing naval threat. In sharp contrast, the carrier era placed great emphasis on keeping "combat credible" carrier battle groups dispersed forward in two or three operating theaters, both to deter potential enemies and to assure allies of US resolve. This deployment pattern, which facilitated the rapid concentration of naval power in the event of a crisis, demanded that the fleet be organized, trained and equipped to maintain a rotational queue of ready forces for periodic deployment. This requirement led to the carrier era's signature six-month task group deployment pattern, generally evident in fleet operations since about 1947.[57]

The role of surface combatants also changed dramatically between the two eras. During the battleship era, a warship's role was defined by its relationship to the battleships that made up the fleet battle line. Armored/heavy cruisers augmented the battle line and led independent surface action groups. Scout/light cruisers scouted for the battle line. Destroyers screened the battle line from torpedo attack and conducted scouting missions. Ship types were defined, ultimately *by treaty*, by the size of the guns they carried: destroyers carried naval guns 5.1 inches in diameter or less; light cruisers carried guns 6.1 inches in diameter or less; heavy cruisers carried 8 inch cannon; and battleships carried monster guns designed to penetrate an opposing battleship's heaviest armor—cannons up to 18-inches in diameter.[58] However, regardless of a ship's fleet role or the size of the gun it carried, the surface warfare community was conditioned, by training and instinct, to treat every surface warship in the fleet as an *offensive* instrument of war that was designed to take the fight to the enemy.

The shift from the gun to the carrier era was so profound that during World War II every class of US surface combatants except for mine countermeasure ships was used for a different role than

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[57] Although accurate from a macro-level view, this description is a gross over simplification of the Navy's different deployment patterns. For the best micro level view of shifting Navy deployment strategies, see the superb monograph by Peter M. Swartz, *Sea Changes: Transforming US Navy Deployment Strategy: 1775-2002* (Alexandria, VA: Center for Naval Analysis, July 31, 2002).

[58] The Japanese were the only navy to field 18-inch guns, on their two "super battleships" *Yamato* and *Musashi*. The US Navy preferred to arm their battleships with 16-inch cannon. By the 1930 London Treaty, the correlation between gun size and ship type started to break down. For example, there was no limitation on "gunboats" or "sloops" ranging between 600 and 2,000 tons and carrying up to a 6.1 in cannon. See Freidman, *US Cruisers: An Illustrated Design History*, (Annapolis, MD: Naval Institute Press, 1984), Chapter 6.

that for which it was originally designed.[59] During the Pacific campaign, major combatants were defined first by foremost by their relationship to, and the missions performed within, the carrier task or battle group. Those combatants fast enough to keep up with the new 33-knot *Essex*-class fleet carriers—i.e., those that were "battle force capable"—screened the carriers from air, surface, and submarine attack. Slower combatants protected merchant and amphibious shipping or conducted shore bombardment duties and other non-battle group related tasks.

After World War II, as the Navy confronted the new challenges associated with jets, missiles, and fast attack submarines, the surface warfare community gradually adjusted to its new primarily *defensive* role within the framework of fast carrier task forces. As a result, classification of ship types began to change. By 1975, the Navy decided the surface combatant fleet would consist of just four basic ship types[60]:

- Guided missile cruisers (CGs), multi-mission ships optimized for anti-air and anti-cruise missile defense of the carriers;

- Guided missile destroyers (DDGs), multi-mission combatants also optimized for fleet air and missile defense, and capable of operating as part of independent surface action groups;

- Destroyers (DDs), multi-mission ships optimized for anti-submarine defense of carriers; and

- Frigates (FF) and multi-mission guided missile frigates (FFGs), optimized for anti-submarine screening and local (i.e., short-range) air defense of convoys, amphibious ships, and underway replenishment groups.[61]

The larger guided missile cruisers, guided missile destroyers, and destroyers were considered to be "first-rate" battle force capable combatants. In contrast, although the smaller FFs and FFGs routinely deployed with carrier battle groups during peacetime deployments, they were classified as "protection of shipping" (ocean escort) combatants and were considered incapable of sustained wartime operations with carrier strike forces.

The defensive orientation of the surface combatant fleet continued into the 1980s when, in response to the threat of saturation missile raids conducted by long-range Soviet aviation and submarine forces, the surface warfare community introduced a new anti-air warfare (AAW) combat system called AEGIS and a new missile launching system called the vertical launch

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[59] Hughes, "LCS Isn't Right Yet. That's A Good Reason to Build It."

[60] For a more thorough discussion of Navy ship classification guidelines, see Appendix A.

[61] See Polmar, *Ships and Aircraft of the US Fleet*, 13th edition, for thorough explanations of each ship type in fleet service. All modern Navy surface combatants carry guided missiles of some type (e.g., anti-ship cruise missiles, surface-to-air missiles, point defense missiles). Those ship types that carry the appendage "G," such as CG, DDG, and FFG, are equipped with either a longer-range area or a shorter-range local surface-to-air missile system.

system (VLS).[62] However, the introduction of the new VLS—ostensibly to improve fleet *defenses*—helped to hasten events that would ultimately propel the Navy toward an entirely new operational model for its battle fleet.

Early missile-armed surface combatants designed to screen the carrier first from aerial attack by jet aircraft and later by anti-ship cruise missiles carried one or two above-deck missile launchers, each served by below-deck rotary missile magazines.[63] By comparison, the vertical launch system introduced bundles of missile "cells" nestled inside the hull of a ship. Each cell served as both missile magazine and launcher. Once fed the proper firing data and launched, a missile inside a cell simply fired straight up out of the hull and "tipped over" on the proper bearing to speed toward its target.[64]

One big advantage of the VLS was that it was far more space efficient than the earlier above-deck launcher/below-deck rotary magazine arrangement. For example, the first five ***Ticonderoga*-**class cruisers were armed with a Mk-26 twin-rail missile launching system both fore and aft, each located over a rotary magazine with a capacity of 44 missiles. The next 22 VLS-equipped *Ticonderogas* carried 64 missile cells forward and 64 missile cells aft (although six cells were not used for missile storage).[65] Switching to the VLS system thus allowed the newer cruisers—with hulls identical to those of the earlier ships—to increase their total magazine capacity from 88 to 122 missiles. In other words, VLS allowed for a 38 percent increase in comparable ship magazine loads. This meant a smaller fleet of VLS-equipped combatants could pack the same equivalent defensive punch as could a larger fleet of combatants not so equipped.

A single VLS cell is a rectangular box with an opening on one end measuring 25x25 inches.[66] These cells come in three different lengths, and they can be configured to carry either four short-

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[62] "The commissioning of *USS Bunker Hill* (CG 52) opened a *new era in surface warfare* as the first AEGIS ship outfitted with the Vertical Launching System (VLS), allowing greater missile selection, firepower and survivability" (emphasis added). From "AEGIS Combat System," Navy Fact File, found at http://www.chinfo.navy.mil/navpalib/factfile/weapons/wep-aeg.html. For a complete description of the AEGIS combat system, see Polmar, *Ships and Aircraft of the US Fleet*, 17th edition, p. 133, and "AEGIS Weapons System MK-7" at http://www.fas.org/man/dod-101/sys/ship/weaps/aegis.htm. For a discussion of AEGIS developmental history, see Norman Friedman, *US Cruisers: and Illustrated Design History* (Annapolis, MD: Naval Institute Press, 1984), pp. 419-21.

[63] To fire a missile, a hydraulic system would rotate the magazine so that a missile slotted into a feed system; the above deck missile launcher would swing to align its launch "rails" with the magazine feed mechanism; the missile would slide out on the launch rail; the feed system would retract and the launcher would spin away and align its self on the proper firing bearing; and the missile would launch. Firing cycles would be repeated until the threat was eliminated or the magazine was exhausted.

[64] See "Mk 41 Vertical Launch System," at http://www.fas.org/man/dod-101/sys/ship/weaps/mk-41-vls.htm. See also comments made by Friedman in *US Destroyers: An Illustrated Design History*, p. 387.

[65] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, p. 136.

[66] Information on the Mk-41 VLS system can be found in Polmar, *Ships and Aircraft of the US Fleet*, 17th edition, pp. 495-96.

range self-defense missiles in a special "quad pack" arrangement[67]; one surface-to-air (SAM) missile;[68] one anti-submarine rocket (ASROC);[69] or a single Tomahawk land attack cruise missile.[70] The introduction of the VLS thus allowed for far more flexible weapon load outs and resulted in the dramatic reduction of special purpose above-deck launchers on fleet surface combatants.[71]

The VLS was also adapted for use aboard fleet submarines. Later versions of the fleet's large force of *Los Angeles* class attack submarines (SSNs) carry a 12-cell VLS battery nested in the forward part of their hulls. The cells are normally loaded with 12 Tomahawk land attack missiles. Since the addition of VLS did not reduce the number of weapons carried in a submarine's torpedo room, a VLS-equipped submarine carried 12 additional weapons on patrol—representing a 46 percent increase in warload over that of a non-VLS-equipped boat.

The introduction of VLS held far more important implications for the fleet than mere efficiency improvements, however. As mentioned above, the VLS enabled both defensively-oriented surface escorts and anti-submarine warfare (ASW)-oriented submarines to store and fire large-

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[67] The new Evolved Sea Sparrow Missile, or ESSM, is a more capable version of the earlier NATO Sea Sparrow "point defense" missile. It has a modified 8-inch diameter forebody from the NATO Sea Sparrow attached to a new 10-inch diameter rocket motor that gives the missile greater range and capability against anti-ship cruise missiles. See "RIM-7 Sea Sparrow Missile" at http://www.globalsecurity.org/military/systems/munitions/rim-7.htm.

[68] Navy medium- and long-range surface-to-air missiles all belong to the Standard missile family. See Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, p. 518-19, and Richard Scott, "Raising the Standard," *Jane's Navy International*, April 2001, pp. 18-24.

[69] For information on the ASROC, see Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, p. 501, 525.

[70] The Tomahawk family of missiles originally included a 300-mile range anti-ship cruise missile version called TASM. However, these missiles have all passed from fleet service, leaving only conventionally-armed and a small number of nuclear armed land attack versions in the Navy's inventory. Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, pp. 520-21.

[71] Above deck launchers and rotary missile magazines are designed to handle common-diameter missiles. In the US Navy, current short-range self-defense missiles (e.g., NATO Sea Sparrow) are 8 inches in diameter; long-range surface-to-air (SAM) missiles (e.g., Standard SAM), medium-range anti-ship cruise missiles (e.g., Harpoon), and anti-submarine rockets (ASROC) are all approximately 13 inches in diameter; and long-range land attack cruise missiles (e.g., Tomahawk) are approximately 21 inches in diameter. The differences in missile diameters led to a proliferation of launch systems on early carrier era surface combatants. Perhaps the best example of the effect of having to carry missiles with varying diameters was the Tomahawk-armed, non-VLS equipped *Spruance* DD, which carried no less than four distinct above-deck launching systems: one for its NATO Sea Sparrows, one for its ASROCs, one for its Harpoons, and one for its Tomahawks. Obviously, this situation was not optimal, and the Navy pursued multi-purpose launch systems whenever possible. For example, the aforementioned Mk-26 missile launch system could handle missiles approximately 13 inches in diameter, allowing a ship so equipped to fire anti-aircraft, anti-submarine, and anti-ship missiles from the same rotary magazine. However, the ship would have to carry separate launchers if equipped with land attack or short-range self-defense missiles. Thus the move to VLS led to further reductions in special purpose launch systems. For example, VLS-equipped *Ticonderoga* CGs and *Arleigh Burke* DDGs carry only eight above-deck "canister" launchers for their Harpoon missiles (Harpoons were not designed for vertical launch); all other missiles are stored below decks in their VLS cells. The benefits for fleet maintenance and logistics associated with a reduction in special purpose launchers are obvious. The information of missile diameters was taken from Polmar, *Ships and Aircraft of the US Fleet, 17th edition,* from the chapter entitled "Weapon Systems." The information of a Tomahawk-armed *Spruance* can be found in Polmar, *Ships and Aircraft of the US Fleet, 16th edition* (Annapolis, MD: Naval Institute Press, 1997), pp. 132-34.

diameter, long-range *offensive* land attack missiles. As such, its introduction heralded a widespread distribution of the battle fleet's offensive firepower. By 2000, 81 of the Navy's 86 battle force capable surface combatants carried the VLS,[72] as did 31 of the Navy's 55 attack submarines. Moreover, all remaining 24 SSNs could fire Tomahawks from their 21-inch diameter torpedo tubes.[73]

In other words, with the widespread introduction of the VLS and the Tomahawk land attack cruise missile, the offensive striking power of the carrier era fleet would be no longer concentrated on the decks of just 15 fleet carriers. Instead, the striking power of the carrier air wings would be augmented by 136 surface combatants and submarines that could strike targets at ranges that rivaled that of naval tactical aviation.[74] Moreover, because surface combatants retained their formidable defensive armament and submarines were endowed with a high degree of stealth, the fleet could consider organizing itself more flexibly into smaller, more distributed carrier task forces, independent surface strike groups, or independent covert strike bases.[75] If this distributed striking power could be networked so that independent ships and task groups could operate as a single warfighting entity, concentrating their offensive fires even while dispersed, the impact on naval operations and tactics would be profound.[76]

The fleet had long recognized the power of networking battle force *defenses*. World War II Combat Information Centers (CIC), long-range search radar and sensors, and radio links comprised a "track whole-scan (search) system" to improve battle group combat air patrol coverage and anti-aircraft fire.[77] After World War II, with the threat of *kamikazes* (the first long-range guided cruise missile) still on their minds, and with the specter of bomber-launched anti-ship missiles looming, fleet planners sought first to automate the manual CIC tracking function to prevent information overload during enemy saturation attacks. The first step toward this goal occurred in 1951, when the Comprehensive Data Display was introduced. This was followed in 1956 by a new data handling system called EDS (for Electronic Data System).[78]

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[72] The exceptions were the first five *Ticonderoga*-class CGs (out of a class size of 27). See Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, pp. 136-140.

[73] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, pp. 180-84.

[74] Norman Friedman, James S. O'Brasky, and Sam J. Tangredi, Chapter 19, "Globalization and Surface Warfare," in Tangredi, ed., *Globalization and Maritime Power*, p. 376.

[75] See for example "Naval Firepower Comes of Age," editorial supplement in *Jane's Defence Weekly*, November 13, 2002. See also Freidman's comments in Chapter 16, "The Future," in *US Destroyers: An Illustrated Design History*, p. 388.

[76] Friedman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," p. 376. Concentration of defensive fires is much harder than concentration of offensive fires, which leads to a constant tug between the forces of dispersal (to achieve greater strike coverage) and the forces for concentration (to improve defensive fires). See Hughes, *Fleet Tactics and Coastal Combat*, pp. 286-290.

[77] Freidman, *US Destroyers: an Illustrated Design History*, pp. 206-07.

[78] Freidman, *US Destroyers: an Illustrated Design History*, pp. 206-07.

However, the ultimate goal of Navy planners was to integrate and automate detection and tracking functions so that a ship's firing data could be computed by specialized combat systems and fed directly to its missile or guns, and then to link this process among all ships in a concentrated battle group. In 1959, the Navy linked the data from four radar ships separated over 400 miles using a teletype and analog display. But the giant step forward occurred in 1961 with the introduction of the Naval Tactical Data System (NTDS). NTDS combined the data handling of the earlier EDS with a ***digital*** inter-ship data link that is now know as "Link 11." If all ships were in proper position in a battle group's defensive screen, the NTDS could analyze shared data and assign all ships firing responsibilities based on the most pressing inbound threat. Note this was primarily an automated battle group threat prioritization system, designed to prevent inbound missiles from saturating battle group defenses; a firing ship still had to register an assigned target on its own shipboard sensors to execute a missile intercept.[79]

Battle force defensive networking accelerated during the 1980s as the fleet grappled with the aforementioned challenge of warding off saturation missile raids conducted by Soviet naval units. Inner battle group defenses were bolstered by the arrival of the new AEGIS AAW combat system as well as the New Threat Upgrade (NTU) for older AAW systems.[80] These improved missile systems were designed to deal with anti-ship cruise missiles that broke through outer battle group defenses provided by E-2C airborne early warning aircraft and F-14 long-range interceptors (which worked together to shoot down the bombers that launched the missiles). With their longer sensor reach, these systems could generate missile firing solutions against inbound targets at greater ranges than previous anti-air warfare system, allowing the fleet to exploit the maximum ranges of its various defensive SAMs. When combined with the VLS—which facilitated a higher rate of selective defensive missile fire than past rail launchers—the net result was greatly improved battle group missile defenses.[81]

By the latter part of the Cold War, visionary officers began thinking about the implications of networking the surface combatant fleet's new VLS-enabled distributed ***offensive*** firepower in the same way that had proven so successful with its ***defensive*** firepower. For example, in January 1988, Vice Admiral Joseph Metcalf III, in an article entitled "Revolution at Sea," foresaw a fleet of numerous, dispersed, lightly manned, semi-submersible combatants armed with VLS that could concentrate enormous amounts of missile fire on an enemy fleet or against targets ashore through the power of networking. In essence, Admiral Metcalf was arguing for a new offensive battle fleet model based on the idea of distributed fleet battle networks.[82]

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[79] Freidman, *US Destroyers: an Illustrated Design History*, pp. 206-07.

[80] For a description of the NTU, see "CG-16 Leahy class" at http://www.fas.org/man/dod-101/sys/ship/cg-16.htm.

[81] See "AEGIS Weapons System MK-7" at http://www.fas.org/man/dod-101/sys/ship/weaps/aegis.htm. For a discussion of AEGIS developmental history, see Norman Friedman, *US Cruisers: and Illustrated Design History* (Annapolis, MD: Naval Institute Press, 1984), pp. 419-21.

[82] Vice Admiral Joseph Metcalf III, USN, "Revolution at Sea," ***Proceedings,*** January 1988, pp. 34-39.

While Admiral Metcalf's large semi-submersible ship has yet to be built, the underlying notion of networking the surface combatant fleet's defensive ***and*** offensive firepower proved to be enduring. AEGIS, NTU and VLS were introduced into fleet service just as Information Age technologies were beginning to change the way the fleet processed and shared tactical information, as well as the way it attacked targets ashore. The combination of "precision intelligence" and "precision weapons" promised to greatly expand the reach and power of fleet battle groups. Indeed, two of the key lessons the Navy took away from the first Persian Gulf War was that it needed to better exploit the shared power of information and precision in its fleet operations and tactics, and it needed to improve its connectivity with other services, especially the Air Force.[83] The 1990s thus saw a concerted push by Navy planners to introduce powerful fleet information networks; to pursue a variety of "web-based" knowledge management tools; to field new types of precision weapons; and to "get connected" with joint forces.[84]

The Navy's emphasis on joint, information-based, "effects-based" operations began to change many fleet "transactions" and tactical processes—just as it was doing in the American business sector. For example, the fleet began experimenting with a new defensive networking concept called the Cooperative Engagement Capability (CEC), which is now being fielded and operationally tested. This system will hopefully allow all ships in a battle group to digitally share their sensor and track data to create a common battle group air defense picture with fire control quality data, allowing battle group escorts to engage targets that do not even register on their own sensors![85] The Navy also worked with the Air Force to create a "joint fires network."[86] These types of improvements in fleet tactical operations became routine as the power of information and networking was demonstrated in fleet operations and their promise became more evident to serving officers.

Time precludes a more general discussion here of "network centric warfare"—the term currently in vogue that best explains the potential impact of Information Age technologies and processes on 21st century warfare.[87] But at its heart, network centric warfare espouses the idea of linking

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83 There were many Persian Gulf after action reports that stressed the importance of joint connectivity and precision in the Persian Gulf War. For two contemporary examples, see Representatives Les Aspin and William Dickinson,, *Defense for a New Era: Lessons of the Persian Gulf War* (Washington, DC: Brassey's, 1992), and James Blackwell et al, *Gulf War: Military Lessons Learned/Interim Report of the CSIS Study Group on Lessons Learned From the Gulf War* (Washington, DC: Center for Strategic and International Studies, 1991).

84 Rear Admiral Thomas E. Zelbor, USN, "'FORCEnet' is the Navy's Future," *Armed Forces Journal,* December 2003, pp. 48-53. See also Vice Admiral Edmund P. Giambastiani, Jr, USN, "An Investment Portfolio…For the Navy After Next," *Sea Power,* April 2001, pp. 9-19; and "USN Assesses Web-based Conferencing," *Jane's International Defense Review,* July 2003, p. 10.

85 See Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, p. 134. See also Robert Keno, "Cooperative Engagement Capability and the Interoperability Challenge," *Sea Power,* March 1999, pp. 45-48; Nathan Hodge, "Navy Needs CEC ASAP: Admiral," *Defense Week,* May 20, 2002, p. 64.

86 Sandra I. Erwin, "Navy, Air Force Team Up in 'Joint Fires Network'," *National Defense,* March 2003, pp. 22-23.

87 See "Network Centric Warfare: Department of Defense Report to Congress" at http://www.defenselink.mil/nii/NCW.

widely distributed fleet sensors and defensive and offensive firepower to form coherent joint and fleet "battle networks." These networks consist of inextricably connected sensor, command and control, and engagement grids with multitudinous direct and indirect machine-to-machine and man-to-machine interfaces. Network centric proponents argue that, if properly constructed, these battle networks help to facilitate an unprecedented degree of common joint and fleet situational awareness and rapid collaborative battle planning and tactical action, and thereby afford US forces a decisive combat edge.[88]

Exploiting the offensive and defensive firepower of the AEGIS/VLS-equipped surface combatant fleet through the power of networking thus can be seen as the first important physical manifestation of a Navy in the early stages of transformation to a new battle fleet model—the distributed, networked battle fleet—in which the combined firepower of a widely dispersed naval battle network can be "brought immediately to bear against a whole or part of an enemy's naval force." As is the case when any new operating model threatens an existing dominant paradigm, the idea of a distributed networked battle fleet threatened many communities in the Navy still wedded to the operating models of the carrier era. This helps to explain the fate of the earliest and perhaps most radical ship concept associated with the new operational model—the "Arsenal Ship."

The Arsenal Ship, championed by Admiral Mike Boorda, Chief of Naval Operations from 1994-1996, was in essence the first manifestation of Admiral Metcalf's "revolution at sea." It was an attempt to exploit the power of networked offensive missile firepower in support of land campaigns. Admiral Boorda proposed building a small class of six "Large Capacity Missile Ships"—minimally-crewed "remote missile magazines" consisting of up to 500 VLS cells, and whose weapons could be selected and launched by nearby AEGIS combatants, or Air Force command and control or intelligence aircraft, or even ground units maneuvering ashore. Although this small class of ships was to operate alongside a second class of ships called "Sea Dominance Combatants" that would be built in much numbers to maintain the surface combatant force structure at 130 ships, it was the image of an "Arsenal Ship"—rippling off hundreds of cruise missiles towards distant targets in minutes—that captured the greatest public attention.[89]

Unfortunately, however, it also captured the attention of the carrier community, which worried that such a ship parked off the shores of North Korea or Iraq might lead some to question the need for *carrier* forward presence, upon which the justification for carrier force structure largely rested. It also captured the attention of the surface community, which was vaguely repelled by

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[88] Jeffrey R. Cares, Raymond J. Christian, and Robert C. Manke, *Fundamentals of Distributed, Networked Military Forces and the Engineering of Distributed Forces* (Newport, RI: Naval Undersea Warfare Center, 9 May 9, 2002). For a good early discussion about network centric warfare, see David S. Alberts et al, *Network Centric Warfare, Developing and Leveraging Information Superiority* (Washington, DC: Department of Defense, 1999). See also David Hughes, "Networking, Swarming and Warfighting," *Aviation Week and Space Technology,* September 29, 2003.

[89] For a thorough discussion of the Arsenal Ship see Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, Appendix E. For a discussion how Arsenal Ship was envisioned as part of the TSBF, see Michael Lindemann, "DD-21 Brings Fundamental Changes to the Land Battle," *Surface Warfare,* May/June 2000, p. 27.

the idea of commanding a remote missile magazine whose weapons were fired by some distant and unknown entity, and which in the 1990s began augmenting carrier presence with seven 3-ship surface action groups armed with Tomahawk missiles. And it also captured the attention of the submarine community, which saw the ship as a threat to its new land attack mission carried out by its growing fleet of Tomahawk-armed submarines.[90]

In the end, regardless of the ship's other analytical merits or demerits, a small class of powerful ships in a fleet in which firepower was already being widely distributed through the proliferation of VLS and Tomahawk proved to be too challenging to too many Navy warfighting communities. As a consequence, Admiral Boorda re-designated the Arsenal Ship as the Maritime Fire Support Demonstrator (MFSD) program, and moved it to an organization outside the Navy—the Defense Advanced Research and Projects Agency (DARPA)—to preserve it. However, with Admiral Boorda's tragic death in 1996, the MFSD lost traction even there. The program was quietly shelved in November 1997 due to lack of Navy interest and inadequate funding.[91]

However, even as the Navy and surface warfare community were rejecting the first ***ship*** concept associated with a new distributed battle network model, they started to gain an increased appreciation for ***unmanned systems***, which held great promise as distributed components within a knowledge-enabled battle network. The Navy had been an early innovator in unmanned/robotic systems; the command detonated electrical mine was the conceptual forerunner of all remotely operated (underwater) vehicles (ROVs), just as the automobile torpedo was the conceptual forerunner of autonomous underwater vehicles (AUVs).[92] However, during the battleship and carrier eras, the Navy's interest in unmanned systems was generally confined to unmanned *weapons*. Wire-guided and acoustic torpedoes, wake-homing torpedoes, submarine launched mobile mines, and mines using encapsulated torpedoes were progressively more sophisticated remote or autonomous weapons. And the missile age spawned entirely new family of unmanned systems, essentially long-range robotic kamikazes, whose individual characteristics were determined first by the target they were designed to hit and kill, and second by the launch system necessary to propel them toward their targets.

While the Navy and surface warfare community made some modest attempts to incorporate unmanned systems into fleet operations during the latter years of the carrier era, it was not until the last decade of the 20th century that unmanned systems began to be seriously considered. The increasing costs of manpower in the joint All-Volunteer Force (AVF) provided impetus toward a greater appreciation for unmanned systems. However, it was the increasing capabilities of

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[90] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, Appendix E. See also Norman Polmar, "State of the Fleet," in the US Navy, *Proceedings,* January 2001, p. 103.

[91] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, Appendix E; and Thomas G. Mahnken, "Transforming the US Armed Forces: Rhetoric or Reality?" *Naval War College Review,* Summer 2001, at http://www.nwc.navy.mil/press/Review/2001/Summer/art6-sul1.htm, pp. 5-6.

[92] *Maritime Futures: The Undersea Environment* (Washington, DC: Center for Strategic and Budgetary Assessments, January 2003), pp. 14-17.

unmanned systems that contributed most mightily to the renewed interest of fleet operators. Throughout the 1990s, unmanned aerial vehicle (UAV) system reliability improved dramatically, and the number of types and capabilities of these vehicles expanded rapidly; the number of unmanned mine warfare systems and drones steadily increased; and the scientific and commercial offshore oil and gas industries championed increasingly capable ROVs and AUVs that could be modified to perform a variety of different combat support roles.[93]

Also hastening the increased attention on unmanned systems were war games and studies sponsored by the Office of Net Assessment, Office of the Secretary of Defense (OSD), the Naval War College (NWC), and the Chief of Naval Operation's Strategic Studies Group (SSG). All of their efforts suggested that linking manned platforms with unmanned systems—autonomous intelligence, surveillance, and reconnaissance (ISR) systems;[94] remote stationary sensors; UAVs and unmanned air combat vehicles (UCAVs);[95] unmanned underwater vehicles (UUVs),[96] unmanned surface vehicles (USVs),[97] and remotely fired "weapon pods"—would change naval warfare in ways that could not be fully imagined.

By the late 1990s, informed naval officers no longer appeared to question ***if*** the Navy would embrace unmanned systems in fleet operations; the only significant questions were ***when*** and to what ***degree.*** These questions would be answered once the Navy came to grips with the two central issues associated with their introduction:

- How would the fleet best employ, control, and coordinate its unmanned systems?; and

- How would the fleet best be organized to operate as heterogeneous battle networks composed of both manned ***and*** unmanned systems?

In summary, then, in 1889 the Navy rejected an operational model that emphasized dispersed and independent warship operations in favor of one that saw all ships in the Navy as part of a single integrated battle fleet designed to concentrate its fires on a whole or part of an enemy's fleet. One hundred years later, the battle fleet model had evolved through two distinct eras. The battleship era saw a single battle line, generally concentrated in home waters, linked first by

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[93] ***Maritime Futures: The Undersea Environment,*** pp. 26-31. See also Edward C. Whitman, "Beneath the Wave of the Future," ***Undersea Warfare,*** Summer 2002, pp. 21-24.

[94] Nick Cook, "ISR-Manned Or Unmanned? Going Solo?" ***Jane's Defence Weekly,*** November 19, 2003.

[95] See for example Patrick Yates, "UCAVs Can Improve Surface Ships," ***Proceedings,*** October 2002, pp. 73-75; Norman Polmar, "Unmanned and Unafraid," ***Proceedings,*** September 2003, p. 42; and David A. Fulghum, "Unafraid and More Than Alone," ***Aviation Week and Space Technology,*** December 15, 2003, pp. 60-62.

[96] See James H. Patton, Jr., "UUVs Will Foster Fundamental Change in Naval Warfare," ***Sea Power,*** July 2003, pp. 33-35; and Mark Hewish and Joris Janssen Lok, "Silent Sentinels Patrol the Depths," ***Jane's International Defense Review,*** April 2003, pp. 49-54.

[97] Helmut H. Portmann, Seth L. Cooper, Mathew R. Norton, and David A. Newborn, "Unmanned Surface Vehicles: Past, Present, and Future," found at http://www.globalatlantic.com/unmanned.html.

signal flag and lights and later by radio. This era lasted some 52 years (1889 through 1941). In the carrier era, dispersed carrier task and battle groups, connected by radio, concentrated their offensive fires whenever possible, and used shared information to improve their own battle group defenses. The emphasis on dispersed battle groups was also reflected in the fleet's peacetime deployment patterns, which emphasized six-month rotational deployments of carriers and their escorts

Fifty-six years into the carrier era, an increasing number of indicators—the proliferation of new information and sensor technologies, the introduction of the VLS and the Tomahawk missile, the Navy's determination to improve the networking of both its defensive ***and*** offensive firepower, and a new appreciation for unmanned systems—suggested an impending shift to a new battle fleet model. This model foresaw a battle fleet in which sensing and defensive and offensive striking power would be distributed across large numbers of highly networked manned and unmanned systems, allowing dramatic increases in the fleet's ability to concentrate firepower on the whole, or a part, of an enemy's fleet.

From Blue to Green and Brown: The Navy Looks Ashore

> Surface warfare is the soul of the Navy. Yet within all souls, there are sometimes issues of faith and periods of doubt and reassessment. For the surface warfare community, the end of the Cold War brought a period of reassessment that is still ongoing. It will not be complete until the community grapples with the implications of the era of globalization and resolves a series of issues that appear to place long-term faith in collision with current requirements.[98]

One problem with a new model that promised new ways to concentrate fire on an enemy fleet was that the Navy soon found itself without an enemy fleet to concentrate its fire upon. The early move toward distributed battle networks was complicated by the fact that at the very moment the promise of fleet battle networks was starting to become clear, the culture and predisposition of the Navy in general, and the surface warfare community in particular, was being challenged by dramatic changes in the strategic environment.

During the century lasting from 1889 to 1989, naval officers concerned themselves primarily with the business of sea control. For the majority of surface warfare officers, sea control was usually associated with winning fleet battles against a first-class naval power in decisive battles on, over, and under the world's oceans.[99] The "blue water" ships required to fight these battles were a joy to command; they were generally large and roomy for extended range operations, and were built with a flexible balance of offensive, defensive, and staying power—depending on

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[98] Friedman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," p. 373.

[99] Hagan, *The People's Navy,* pp. xi-xiii; Hughes, *Fleet Tactics and Coastal Combat,* p. 10.

perceptions and analyses of the contemporary threat and the operational and technological preferences of contemporary naval leaders.

Throughout the "sea control century," naval planners had plenty of first-class naval opponents to worry about. During the battleship era, with its famous Rainbow color plans, the US Navy made contingency plans to fight all of the world's great naval powers—including the British Royal Navy. However, up through World War I, the Imperial German Navy garnered the greatest attention of naval war planners, and during the interwar years the gaze of naval war planners turned to the Imperial Japanese Navy.[100] Of course, during the latter half of the Cold War, the Soviet fleet attracted the Navy's greatest attention.

Indeed, in the 100 years between the fleet's embrace of Mahan's sea control vision to the fall of the Berlin Wall, the Navy's focus on battling an enemy fleet wavered only once. For the first two decades following the Second World War, with the Soviet Navy still in its infancy and the threat of atomic weapons seemingly making carrier and amphibious task force increasingly vulnerable, the sea control Navy struggled to define a future compatible with its own operational and cultural preferences.[101] In a superb article written in the May 1954 edition of ***US Naval Institute Proceedings***, Samuel P. Huntington tried to shake the Navy out of its post-war funk, arguing that it needed to shift its attention from sea control to power projection operations along the world's littorals.[102] However, by the time the Navy returned from its long power projection operations off the coasts of Korea and Vietnam, it discovered that Huntington had been about four decades premature: the Soviet Navy had evolved into a first-class naval opponent. Thus, while the Cold War Navy's celebrated 600-ship, sea control TSBF may have looked different in size and structure than the "New Navy" constructed from 1889-1907, it performed missions instantly recognizable by any ardent student of Mahan.[103]

If anything, with the passing of the Soviet Union, US Navy officers were even more bewildered and disoriented by the lack of a first-class naval opponent than were the officers immediately following the Second World War. Barring the unexpected resurgence of the Soviet Navy, the only potential naval opponent on the horizon was the Chinese Navy—and it gave no indication that it ever intended to engage in an ***open-ocean*** competition with the US, preferring instead to control the close seaward approaches to China. In other words, "fleet-versus-fleet surface

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[100] For a concise discussion about interwar period war plans, see "Chapter I: The War Plans," at http://www.army.mil/cmh-pg/books/wwii/Sp1941-42/chapter1.htm.

[101] See Chapter 12, "In Search of a Mission," in Hagan, *The People's Navy,* pp. 333-61.

[102] Huntington, "National Policy and the Transoceanic Navy," pp. 483-91.

[103] President Ronald Reagan and his aggressive young Secretary of the Navy, John Lehman, made "regaining" US maritime superiority a high priority during the 1980s. The "600-ship" Navy was the embodiment of their plans, and it has become the benchmark by which the contemporary Navy is often judged. See Hagan, *The People's Navy,* pp. 380-85.

warfare [had become] the *least likely* form of combat in which the US Navy [would] engage for the foreseeable future."[104]

Moreover, naval leaders could simply not "wait around" for a first class naval opponent to appear. Unlike circumstances at the end of the Second World War, the Office of the Secretary of Defense had become a much more powerful influence in guiding service development efforts, the Marine Corps had become a more equal (and demanding) partner within the Department of the Navy, and all of the Services had to spend time developing and articulating their future visions to external audiences to a degree that would have astonished earlier generations of naval leaders. These three truths led to the rapid publishing of *…From the Sea* in 1992, followed two years later by ***Forward…From the Sea.***[105]

Together, these two documents represented the Department's first attempt to come to grips with the passing of the sea control century. Indeed, both documents could have been penned by Samuel Huntington nearly four decades before, as they both explicitly recognized the need for Navy officers to shift their attention from sea control on the "blue waters" of the world's oceans to power projection operations in the "green waters" of the world's narrow seas, and the "brown waters" of coastal and river waterways. As Admiral Jay Johnson, then-Chief of Naval Operations, explained in 1997 in his guidance implementing *…From the Sea* and *Forward…From the Sea*:

> Our attention and efforts will…be focused on operating in and from the littorals. The landward side of the littoral can be supported and defended directly from the sea. It encompasses areas of strategic importance to the United States. Seventy-five percent of the Earth's population and a similar proportion of national capitals and major commercial centers lie in the littorals. These are the places where American influence and power have the greatest impact and are needed most often. For forward-deployed naval forces, the littorals are a starting point as well as a destination. Tactically, the distance we reach inland from the sea depends on terrain and weather, the contributions of joint and coalition forces, the potential adversary's capabilities, and the nature of our mission. The mission may require us to exercise our considerable reach and operate far inland.[106]

However powerful and logical these words were, shifting focus from sea control to power projection in the littorals was not as straight forward or as easy as it sounded for the Navy's officer corps. One of today's foremost naval tacticians explains that a navy performs four functions, and no others. ***At sea***, it:

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[104] Friedman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," p. 374.

[105] *…From the Sea* (Washington, DC: Department of the Navy, September 1992), and *Forward…From the Sea* (Washington, DC: Department of the Navy, September 1994). Both documents can be found at the Navy Warfare Development Command website at http://www.nwdc.navy.mil/Library/Documents.

[106] Admiral Jay Johnson, USN, *Forward…From the Sea: The Navy Operational Concept* (Washington, DC: Department of the Navy, March 1997), found at http://www.chinfo.navy.mil/navpalib/policy/fromsea/ffseanoc.html.

- Assures that one's own goods and services are safe, and

- Assures those of an enemy's are not.

And *from the sea*, it

- Guarantees safe delivery of one's goods and services ashore, and

- Prevents delivery ashore by an enemy navy.[107]

Within this context, a sea control navy is generally organized, trained, and equipped to perform the first two functions. However, a navy without a first class naval opponent capable of challenging its supremacy at sea must necessarily focus its attention on the third function, which causes it to have to contend with smaller "coastal" navies that focus their attention on the fourth. Thus the shift in fleet orientation outlined in *From the Sea* and *Forward…From the Sea*, logical as it may have sounded, had enormous implications for fleet design, operations, and tactics—not to mention the ingrained culture of an officer corps steeped in over 100 years of sea control theory and doctrine.

As a result, while their heads may have told them that they would have to shift their thinking from open-ocean sea control warfare to joint power projection operations in the littorals, it seems clear that for the first five to eight years after the fall of the Berlin Wall, the hearts of most Navy officers were simply not in it. The Navy's institutional focus during the 1990s was to extol the virtues of naval crisis response, and to protect the carrier fleet from the increasingly popular notion that the end of the carrier era, like the battleship era before it, had finally come.[108] The thrust of Navy operational thinking focused on the need to maintain fleet numbers for forward presence; to sustain a minimum carrier force of 12 carriers and to fight for a maximum of 15; to improve carrier air wing contributions in joint operations by improving carrier command and control capabilities; to speed new precision weapons into carrier magazines; and to create seven 3-ship surface action groups to lessen the "risk" associated with "gaps" in overseas carrier presence. Clearly, the influence of the carrier era's operational model, then in its sixth decade of existence, remained quite strong.

In fairness, the focus of the Navy's operational thinking during the 1990s was not altogether misplaced. The level of uncertainty immediately after the fall of the Berlin Wall was high, arguing against any precipitous shift in thinking or direction. There was no existing coastal navy that could seriously challenge the existing fleet, denying any immediate threat-based impetus for

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[107] Hughes, *Fleet Tactics and Coastal Combat,* p. 9.

[108] Friedman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," p. 382. For examples of contemporary views about the aircraft carrier's increasing vulnerability, see Andrew F. Krepinevich, *A New Navy For A New Era* (Washington, DC: Center for Strategic and Budgetary Assessments, May 1996), and Dave Moniz, "Biggest US Ships Called Vulnerable," *USA Today,* May 21, 2001. Much of the writing about carrier vulnerability was due to the Navy's initial reluctance to operate its carriers inside the Persian Gulf in 1990 and 1991. See Hagan, *The People's Navy,* p. 387.

change. And more importantly, the pressing requirements of managing the substantial post-Cold War fleet demobilization while simultaneously maintaining a quality all-volunteer force—a dual requirement never before faced by naval officers—diverted much of the attention of the Navy's leadership.[109]

Indeed, the management demands of maintaining the AVF was made all the more difficult due to the breathtaking pace of operations throughout the 1990s. While the fleet was shrinking by over 40 percent, the Navy first surged to fight the Persian Gulf War, then maintained a carrier in the Persian Gulf in support of Operation Southern Watch, supported operations off of Somalia, conducted continuous maritime interdiction operations in the Gulf, responded to crises off Korea and Taiwan, and supported allied operations in Bosnia and Kosovo.

The brutal pace of operations is better illuminated by the following figures: from 1970 to 1989, the average number of crises to which US naval forces responded was 2.9 per year, and the median length of the required response was under a month; from 1990 to 1996, the average number of crises per year jumped to 5.0 per year, and the median duration of fleet responses increased to over a year.[110]

Moreover, despite its adamant adherence to the operational precepts of the carrier era, the demands of managing a substantial fleet drawdown, and the fast pace of operations, during the 1990s the Navy did address important cultural issues and push dramatic improvements in its capabilities. The Navy, long the most independent of the armed Services, gradually embraced the move toward joint operations, and reorganized both its Washington-based and numbered fleet staffs to reflect the organization of the Joint Staff.[111] It also pushed a widespread infusion of information-based technologies through its Information Technologies for the 21st Century (IT-21) program, saw a big increase in the number of VLS-equipped surface combatants, and enthusiastically pursued precision-guided weapons. As a result, the 1990s saw continuous improvements in fleet fighting power.[112] Indeed, the dramatic improvements in fleet combat capabilities evident throughout the decade only served to further distance the US Navy from the

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[109] In 1999, the author joined the Secretary of the Navy's staff in Washington, DC Much of the attention of Richard Danzig, then-Secretary of the Navy, was to repair the damage to fleet manning that resulted, in part, because of the large fleet demobilization after the Cold War.

[110] C.B. Barfoot, *Crisis Response: Analysis of Historical Data* (Arlington, VA: Center for Naval Analysis, December 1997).

[111] From conversations with Adam B. Siegel, Senior Analyst at Northrop Grumman Analysis Center.

[112] See Vice Admiral Robert J. Natter, USN, in comments made before the Research and Development and Procurement Subcommittees of the House Armed Services Committee on Defense Information Superiority and Information on 23 February 1999, at http://www.chinfo.navy.mil/navpalib/testimony/information/natr0223.txt. See also Gregory Slabodkin, "Navy's IT-21 Steams Ahead With Global Intranet," *GCN*, December 15, 1997, found at http://www.gcn.com/archives/gcn/1997/December15/cov2.htm. See also Robert K. Ackerman, "US Navy's 7th Fleet Serves as Transformation Bow Wave," *Signal Magazine*, December 2002.

operational capabilities of both its potential adversaries as well as allies. This helped, in no small way, to further dampen any pressing internal call for change.[113]

Even considering these facts, however, it is hard not to be struck by the general absence of an internal Navy tactical debate during the first ten years after the fall of the Berlin Wall over the implications of conducting prolonged operations in the littorals in a world devoid of any compelling sea control threats.[114] This lack of internal debate is all the more striking because throughout the early 1990s an increasing number of defense experts and naval analysts began to think and write about the potential challenges associated with shifting fleet operations into the narrow seas along the world's land masses. These experts argued that future enemy coastal navies and land forces could and would erect formidable maritime "anti-access" (A2) and "area-denial" (AD) networks, which would make future naval power projection operations increasingly problematic and more costly unless fleet weapons, platforms, and tactics were adjusted.[115]

Small pockets of innovation and thought did spend their time thinking about the potential emergence of powerful naval A2/AD networks and their impact on future fleet operating models and architectures. One such pocket of progressive operational thought was the aforementioned CNO's Strategic Studies Group, located in Newport, Rhode Island. Led by retired Admiral James R. Hogg, and home to bright naval thinkers on a year's sabbatical and internship, the SSG had been thinking about the implications of the Navy's shift in operational focus toward the littorals—as well as that of fleet battle networks—at least since 1995.[116] Another pocket of innovation was the Naval War College itself, where students had both the time and inclination to muse about the changing naval environment.[117] However, while these and other such pockets of innovative worked to understand and address the changing nature of naval warfare, their work generally had little impact on the direction of fleet operations or tactics.

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[113] See comments in A.D. Baker, III, *Combat Ships of the World 1998-1999* (Annapolis, MD: Naval Institute Press, 1998), p. xiv. After reviewing worldwide naval trends, Baker wrote: "The smaller US Navy, relative to the threat it faces, has not in any way diminished its relative power."

[114] Friedman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," p. 378-379.

[115] The writings about the potential challenges of confronting A2/AD network proliferated in the late 1990s and the early 2000s. See for example, Robert Uy and Sherrill Lingel, *Anti-Access Strategies: A Quantitative Analysis of Military Methods for preventing, Delaying, and Degrading US Force Buildups* (Washington, DC: RAND Corporation, February 2003); Owen R. Cote, Jr., *Assuring Access and Projecting Power: the Navy in the New Security Environment* (Cambridge, MA: Security Studies Program, Massachusetts Institute of Technology, 2001); Christopher J. Bowie, *The Anti-Access Threat and Theater Air Bases* (Washington, DC: The Center for Strategic and Budgetary Assessments, 2002); and Krepinevich, Watts, and Work, *Meeting the Anti-Access and Area-Denial Challenge.*

[116] See "Chief of Naval Operations Strategic Studies Group History," in Chief of Naval Operations Strategic Studies Group XX, *FORCEnet and the 21st Century Warrior* (Newport, RI: CNO Strategic Studies Group, November 2001), pp. xiii-xiv.

[117] See for example, Adam B. Siegel, "LIC and the Navy in the New Strategic Environment," a paper submitted to the Naval War College in partial satisfaction of the requirements of the Department of National Security Decision Making, Spring 1990.

Then, in 1997, the National Defense Panel (NDP), a group of defense experts charged by the Congress to consider future national security and military requirements, explicitly called for the "transformation" of the entire armed forces so that they would be better prepared for the serious challenges that US power projection operations might face over the long term.[118] The Navy's leadership responded to this call. In November 1997, Chief of Naval Operations Admiral Jay Johnson explicitly seconded the NDP's concern over future power projection operations in littoral waters when he wrote:

> I anticipate that the next century will see those foes striving to target concentrations of troops and material ashore and attack our forces at sea and in the air. This is more of a sea denial threat or a Navy problem. It is an area-denial threat whose defeat or negation will become the single most crucial element in projecting and sustaining US military power where it is needed.[119]

So, as 1998 began, the prospects for an earnest internal debate over the implications of the passing of the sea control century were far brighter than they had been in the early 1990s. With almost a decade having passed since the fall of the Berlin Wall; with the most senior Cold War admirals having been retired; with the continued lack of any compelling sea control threat evident on the horizon; and with more operational experience in the world's littorals supporting joint power projection operations, the officer corps was much more inclined to start thinking coherently about the implications of fleet battle operations in constricted littoral waters, as well as new fleet architectures necessary to prosecute them. All they needed was a focal point for a debate.

They were about to get one.

MAINTAINING AND TRANSFORMING THE SURFACE COMBATANT FLEET

> Building a new navy from scratch, as the United States did with the New Navy of 1881-1914, is simplicity itself compared with the job of transforming a navy that already exists and plays a vital defense role, as the US Navy does today.[120]

Information technologies, networking, VLS, precision weapons, and unmanned systems certainly suggested an impending shift to a dramatically different 21st century battle fleet, and the

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[118] National Defense Panel, *Transforming Defense: National Security in the 21st Century* (Arlington, VA: The National Defense Panel, December 1997). A copy of the document can be found at http://www.dtic.mil/ndp.

[119] Admiral Jay Johnson, USN, "Anytime, Anywhere: A Navy for the 21st Century," *Proceedings,* November 1997, p. 49.

[120] Hughes, *Fleet Tactics and Coastal Combat,* p. 235.

challenge of confronting anti-access and area-denial networks in littoral waters was potentially one which could radically alter fleet operations and tactics. In an ideal world, the Navy would patiently let these two trends to play out, make some informed decisions, and then build a "new navy from scratch" to account for them.

However, the US Navy didn't exist in an ideal world. Instead, naval leaders were forced by practical force management pressures to maintain and transform a battle fleet that already exist[ed] and play[ed] a vital defense role," well before the exact nature of future threats or fleet requirements was entirely clear. As a result, whatever the Navy decided would be subject to endless questioning, uncertainty, and debate.

To better understand the practical pressures confronting fleet operational architects, one must understand the state of the surface combatant fleet as the 1990s drew to a close. Since 1889 when the Navy shifted away from a commerce raiding fleet to a concentrated battle fleet, the surface combatant force has evolved through a total of six generations of combat vessels. The battleship era included three: the pre-dreadnought generation (1895-1909); the dreadnought generation (1910-1922); and the treaty-constrained interwar generation (1923-1936).[121]

Although each successive generation of ships in the battleship era had different design features, combat systems, and weapons, the combined battle fleet was always characterized by a mixture of large, intermediate, and small combatants. As discussed earlier, the "large" ships were heavily armored and designed to fight either as part of the battle line or to conduct important long-range independent operations. These ships included battleships, armored cruisers, and battlecruisers. The "intermediate" ships were cruisers or large gunboats, designed for long-range independent steaming. These ships performed distant and tactical scouting for the battle line; undertook trade protection or attack; and led fast moving and hard-hitting surface action groups. Numerous "small" ships screened the large and intermediate vessels from attack by swarming torpedo boats, submarines, and later, airplanes (defensive screening); conducted swarm attacks of opposing battle lines and their defensive screens (offensive screening); protected convoys from submarine attack; and a host of other missions.

Freed of the tonnage limitations of the Washington and London Naval Treaties, the surface combatants built just before World War II as well as those built during and immediately after the World War represent the "inter-era generation" of surface combatants (i.e., those built between 1937 and 1959). Their designs were heavily influenced by the battleship era preferences, so they could be viewed as the fourth and last generation of battleship era combatants. However, during World War II they and newly built combatants operated within the entirely new battle fleet model of the carrier era, so they could also be considered the first-generation of that new era.

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[121] In 1895, the "first rate" battleship USS ***Indiana*** was commissioned, right on the heels of the "second rate" battleships ***Maine*** and ***Texas***. These were the first ships of the pre-dreadnought generation. The ***South Carolina*** and ***Michigan***, commissioned in 1910, were the Navy's first "all big gun" battleships, and are referred to herein as dreadnought era ships as indicated in http://www.warships1.com/US/US_battleships.htm (although many naval architects might argue that the later Nevada and Oklahoma marked the truly big inter-generational shift). The Washington Naval Treaty, although signed in 1922, actually started to affect US ship designs and decisions earlier as the Navy anticipated its effects.

The transitive nature of the inter-era generation of surface combatants helps to explain the aforementioned observation that the surface ships of World War II performed fleet roles for which they were never intended.[122]

After the end of the Second World War, with a young, powerful, and modern fleet and no immediate naval challenger to worry about, the Navy decided it could afford to delay the introduction of an entirely new generation of surface combatants. The technological advancements of nuclear weapons, jets, guided missiles, and fast attack submarines demanded a thorough reappraisal of battle fleet tactics and weapons. The Navy thus prudently elected to modify or modernize its wartime combatants so they would remain effective during the early nuclear, jet, missile, and fast submarine age, and to augment them with a small number of post-war pathfinder classes extrapolated from wartime designs.

Two early decisions made by fleet planners during this period of technological upheaval were to have lasting effects on the character of surface combatants during the carrier era. First, with surface combatants shifting into a primary defensive role within carrier battle groups, fleet planners gradually began to deemphasize ship gun armament in favor of guided missile armament. Second, they concluded that a nuclear weapon detonation in the vicinity of a ship would result in its total destruction. Therefore, they decided that the "staying power from armor, compartmentation, damage control by the crew, and ***large displacement*** would have little value (emphasis added)."[123] As a result, the 1950s saw the gradual elimination the very large gun-armed surface combatants associated with the battleship era. With the exception of two heavy cruisers kept for shore bombardment duties, all battleships, large cruisers, and all remaining heavy gun cruisers disappeared from the TSBF by the early 1960s, having been broken up, transferred to allied navies, or placed in reserve.[124]

The elimination of very large gun-armed combatants from the TSBF resulted in a *de facto* redefinition of large, intermediate, and small combatants within the fleet. The only "large" combatants would include the two aforementioned gun cruisers and a small number of World War II heavy and light cruisers modified to carry surface-to-air missiles. As a result, by 1960 the largest surface combatants in the fleet had a displacement of 21,000 tons, as opposed to the 59,000 tons of the largest US battleships in the foregoing battleship era. "Intermediate" combatants would include a new type of missile-armed battle force escorts called ***frigates*** which were smaller than World War II cruisers but larger than World War II destroyers, as well as

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[122] Friedman sees four distinct generations in warship design from 1936 through the end of the Second World War. The author has chosen to lump them in one broad "inter-generational era" which was itself highlighted by the greatest naval war in history. See Friedman, *US Cruisers: An Illustrated Design History,* p. 287.

[123] See Hughes, *Fleet Tactics and Coastal Combat,* pp. 147-48. "Staying power" is Wayne Hughes' term for a ship being able to withstand hits and keep fighting.

[124] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, Appendix A, "Navy Force Levels, 1945-2000."

numerous large World War II era destroyers. All ships smaller than the large World War II-era destroyers made up the fleet's small combatant component.[125]

The first true generation of carrier era surface combatants included those ships designed from the keel up for jet- and missile-age warfare and combat against fast attack submarines. This generation was introduced with ships commissioned starting in 1960.[126] They were at first characterized by state-of-the-art analog combat systems; special purpose above-deck missile launchers designed to fire a variety of short-, medium, and long-range SAMs and anti-submarine weapons; large bow mounted sonars; and a variety of modern long-range sensors and electronic warfare systems. Later, they received new digital combat systems and small manned helicopters. This generation also was also characterized by a variety of power plants, as ship designers worked to find the most efficient and cost effective fleet-wide propulsion system. For example, the first nuclear-powered surface combatants were designed during this era, to provide the new nuclear-powered aircraft carriers with fast, long-endurance escorts.[127]

The second-generation of carrier era surface combatants, the ultimate Cold War fighting ships, began entering the fleet in 1975 with the commissioning of the large 8,000-ton ***Spruance*-**class destroyer. These ships all shared variations the same basic gas turbine propulsion plant, and they were equipped with advanced digital combat systems. They introduced the aforementioned AEGIS anti-air warfare combat system and vertical launch missile system, the highly capable LAMPS III helicopter, new digital undersea warfare systems, new electronic warfare systems, and a variety of new weapons such as the Harpoon anti-ship cruise missile and the Tomahawk anti-ship and land attack cruise missiles.

This second-generation of surface combatants saw continued consolidation of fleet combatant ship types. As was mentioned earlier, after 1975 the surface combatant fleet had only four basic types of ships: guided missile cruisers; guided missile destroyers; destroyers; and guided missile frigates. Indeed, consolidation and standardization were explicit design goals for second-generation carrier era ships, which eschewed different ***classes*** of ships within each ship type, preferring instead to produce smaller ***"flights"*** of the same basic class. Each successive ship flight incorporated the most up-to-date variations of fleet combat systems and weapons.[128] Moreover, different ship types also began to share the exact same hull, their differences marked only by the combat systems carried onboard. For example, the hull form for the 31-ship

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[125] For those interested in the shifting character of the US TSBF during the carrier era, see Freidman, *US Destroyers: An Illustrated Design History,* and *US Cruisers: An Illustrated Design History.*

[126] For the purposes of this paper, the *Charles F. Adams* DDG and *Farragut* class DLG (later redesignated as a DDG), both commissioned in 1960, represent the first of the initial carrier era ships. See Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, p. 154.

[127] Descriptions of these ships can be found in Freidman, *US Destroyers: An Illustrated Design History,* and *US Cruisers: An Illustrated Design History,* and earlier editions of Polmar, *Ships and Aircraft of the US Fleet.* For a recapitulation of nuclear powered surface combatants, see Polmar's 17th edition, pp. 134-35.

[128] Freidman, *US Destroyers: An Illustrated Design History,* p. 372.

Spruance DD class was the same used for the 4-ship *Kidd* DDG and the 27-ship *Ticonderoga* CG classes.[129]

As a result of the Navy's explicit emphasis on type consolidation and combatant standardization, the only relevant distinction between ships of this generation was whether or not they were battle force capable (i.e., whether or not they could escort carriers during wartime). And among battle force capable combatants, the distinction between cruisers, guided missile destroyers, and destroyers began to lose significant meaning. Displacements of these three types of ships settled into a narrow displacement band of 8,000 to 10,000 tons, and their capabilities were broadly similar. For example, the only difference between the first five ***Ticonderoga*-**class guided missile ***cruisers*** and the four guided missile ***destroyers*** of the ***Kidd***-class was that the former carried the AEGIS combat system and the latter did not. Indeed, the first ***Ticonderoga*-**class cruiser, CG-47, was to have carried the ship designation DDG-47 before the 1975 type consolidation.[130]

The Navy's non-battle force capable ships were also changing. In previous generations of surface combatants, ocean escorts were generally single-mission platforms focused primarily on anti-submarine warfare. However, the second generation ***Perry*** FFG carried a modest local air defense system in addition to its substantial anti-submarine warfare capability. As a result, it was more of an austere multi-mission destroyer than previous escort designs, with a displacement of about 4,000 tons. In other words, during the latter part of the carrier era, the surface combatant fleet gradually got rid of both its "large" and "small" warships, resulting in a TSBF that emphasized "intermediate"-size ships with displacements between 4,000 and 10,000 tons.[131]

Picking the exact year that marks the start of a new generation of ships is a subject of endless debate among naval scholars. For the purposes of this paper, however, between 1889 and 1975, the shifts from one broad generation of surface combatants to the next occurred, on average, about once every 16 years, in a range from 13 to 23 years. Based on this simple calculation, an entirely new generation of combatants might have been expected in 1991, 16 years after the introduction of the *Spruance*-class destroyers. However, this second-generation of carrier era combatants was an extended one, with (coincidentally) 16 years between the first ship type in the generation and the last.[132] Moreover, when the Berlin Wall came down and the Cold War ended, because of their design emphasis on flight and mid-life modernization, the second-generation ships of the carrier era easily remained the best and most powerful of their types in the world.

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[129] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, ship descriptions.

[130] Freidman, *US Destroyers: An Illustrated Design History,* 320-22.

[131] All of the second-generation carrier era ships remain in service, although the Navy has decided to retire the *Spruance* class DDs in order to free up money for transformation. Good descriptions of all of these vessels can be found in Polmar, *Ships and Aircraft of the US Fleet,* 17th edition.

[132] The carrier era's second-generation of surface combatants included four ships. In the order they were introduced, the *Spruance* DD (first ship commissioned in 1975); the *Perry* FFG (first ship commissioned in 1977); the *Ticonderoga* CG (first ship commissioned in 1983); and the *Burke* DDG (first ship commissioned in 1991).

A better sense of what the Navy was facing in 1989 therefore comes from comparing its circumstances with those that confronted the Navy immediately after the end of the Second World War. Then, as was the case in 1989, with a hard-fought war just won Navy leaders could anticipate an inevitable post-war demobilization and consolidation that would result in a relatively young and modern fleet. Then, as was the case in 1989, with no immediate naval challenger on the horizon, and with the ships in service quite capable of meeting any potential near- to mid-term threat, the urgency for designing an entirely new generation of combat ships was quite low. And then, as was the case in 1989, the uncertainties over the precise direction of future naval combat were quite high. All of these circumstances suggested that the most prudent hedging strategy would be to continue to build second-generation carrier era ships and to modify or adapt them for near-term combat requirements until the situation stabilized. After all, the first true post-World War II generation of ships did not appear until 15 years after the war's end, and numerous inter-era generation ships modified for missile age operations served effectively for three decades after the Japanese surrender.

In other words, the clock for shifting to a new generation of surface combatants started running in 1990, not 1975. In the immediate aftermath of the Cold War, naval planners could be relatively confident that an entirely new generation of warships, designed for the new "post-war" operational regime, need not be introduced for some 13-23 years after the end of the Cold War, the exact timing depending on the evolution of naval threats and the material condition of the fleet.

The subsequent path taken by the Navy was thus both historically and fiscally prudent. The final second-generation carrier era combatant—the *Arleigh Burke* DDG—was to begin entering the fleet in 1991. The Navy elected to continue building this "Cold War" design, and to modify its subsequent flights to account for the shift in operational focus toward the littorals. For example, the ***Burke's*** improved Flight IIA design, introduced into production in 1996/97 and first commissioned in 2000, incorporated a radar modified for near-shore operations, a hull-mounted mine-hunting sonar, a hanger capable of housing two medium helicopters, and a new 5-inch naval gun designed to fire shells up to 63 nautical miles in support of land forces.[133]

With regard to overall fleet size, the ultimate overall warfighting requirement for the Cold War surface combatant fleet was for 137 battle force capable ships (CGs, DDGs, and DDs) and 101 non-battle force capable ships (FFs and FFGs), for a total force of 238 ships.[134] By the time the Cold War ended in 1989, the Navy's Total Ship Battle Force included approximately 200 surface combatants, consisting of a heterogeneous mix of first- and second-generation carrier era ships carrying a multitude of varying propulsion systems, combat systems, and weapons systems and launchers.[135] From 1989 on, as the Navy demobilized along with the other Services, the surface

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[133] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, pp. 143-44.

[134] Polmar, *Ships and Aircraft of the US Fleet,* 13th edition, p. 110 and 160.

[135] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, Appendix A, "Navy Force Levels, 1945-2000."

combatant component of the 600-ship Cold War Navy was reduced along with all other TSBF components, ultimately toward a target of some 116 surface combatants.[136]

While many naval officers bemoaned the reduction in fleet numbers, a very salutary effect of this drawdown was that fleet planners were able to discard older, less capable ships. With the retirement of the last first-generation carrier era ships in 2000, the surface combatant fleet consisted of 27 *Ticonderoga* CGs (all but five equipped with VLS), 24 VLS-equipped *Spruance* destroyers, 28 Flight I and II *Burke* DDGs (all VLS-equipped), and 36 *Perry* FFGs.[137] The overall fleet condition was unprecedented. Not only was the fleet composed of a single generation of combatants—with all of the training and maintenance benefits attendant thereto—but the ***oldest*** combatant in the fleet had been in service for just 25 years. Indeed, by 2000 the average age of Navy surface combatants was approximately that of the average age of the Department of the Navy's tactical ***aircraft*** fleet.[138]

Given these happy circumstances, one could argue that naval planners should simply have continued production of *Burkes* until more of the uncertainties over future naval combat resolved themselves. After all, throughout the 1990s and into the new century, the Navy's leadership freely acknowledged the TSBF was without peer, and that it continued to overmatch likely near- and mid-term naval challenges.[139] However, the Navy could not wait to start the move toward the next generation of combatants indefinitely. Regardless of the relative young age of the fleet and how future threats might actually evolve, it was undeniable that second-generation carrier era ships were optimized for open-ocean, and not littoral, naval combat. For example, the navigational minimum draft for second-generation battle force capable ships was 31 feet.[140] One would expect a fleet designed to fight closer to shore to have shallower drafts.

Moreover, the Navy was anxious to introduce a new propulsion system into fleet service. Recall that the carrier era's second-generation combatants all had variations of the same basic gas turbine propulsion system, giving them a marked performance and cost advantage over the previous generation's mixed steam and nuclear propulsion plants. However, in September 1988, then-Chief of Naval Operations Carlisle Trost said "I am declaring that integrated electric drive,

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[136] William S. Cohen, Secretary Of Defense, *The Report of the 1997 Quadrennial Defense Review* (Washington, DC: Office of the secretary of Defense, May 1997), found at http://www.defenselink.mil/pubs/qdr/sec5.html.

[137] For a comparison of this fleet with that of the 1989 fleet, see Work, *The Challenge of Maritime Transformation: Is Bigger Better?*

[138] Congressional Budget Office, *The Long-Term Implications of Current Defense Plans* (Washington, DC: Congressional Budget Office, January 2003), pp. 60-64.

[139] See, for example, the comments of Vice Admiral Dennis McGinn, in testimony before the House Armed Services Committee in February 2001. From a transcript provided to the author by the Department of the Navy, Office of Legislative Affairs.

[140] The navigational drafts of the *Ticonderoga* CG, *Burke* DDG, and *Spruance* DD are 33, 31, and 32 feet respectively. The navigational draft of the non-battle force capable *Perry* FFG is 26 feet. From the Naval Vessel Registry, found at http://www.nvr.navy.mil/nvrships.

with its associated cluster of technologies, will be the method of propulsion for the next class of surface battle combatants…"[141]

The move toward electric drive promised to be "the most decisive new engineering venture for the ship-driving Navy in years."[142] Gas turbine or other engines drive a long propeller shaft to propel a ship through the water. As a result, the engines have to be connected to the shaft, and must be positioned near the bottom of the ship close to its stern. In contrast, the main power plant on an electric drive ship generates electricity, which can then be transferred through an integrated power system to distant motors that drive the ship's propellers. As a result, integrated electrical power plants can be located throughout the ship—distributed in such a way as to increase overall ship survivability—and electric motors and propellers can be housed either within the ship's hull or in external "pods."[143] In addition to offering fuel savings, integrated electrical power systems can also immediately shunt power to other ship systems, such as electrically powered sensors or even weapons systems, upon demand. This opened the door for more exotic and potentially more revolutionary shipboard weapons like electromagnetic guns or lasers.[144]

Despite the undeniable promise of electric drive, the technological maturity of its "associated cluster of technologies" in the late 1980s did not support Admiral Trost's then-enthusiastic embrace of the new system. However, one consequence of foregoing a quick move to a new generation of post-Cold War surface combatants was that the Navy gained additional time to address the technological risks associated with electric drive and integrated power systems. By the late 1990s, the Navy concluded that these technological risks had been reduced to the point that electric drive could, and should, be adopted in fleet service. The Navy thus determined that it would introduce integrated electric drive into its next generation of surface combatants, and it became increasingly anxious to make the move.[145]

Finally, the most glaring problem associated with the carrier era's second-generation of ships was the large size of their crews. The *Spruance* DDs, *Ticonderoga* CGs, and *Burke* DDGs—the first two designed during an age of conscription and all before major advances in ship automation—had crews of well over 300 officers and Sailors, making their operation and support (O&S) costs quite high. Although the Navy instituted programs to reduce the crew sizes on these

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[141] Ed Walsh, "DD(X) Pushed Electric Machinery," in Naval Systems, *Proceedings,* November 2002, p. 88.

[142] Walsh, "DD(X) Pushed Electric Machinery," p. 88.

[143] Sandra I. Erwin, "Novel Ship Hull Forms Still a 'Tough Sell'," *National Defense*, July 2001, found at http://www.nationaldefensemagazine.org/article.cfm?Id=538, pp. 2-3.

[144] James D, Hessman, "Nanotechnology, the All-Electric Ship and Future Warriors," *Sea Power,* December 2003, p. 14. See also Christopher J. Castelli, "Navy Envisions Surface Combatants With Powerful Laser Guns," *Inside the Navy,* December 9, 2002, p. 1, and Lieutenant Commander David Allan Adams, USN, "Naval Rail Guns Are Revolutionary," *Proceedings,* February 2003, pp. 34-37. Hunter Keeter, "Lasers, Rail Guns Could Be Ready for DD(X) by 2010," *Defense Daily,* April 16, 2003, p. 9.

[145] Walsh, "DD(X) Pushed Electric Machinery," p. 88.

"legacy" ships, the Navy concluded that new ship designs were needed to accrue the greatest possible personnel savings.[146] Only in this way could the Navy exploit the full advantages of smaller future average crew sizes: reduced fleet recruiting requirements; lower at-sea re-supply demands, and fewer personnel placed at risk in combat operations.[147] Delaying the move toward minimally crewed combatants would become increasingly burdensome on fleet operating expenses over time.[148]

As a result of these foregoing considerations, the Navy decided it would end the production of second-generation carrier era surface combatants sometime in the first decade of the 21st century, and introduce the first of a new generation of combatants into fleet service around 2010. Seen through the lens of history, the Navy's patience can be better appreciated: 2010 would be *35 years after second-generation carrier era combatants were introduced*, and *some 21 years after the end of the Cold War.* This would be the longest interval between surface combatant generational shifts in the Navy's history, rivaled only by that of the interval between inter-era generation combatants and first-generation carrier era ships. In that instance, the interval between radically new ships designs was 24 years, and the delay after the end of the Second World War was 15 years.

However, this patience had its consequences, chief among them the removal of much further margin for delaying the introduction of the next generation's new ships. As naval analyst Norman Polmar noted, the current generation of combatants "has reached the end of its survivability…it can't be expanded any more or improved any more."[149] With this in mind, the Navy needed to start pursuing the design or designs for its next generation combatants if it was to avoid a ship production gap as the *Burke* DDG class reached the end of its production run at the turn of the century.

The requirement to avoid a combatant production gap was by no means trivial. A large gap between the production runs of *Burkes* and the next generation of warships would cause serious perturbations in the shipbuilding industry, particularly in its design and construction teams. The art of building large, complex, multi-mission warships is a skill possessed by relatively few nations. Indeed, beyond those in the United States, most shipyards capable of building such ships are found in allied countries.[150] Maintaining this expertise both dissuades would-be naval

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[146] See for example David Brown, "Surface Warfare Director Focuses on Better Use of Sailors, Technology," *Navy Times,* June 20, 2003.

[147] "Reduce the Manpower—Don't Increase the Risks," *Jane's Navy International,* September 2000. See also Government Accounting Office, *Military Personnel: Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs* (Washington, DC: Government Accounting Office, June 2003).

[148] See Andrew Koch, "Personnel Cuts Head USN Strategy to Boost Fleet," *Jane's Defence Weekly,* January 21, 2004, and Gopal Ratnam, "US 2004 Budget Will Propose More for New Weapons: Rising Personnel Costs Could Squeeze Funds," *Defense News,* October 14-20, 2002, p. 3.

[149] Renae Merle, "Northrop Wins Navy Contract," *Washington Post,* April 30, 2002, p. 1.

[150] A.D. Baker, III, "Naval Technology at the Beginning of the 21st Century," *The Year in Defense 2001* (Tampa, FL: Government Service Group, 2001), p. 172.

competitors from building ships capable of challenging the US Navy on the open ocean and provides a strategic hedge against the emergence of a first class naval opponent. Maintaining the shipbuilding base is thus a vital strategic investment that is well worth making.

Therefore, even as the average age of its surface combatant fleet was dropping as a result of the post-Cold War demobilization—giving the impression that the fleet was relatively modern—practical strategic, operational, and design considerations compelled the Navy to start its move toward a new generation of surface combatants in the mid-1990s. Accordingly, the Twenty-first Century Surface Combatant (SC-21) Mission Need Statement—the Navy's formal notification to the Office of the Secretary of Defense that it intended to pursue a new generation of surface combatants—was approved by the Joint Requirements Oversight Council (JROC) in September 1994.[151] Soon thereafter, on January 18, 1995, the Defense Acquisition Board (DAB) gave approval to Milestone 0 for SC-21 Acquisition Phase 0 (Concept Exploration and Definition), and provided written guidance for the Cost and Operational Effectiveness Analysis (COEA) required for Milestone I review and approval.[152]

OSD directed that the COEA use the 9,000-ton Flight IIA *Burke* DDG as its cost and analysis baseline. It highlighted three "mod-repeat" designs of ships then in production, including variants of the Flight IIA DDG-51, variants of the 24,000-ton LPD-17 (a large amphibious ship then being designed), and variants of the 40,000-ton LHD (a large amphibious ship designed to carry helicopters and short take-off/vertical landing jet aircraft). New ship concepts were to include "the most advanced multi-mission ship capable of being designed and built by 2010;" a multi-mission ship more affordable that the *Burke*; "tailored capability" ships with high capability in one or two warfare areas; and a family of combatant ships ***with a single hull design with common machinery and engineering systems capable of carrying configurable combat systems***.[153] This final bit of guidance was based on the successful experience of sharing a single hull among different ship types in second-generation carrier era ships.

Note, however, that this OSD guidance, undoubtedly prepared with substantial input from the Navy, heavily favored combatants that were either the same size as second-generation carrier era battle force capable ships ***or larger***. All explicitly listed analytical excursions were greater than 9,000 tons. And if the SC-21 "family" was to have a ***single*** (not ***scalable***) hull form capable of carrying out all possible missions, smaller combatants were implicitly excluded, since a small hull would never be capable of performing all required missions, such as volume land attack,

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[151] See ***SC-21—21st Century Surface Combatant,*** at http://www.globalsecuirty.org/military/systems/ships/sc-21.htm. An unclassified version of the SC-21 Mission Need Statement can be found at http://www.fas.org/man/dod-101/sys/ship/docs/mns_sc21.htm.

[152] ***SC-21—21st Century Surface Combatant,*** and The ***Surface Combatant for the 21st Century: Milestone I COEA Guidance*** can be found at http://www.fas.org/man/dod-101/sys/ship/docs/adm1.htm.

[153] ***Surface Combatant for the 21st Century: Milestone I COEA Guidance.***

extended range air defense, or the emerging requirement for theater and national ballistic missile defense.[154]

The decision to pursue a larger surface combatant marked a sharp turn in the evolutionary pathway of carrier era warships. As has been discussed, prior to the SC-21, the surface combatant fleet had been evolving toward a homogenous blend of intermediate size multi-mission combatants. The SC-21 promised to re-introduce much larger combatants into the fleet's operational architecture. The requirement for these larger combatants was dictated, to a large degree, because of the expected "littoral warfare threat environment," which would demand a ship with a "nearly 'puncture proof' self-defense capability" and a "highly survivable total ship design" that allowed the ship to "fight hurt and survive."[155] In other words, ***staying power*** was to be a critical design requirement for the new ship, a characteristic often associated with larger, armored warships.

With OSD's approval of its request to move forward with the next generation of combatants, the Navy began to study the design alternatives. With its COEA expected to be complete in 1997, the Navy seemingly moved ever farther down the road toward its next generation of surface combatants. However, the road was to prove much more bumpy than expected.

CONVERGENCE: THE FUSE IS LIT

In 1998, the movement toward a distributed networked battle fleet; the Navy's shift of operational focus into littoral waters; and its plans for its next generation surface combatant all converged, setting the stage for a contentious debate that still reverberates within the US Navy today. At the center of the debate was whether or not small combatants should become part of the Navy's future TSBF. But when viewed within the context of these three powerful forces, the argument over small combatants is best seen as an important component argument within a more portentous debate over the correct future battle fleet model and its associated fleet operational architecture.

The proximate cause for the debate was the explosive combination of three catalysts. The first was the aforementioned COEA guidance that both explicitly and implicitly favored combatants that were the same size as the carrier era's second-generation of combatants, or larger.

The second catalyst was the 1997 QDR, mandated by the Congress and conducted by the second Clinton Administration. The 1997 QDR set the floor for the Navy's post-Cold War demobilization at approximately 300 ships, including 12 carriers (11 active, one reserve) and a surface combatant fleet of 116 ships.[156] For a Navy that had invested great effort during the 1990s trying to arrest the decline in fleet numbers in general, and in aircraft carriers in particular,

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[154] Friedman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," pp. 379-80.

[155] *Unclassified Mission Need Statement for a 21st Century Surface Combatant.*

[156] Cohen, *Report of the 1997 Quadrennial Defense Review.*

the establishment of firm fleet ship targets was most welcome. Significantly, however, the review stood mute on the *makeup* of the 116 surface combatants. The surface fleet was defined first and foremost by a simple number. In other words, in the eyes of the review (and by inference, the Office of the Secretary of Defense), all surface combatants—regardless of size, shape, displacement, armament, or crew size—were equal.

The combination of the COEA's large-ship preference and a platform-based rather than capabilities-based fleet target defined a clear incentive structure for fleet planners, and initiated the first stage reaction. Not unreasonably, the Navy's leadership concluded that it should endeavor to retain and maintain the largest, most capable 116 surface ships possible within expected budget ceilings. And not surprisingly, then, the results of the Navy's COEA showed that the most cost-effective option for the next generation of surface combatants was to pursue a *family* of battle force capable ships with a "a *single hull design* and common [hull machinery and systems] which is configured for adaptability to alternative mission or combat system capabilities" (emphasis added).[157]

In January 1998, the DD-21—the first planned member of the SC-21 family of ships, achieved Milestone I when Dr. Jacque Gansler, Undersecretary of Defense for Acquisition and Technology, signed the Acquisition Decision Memorandum from the program.[158] Unlike previous carrier era destroyers and guided missile destroyers that were designed primarily to protect aircraft carriers from attack, the DD-21 would be a multi-mission ship designed primarily to support joint forces ashore, and be optimized for land attack. Because the DD-21 would, by necessity, need to venture close to contested shores, its design characteristics was to include "submarine-like survivability" with a "significantly reduced radar signature" and the "most advanced undersea combat system ever installed on a surface combatant"[159]—all in a ship with a projected average construction cost of only $750 *million*.[160] The DD-21 would be followed by a "full capability" CG-21 around 2020, as the *Ticonderoga*-class CGs reached the end of their projected 35-year service lives.[161]

As a result of Dr. Gansler's decision, the Navy released the formal solicitation for the DD-21 "land attack destroyer for the 21st century" on March 24, 1998. At the same time, the Maritime

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[157] Scott C. Truver, "Team Effort," *Jane's Defence Weekly*, April 9, 2003, p. 27, and .*Surface Combatant for the 21st Century: Milestone I COEA Guidance.*

[158] *DD-21 Zumwalt—Program,* found at http://www.globalsecurity.org/military/systems/ship/dd-21-prog.htm.

[159] Admiral Jay Johnson, "DD-21: A New Way of Doing Business," *All Hands,* January 1998, found at http://www.mediacen.navy.mil/pubs/allhands/jan98.

[160] *DD-21 Zumwalt* at http://www.fas.org/man/dod-101/sys/ship/dd-21.htm.

[161] *SC-21—21st Century Surface Combatant.*

Fire Support Demonstrator project, the last vestige of Admiral Boorda's Arsenal Ship concept, was incorporated into the DD-21 program.[162]

Simultaneously, the Navy announced its shipbuilding plans designed to maintain the surface combatant force structure at 116 ships. The Navy planned to halt production of the ***Burke*** DDGs after 57 ships, and to shift over production to the DD-21 in FY 2004, with the first ship to be delivered in FY 2008. With the 27 Ticonderoga class cruisers in fleet service, this meant the planned 21st century "New Navy" would include 84 AEGIS combatants optimized for defense of the carriers, and 32 DD-21s optimized for operations in the littorals.[163] Thought about the size of the DD-21 class was that basic. It rested more on overall fleet target of 116 ships and simple deductive mathematical reasoning and less on deep analysis.

In short, the result of the OSD-approved TSBF incentive structure was a future surface combatant fleet that would be made up of 116 intermediate and large multi-mission combatants. In response to the shift in operational focus from open ocean sea control toward littoral combat, the carrier era's protection of shipping component of the surface combatant fleet would be replaced by a "protection of joint land forces" component, embodied in the large land attack DD-21.

Importantly, however, while the first class of the new generation of surface combatants would have improved networking capabilities, be designed for littoral operations, and be capable of "independent forward presence,"[164] it would still operate within the conceptual framework of the carrier era. All Navy planning documents continued to depict the carrier as the fleet's capital ship, and continued to show twelve or more carrier battle groups as the key task groupings in the fleet's future operational architecture.

Then, in 1998, just as the Navy began to solidify its plans for its future TSBF and its associated fleet operational architecture, the last and most combustible catalyst was added to the mix. In July of that year, Vice Admiral Arthur Cebrowski assumed command at the Naval War College. In addition to being responsible for the Navy's premier learning institution, he simultaneously assumed oversight over the new Navy Warfare Development Command. The NWDC, created partially in response to charges that the Navy was being slow to respond to emerging 21st century naval challenges, was to be responsible for the development of future operational concepts, fleet characteristics, and alternative operational architectures.[165]

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[162] *DD-21 Zumwalt—Program.*

[163] *DD-21 Zumwalt—Program.* See also *DD-21 Zumwalt* at www.fas.org.

[164] *Unclassified Mission Need Statement for a 21st Century Surface Combatant.*

[165] Maryann Lawlor, "Navy Plots Innovative Course," *SIGNAL Magazine*, December 2000, found at http://www.us.net/signal/Archive/Dec00/navy-dec.html. The NWDC grew out of the Naval Doctrine Command, established in March 1993. See Rear Admiral Frederick L. Lewis, USN, "Naval Doctrine Command," *Joint Forces Quarterly,* Autumn 1993, pp. 113-116.

Admiral Cebrowski had an advanced appreciation and view of the ramifications of Information Age technologies and processes on military operations in general, and on battle fleet operations in particular. He was an ardent proponent of network centric warfare, and he believed its ramifications were so profound that it defined an "entirely new theory of war." As a result, he felt an obligation to use the "bully pulpit" of the NWC and the newly created NWDC to espouse these views, and loudly. He was determined to prod a naval officer corps that he considered to be mired in an Industrial Age mindset toward a new battle fleet designed specifically for network centric warfare.[166]

By assigning a deft, determined, and headstrong three-star admiral to a billet ostensibly tasked with defining the operational concepts and characteristics of the future fleet—and one unshackled by the constraints of operating on the Chief of Naval Operations Washington-based staff (OPNAV) or under the guiding influence of a senior operational commander—the Navy unwittingly had added the final ingredient for a vigorous internal debate about its next generation of combatants—carried out in the public's eye—that turned out to be both unwanted and unwelcome, but entirely necessary.

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[166] Scott C. Truver, "The BIG Question," ***Jane's Defence Weekly***, April 24, 2002, p. 24.

III. The "Big Bang" Theory: Go Small or Go Home

A New Battle Fleet Era?

During his first six months as head of the Naval War College and Navy Warfare Development Command, Vice Admiral Cebrowski began to pursue and further develop his agenda for a network centric "Navy After Next." Toward this end, his agenda was based on five key points.

First and foremost, Admiral Cebrowski believed that dense networks of sensors—which gathered, collated, and interpreted information faster than any Industrial Age enemy could ever hope to—would give future US forces a key advantage in the information domain. If properly exploited, this advantage could be translated into a high "speed of command," which would allow US forces to act on information faster than the enemy and to concentrate ***effects*** rather than just ***fires***. The concentration of well-conceived effects would help to "lock out" enemy strategies before they could fully develop, and thereby give US forces a decisive edge in combat.[167] In this new sensor dominated regime, the future was thus "no longer about weapons reach…It [was] about total systems reach, which is dependent upon sensor reach."[168] Therefore, he believed that the battle fleet needed to be "re-balanced" for the Information Age.[169]

Second, in line with his thinking that building robust networks should be the central organizing principle of future fleet design, he believed that the fleet's sensing and offensive and defensive power fighting power should be distributed across many platforms—manned and unmanned platforms and systems of varying degrees of size and power, as well as numerous remote off-board sensors and weapons.[170] By directly and indirectly linking these different platforms and systems together, future naval forces would see improvements in the basic functions of sensing; data transport; netting; information fusion and pattern recognition; interpretation, cognition and decision; and influence. These improvements would, in turn, enable the future fleet to fight as a broadly distributed, integrated, and cohesive battle network.[171] Thinking of the fleet in terms of

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[167] Ronald O'Rourke, *Navy Network-Centric Warfare Concept: Key Programs and Issues for Congress,* (Washington, DC: Congressional Research Service (CRS) Report RS20557, updated April 29, 2002), p. CRS-1.

[168] Admiral Cebrowski's comments are found in Dawn S. Onley, "Net-Centric Goal: A Different Military," *Government Computer News,* November 10, 2003.

[169] Comments made by Vice Admiral Arthur K. Cebrowski, USN, at the Current Strategy Forum, Naval War College, June 16, 1999. For a more complete depiction of Admiral Cebrowski's thinking about "network centric warfare," see Vice Admiral Arthur K. Cebrowski, USN, and John J. Garstka, "Network Centric Warfare: Its Origins and Future," *Proceedings,* January 1998, pp. 28-35.

[170] Vice Admiral Cebrowski, Current Strategy Forum, Naval War College, June 16, 1999.

[171] "…the primary source of advantage in distribute, networked forces arises from networked effects that are distributed in many dimensions throughout a force and can be summoned for use in a manner of advantage chosen by clever commanders based on evolving conditions." Cares, Christian, and Manke, *Fundamentals of Distributed, Networked Military Forces and the Engineering of Distributed Systems,* p. 1.

one concentrated battle line or 12 carrier battle groups was no longer appropriate. Alone, these first two ideas strongly argued that the carrier era was over and that the fleet was about to pass into an entirely new era, characterized by a dramatically different battle fleet architecture.

Third, Admiral Cebrowski appreciated more than most officers the profound implications of the passing of the sea control century. The Navy's new operational focus was in littoral waters, and its key operational requirement was clear: to ensure the ***guaranteed safe delivery of goods and services ashore during joint campaigns***.[172] However, he astutely recognized that this mission did not sound as attractive or as meaningful as sea control to most naval officers, and he couched the mission in different terms. He therefore argued that the future fleet had to be designed, first and foremost, to create and maintain joint access in shallower littoral waters anytime, anywhere. The Navy was to be the Nation's 21st century "assured access" force. It had to dominate the littoral operational domain as thoroughly as it had the open ocean domain in the Cold War or future power projection operations would fail.[173] This was an argument that all Navy officers could—and did—embrace.[174]

Fourth, because Admiral Cebrowski believed that the power of future fleet battle networks would increase as the fleet's sensing and defensive and offensive firepower was more widely distributed, he explicitly rejected the idea of constraining the Navy's future distributed network to a relatively small, fixed number of platforms. "Numbers count, they count a lot, and they always counted" he was fond of saying.[175] Admiral Cebrowski thus argued that the Navy's future distributed fleet battle network should be intelligently designed to spread the fleet's combat power over the largest number of inter-connected platforms and systems possible within an overall budget ceiling. In other words, the number of ships in the TSBF could (and should) go up if some ships could be made smaller and cheaper and if the force achieved advantage by doing so. This was a critical point for Admiral Cebrowski, and one that bears constant repeating: in a fleet battle network designed for Information Age warfare, the ***distribution of networked combat power across platforms*** mattered more than the ***unit power of any given individual platform***.[176]

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[172] Derived from Hughes, *Fleet Tactics and Coastal Combat,* pp. 9-11.

[173] Vice Admiral Cebrowski, Current Strategy Forum, Naval War College, June 1999.

[174] By the 2001 QDR, "assured access" had become the key component of the US Navy story. The Navy QDR Team created a briefing and published a handout which listed four returns on the Nation's investment in the Navy: command of the seas, US sovereign power overseas, *assured access,* and enabling transformation of the joint force. ***A 21st Century Navy***, PowerPoint briefing and handout, Department of the Navy, 2001, provided to Dr. Andrew Krepinevich, Director, CSBA.

[175] Hunter Keeter, "Cebrowski: Today's Thinking Won't Do For Tomorrow's Navy," *Defense Daily,* November 3, 1999, p. 1.

[176] Note that to Cebrowski the *combination* of networks and distributed forces was much more powerful than either a networked or a distributed force. Note also that although Cebrowski at first described the "power" of a network as the square of its nodes (which emphasized the force's direct connections), he later described it in terms of the number of indirect connections.

And finally, in line with his thinking about "speed of command," Admiral Cebrowski believed that the key design principle for all battle network platforms, especially those designed to guarantee delivery of goods and services in dangerous littoral waters, should be high speed. High speed—physical platform speed, speed of operations, and "speed of effect"—would allow fleet commanders to rapidly reconfigure littoral battle networks in order to lock out enemy anti-access and area-denial strategies. While the Admiral also talked appreciatively about maneuverability and stealth, it seems clear that speed was, to him, the first among network and platform attributes. It also seems clear that this emphasis was heavily influenced by a life of operational experiences in naval tactical aviation, where the widely accepted mantra is "speed is life."[177]

In other words, just as the Navy had achieved a stable surface combatant force structure target and future fleet operational architecture, and was shepherding the carrier era's third generation DD-21 land attack destroyer toward production, the senior admiral in the Navy tasked with thinking about the "Navy after next" was loudly proclaiming the end of the sea control century and the carrier era. Moreover, he was beginning to explicitly outline the defining, desirable characteristics of a new battle fleet architecture based on distributed battle networks—characteristics that in large measure suggested a fleet quite unlike that being pursued by the Navy's corporate leadership.

Admiral Cebrowski's vision was a powerful one that cogently explained the broad implications of two of the three movements covered earlier. Unquestionably, this vision was worthy of serious reflection and discussion within the Navy.[178] But it was Cebrowski's ideas about how the capabilities of the fleet should spread across a range of platforms that got the most attention, and they triggered a debate that moved quickly from the strategic and operational issues of battle fleet models and operational architectures to tactical questions about ship design.[179]

Perhaps this was Admiral Cebrowski's intent. After all, nothing would get surface warfare officers more involved in a debate than a discussion about the ships they were to command in battle. In any event, it was not until the admiral's views started to be reflected in conceptual ship designs that the sparks really began to fly, causing an "explosion" of heated debate that was to last for two years.

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[177] For example, see Admiral Cebrowski's comments on high speed forces , in "Champion of a 'New American Way of War'," ***Sea Power,*** June 2003, and in "Cebrowski Sketches the face of Transformation," on the American Forces Information Service, found at http://www.defenselink.mil/news/Dec2003/n12292003_200312291.html.

[178] Interestingly, there seems to have been very little internal Navy debate over Admiral Cebrowski's broader assertions about the benefits of network centric warfare. For critics of the concept, see David Hughes, "'New Orthodoxy' Under Fire," ***Aviation Week and Space Technology,*** September 29, 2003. For a more thorough rebuttal of network centric warfare and achieving "information dominance," see Lieutenant Colonel H.R. McMaster, "Cracks in the Foundation: Defense Transformation and the Underlying Assumption of Dominant Knowledge in Future War," an undated monograph.

[179] This was highly unfortunate. As Sam J. Tangredi points out, these strategic-level questions are far more important than the tactical-level questions about LCS design, seakeeping, range, and firepower. See Captain Sam J. Tangredi, "Rebalancing the Fleet: Round 2," ***Proceedings,*** May 2003, p. 36.

1999: ENTER *STREETFIGHTER*

The debate over small combatants actually began with both sides in violent agreement. For a Navy always focused on the number of ships in the Total Ship Battle Force, and buffeted by nearly a decade of fleet downsizing, Admiral Cebrowski's call for a larger "fleet" was at first warmly embraced, even if the underlying logic behind the call was imperfectly understood. On February 24, 1999, Admiral Donald Pilling, Vice Chief of Naval Operations, endorsed Admiral Cebrowski's ideas by speaking approvingly of large numbers of small, fast, modular littoral combatants, which he referred to as "*Streetfighters*."[180] And later, on June 15, 1999, CNO Johnson embraced the tenets of network centric warfare, spoke of the need for "speed and access" in the littorals, and opined that the "asymmetric threat" in the littorals would drive the Navy toward a larger fleet.[181]

It is important to note here that even when pressed in public, Vice Admiral Cebrowski never endorsed the notion that the *Streetfighter* concept was exclusively bound to a small combatant. He believed the fleet's sensing and offensive and defensive capabilities should be distributed across a *range* of platforms: surface combatants both large and small; submarines; aircraft, and unmanned systems. He always spoke of *Streetfighter* in terms of "distributed combat capabilities," not solely in terms of a small combatant. However, as will be seen, the term *Streetfighter* was to rapidly become synonymous with small combatants, which was to help take the debate over future fleet architectures in an unfortunate direction.[182]

In the summer of 1999, Admiral Cebrowski directed that the broader *Streetfighter* concept be explored in the Science and Technology cell supporting the Navy's premier Global War Game held each summer at the Naval War College. The goals of this offshoot effort (separate from the main game) were "to identify the needs and capabilities to assure access, to look at the value of numbers in a littoral counter-A2/AD fight, and to determine areas for follow-on analysis."[183] During this effort, two small *combatant* options were examined: a small "stealthy" warship that carried a 160-ton modular *payload* that could be re-configured so that the ship could serve as either a littoral anti-submarine platform or a littoral mine warfare ship, but not both at the same time; and a logistics variant with a 400-ton *payload* that served as a remote missile magazine for theater air and missile defense and worked in support of the Marine Corps operational maneuver from the sea concept.[184] Both designs were congruent with the Navy's future mission of

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[180] Myth has it that Admiral Cebrowski coined the term "*Streetfighter*." At least in public discussions, that was not true. Admiral Pilling was the first to use the term. In *Streetfighter* and *Streetfighter: Background and Issues.* The former was a point paper and the latter a PowerPoint briefing prepared by the Navy Warfare Development Command in late 2001; both outlined the early development of the *Streetfighter* concept. They were provided to the author by Commander Al Elkins, USN, Action Officer at the NWDC throughout the *Streetfighter* debates.

[181] Navy Warfare Development Command, *Streetfighter: Background and Issues.*

[182] Email to the author from Professor Thomas Mahnken, Professor at the Naval War College throughout the *Streetfighter* debates.

[183] Navy Warfare Development Command, *Streetfighter: Background and Issues.*

[184] Navy Warfare Development Command, *Streetfighter: Background and Issues,* and Navy Warfare Development Command, *Streetfighter.*

guaranteed delivery of goods and services across the littorals, and with Admiral Cebrowski's belief that fleet fighting power should be distributed across a range of platforms.

The aforementioned emphasis put on payload is critical. A general rule of thumb is that a ship's mission payload consumes about 10-15 percent of its total displacement.[185] Ships with 160 and 400 ton payloads thus suggested ships that ranged between 1,600 to 2,700 tons—hardly tiny vessels. However, Admiral Cebrowski talked repeatedly in public about trying to exploit technology to get the "payload fraction" of future ships to 40 percent of their displacements. Possibly as a result, after both the 1999 and 2000 Global War Games it was reported that the first conceptual *Streetfighters* were small 400-ton *displacement* vessels with a 160-ton *payload*, a proposition for which Admiral Cebrowski and the NWDC were severely chided by naval engineers and surface warfare officers.[186]

A review of the public record makes clear that Admiral Cebrowski did believe that raising a ship's payload fraction to 40 percent was both desirable and achievable over time if new design approaches were pursued. However, it is also quite clear that the action officers actually developing the concept concerned themselves first with *what the small combatant could bring to the fight, not the size of the ship.* As the combatant designs associated with *Streetfighter* evolved and as naval architects worked with NWDC to refine these designs, the notional size of the "*Streetfighter* 160s" and the "*Streetfighter* 400s" gradually grew in overall size even as their payloads remained constant.[187]

After the game, and aided by the broadcasting of the concept by an intrigued press, the "buzz" about small *Streetfighter* combatants percolated throughout the surface warfare community. Understandably, some officers worried that the smaller ship might compete directly with larger DD-21 for scarce shipbuilding funds. In a general sense their concerns were justified. If the Navy's budget remained stable, and the Navy tried to distribute battle network combat capabilities across the widest number of network platforms, then small combatants would compete with larger combatants for a piece of the budget share. Of course, the same was true for *any* Navy platform that might function as a network "node"—be they submarines, patrol aircraft, unmanned systems, or other future platforms.

However, surface warfare officers instinctively honor any potential threat to their ship, and as has been discussed there were many practical reasons why movement toward the next generation of surface combatants should not be side-tracked or delayed. As a result, their reaction was both immediate and pointed. During an October 1999 Defense Writer's Group breakfast, Vice

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[185] Commander Stephen H. Kelley, USN, "Small Ships and Future Missions," *Proceedings,* September 2002, pp. 42-44.

[186] Kelley, "Small Ships and Future Missions," pp. 42-44.

[187] For example, by Global 2001, the "*Streetfighter* 400" had grown in size to 3,500-4,000 tons, the approximate size of a *Perry* class guided missile frigate. The author is indebted to Commander Al Elkins, USN, Action Officer at the Navy Warfare Development Command, for emphasizing this point.

Admiral Daniel Murphy, then-Commander of the 6th Fleet and a former Director of Surface Warfare on the OPNAV staff, said—on the record—that *Streetfighter*:

> …(was) a wild idea…There is nothing behind it. There is no analysis. You know, [Vice Admiral Cebrowski] dreamed up a bumper sticker, but in fact what he is talking about, to go into the littorals to get in a tough situation, to fight your way through and deliver power is exactly what we are doing [with DD-21].[188]

Moreover, while he generally endorsed the idea of distributed fleet firepower, Vice Admiral Murphy went on to explicitly reject the idea that the carrier era was ending. He believed that carrier battle groups were the only way to meet the power projection objectives of the Navy and of the regional combatant commanders for "at least" the next ten years. He went on to argue that the Navy's 12-ship carrier force needed to increase by three ships, since only a force of 15 carrier battle groups could hope to maintain continuous carrier presence in the Mediterranean, the Persian Gulf, and the Western Pacific. To support an expanded carrier-centric navy, a fleet size of some 450 ships would be needed. In other words, while he agreed with Admiral Cebrowski that the fleet was too small, he believed the expansion should be in carriers and large, multi-mission ships like the DD-21, and not in small combatants.[189]

This type of blunt and public criticism of a fellow three-star was unusual, to say the least. It indicates, in no small way, the degree to which the surface combatant community had trouble understanding, much less agreeing, with Admiral Cebrowski's envisioned future. It also indicates the degree to which the surface warfare community perceived the threat that *Streetfighter* might pose to the DD-21. However, while Admiral Cebrowski laconically noted that the debate had gotten personal rather fast, it is clear he was unfazed.[190] He had sought a broader debate over the Navy's future direction, and he had gotten one. His response was to further engage the officer corps—and the external public—to explain how *both* DD-21 and *Streetfighter* would complement each other in a distributed fleet battle network.

COMBATING FLEET RISK AVERSION

In early November 1999, during a speech at the Expeditionary Warfare Conference, Admiral Cebrowski argued that the Navy, like all of the armed services, was becoming "risk adverse" in general, and "risk deterred" in particular. As a result, the US military was becoming "increasingly limited" in terms of battlefield access. As examples, Cebrowski described the B-2 bomber as "an absolutely marvelous machine that has no access in daytime," and declared the tactical aviation fleet "had no access below 15,000 feet." He then went on to say, "There are

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[188] "Murphy Slams 'Streetfighter,' Navy Distances Itself from Comments," *Inside the Navy,* October 18, 1999, p. 3.

[189] Hunter Keeter, "Murphy: 'Streetfighter' Concept Unsound," *Defense Daily,* October 15, 1999, p. 5.

[190] Cebrowski, quoted in Greg Jaffe, in "Debate Surrounding Small Ship Poses Fundamental Questions for US Navy," *Wall Street Journal,* July 11, 2001. A copy of the article can be found at http://interactive.wsj.com/articles/SB994801299373912580.htm.

whole places we don't go because we are tactically unstable. We have to take measures that are necessary to rebalance this."[191]

With regard to the Navy, Admiral Cebrowski went out of his way to say that he liked the idea of the large DD-21's robustness and survivability, saying he found the design concepts to be "very powerful."[192] However, he went on to say that he worried that the Navy's preference for putting multi-mission capabilities on a dwindling number of ships—which he called an "Economy A" force, bought according to "traditional Navy thinking"—would likely limit the Navy's access and operational effectiveness in littoral waters should the Navy ever be confronted by a capable anti-access or area-denial network. He therefore argued for an "Economy B" fleet of smaller ships specifically designed to penetrate and fight in the littorals. He went on to say that the Economy B fleet should cost approximately 10 percent as much as Economy A fleet, but contribute 25 percent of the surface fleet's total numbers.[193]

At its core, this was a powerful, if nuanced, argument. Consistent with his thinking, Admiral Cebrowski seemed not to be questioning the need for DD-21s—although he ***was*** implying that the class production run might be less than the 32 ships called for in Navy plans since the price for a Navy Economy B fleet would likely have to be taken out of its hide. Instead, he was simply reiterating his belief that by holding the surface combatant fleet size to 116 ships, the Navy risked crippling the fleet's effectiveness in future littoral combat. By choosing a relatively small number of ***ships*** as the key measure of fleet operational capability, the Navy would inevitably drive toward a homogeneous force of large, multi-mission combatants that would limit the distribution of Navy combat power, and therefore the maximum potential combat power of the Navy's future networked battle fleet. Admiral Cebrowski worried that the resulting TSBF would be ill-suited to meet all of the myriad future challenges associated with littoral warfare. To make this important point explicit, he openly challenged the results of the 1997 QDR, calling for a surface combatant fleet of "about 225 vessels."[194]

However, by couching his argument primarily in terms of risk aversion and battlefield access, Admiral Cebrowski helped to mute this powerful point. When fighting an opposing enemy force, what is often most relevant is not a *platform's physical access to a particular portion of a contested battlespace, but its weapons access to enemy targets*. War is not intended to be fair;

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[191] Keeter, "Cebrowski: Today's Thinking Won't Do For Tomorrow's Navy."

[192] Keeter, "Cebrowski: Today's Thinking Won't Do For Tomorrow's Navy."

[193] Keeter, "Cebrowski: Today's Thinking Won't Do For Tomorrow's Navy."

[194] Keeter, "Cebrowski: Today's Thinking Won't Do For Tomorrow's Navy." Although Cebrowski himself used a number to describe fleet size at this forum, subsequent comments provide compelling evidence that he was using the number only as a foil against the findings of the 1997 QDR and a fleet of 116 multi-mission combatants. For example, in the December 9, 2002 edition of ***Transformation Trends,*** a periodic newsletter published by the Office of Force Transformation, Arlington, VA, the admiral stated: "You have to look at the number of nodes and how you create nodes at different levels, with numbers of players on the net. This could be a ship, and it could be the unmanned vehicles or unmanned weapons a ship launches. So, this notion of a fleet of X-size becomes tougher to justify."

every good commander in history has sought to strike enemies from sanctuary or from beyond the reach of their weapons. The B-2, operating from the "sanctuary" provided by stealth technology and darkness, could strike Serb strategic targets with impunity; other weapons, such as long-range cruise missiles, could strike these strategic targets during daylight hours. Tactical aircraft, operating above 15,000 feet, could strike tactical throughout Kosovo without fear of shoulder-launched missiles. These aircraft may have been able to strike targets more effectively from below 15,000 feet, and their pilots certainly could and would have tried if ordered to do so. However, would this have made any substantial different in the air campaign or to the outcome of the war? Was the claimed condition of risk aversion in this instance due to the "tactical instability" of the allied air forces, or due to other political and military judgments made at the time?

Indeed, risk aversion would seem to be a ***circumstantial*** condition afflicting both political and senior military leaders that is determined more by the likely political fallout of losses or failure and the perceived the stakes of an operation, and less by the numbers or cost of friendly platforms put at risk. The exception to this rule would be if the ***total number*** of platforms to be placed at risk is relatively small, and their loss would have ***disproportionate effects*** on the outcome of a war or operation. For example, during World War I, both the British and German navies had constructed battle lines consisting of a relatively few number of large, expensive, and heavily protected capital ships (less than 25 apiece). Given the disproportionate results that would have occurred if one navy or the other was to suffer a decisive defeat on the open sea, both sides were reluctant to risk them in battle. As a result, the inconclusive Battle of Jutland was the only time the British and German battle lines engaged one another. However, a force of 116 powerful multi-mission surface combatants would likely alter risk calculations in a fundamental way. Was it prudent to argue that *every* Administration, Combatant Commander, or task force commander would reject an important national security objective because one, or two, or even ten of these ships might be put out of action?

Also troubling was that the charge of risk aversion seemed to imply that there were no longer any naval officers willing to utter words like, "Damn the torpedoes, full speed ahead." This hardly seems to be an argument one should make if trying to get the same group of officers to embrace an alien and perhaps threatening new battle fleet model and operational architecture.

In any event, Admiral Cebrowski's key point about distributing fleet fighting power across a large number of ships and platforms was largely lost amid his comments about fleet risk aversion. Moreover, his questioning of the wisdom about building a smaller number of large multi-mission ships—whether originally intended or not—appeared on the surface to be an indirect attack against the multi-mission DD-21. This was the story the press and many in the naval officer corps picked up on, which helped to rapidly "lock in" the tenor of the debate into an "either-or" argument between the Economy B force *Streetfighter* and the Economy A force DD-21.[195]

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[195] The lead sentence for Hunter Keeter's previously referenced article was "The current emphasis of putting a multi-mission capability on a dwindling number of surface combatants may not be the right recipe for structuring future forces, according to a top admiral." This theme was consistently put forward by those at the Naval War

THEY ARE EXPENDABLE

The whole idea of risk averseness quickly turned in an even more unfortunate direction. In the November 1999 issue of *Proceedings*, an influential naval professional journal, Admiral Cebrowski co-authored an article with retired Navy Captain Wayne P. Hughes Jr. entitled "Rebalancing the Fleet." In it, both officers carefully laid out the rationale behind the need to shift to a new battle fleet model based on distributed battle networks and composed of an Economy A force of large multi-mission combatants as well as an Economy B force made up of small, stealthy *Streetfighter* combatants.[196]

However, in contrast to Admiral Cebrowski's more indirect arguments put forth at the Expeditionary Warfare Conference, the article explicitly linked the condition of risk averseness to the Navy's preference for large—and expensive—multi-mission combatants. Small *Streetfighter* combatants would allow future fleet commanders to operate more aggressively in future naval battles since the smaller—and cheaper—combatants would "be expected to suffer most of the combat losses in littoral warfare." After all, "In that risky work, we must expect [the small combatants] to suffer wounds, some of them fatal."[197] The not so subtle implication was that *Streetfighters* would be expendable, and that the cost-effective exchange of these expendable ships would help overcome the fleet's aversion to losing its larger, more capable combatants, and thereby help to guarantee access to the littorals.[198]

The basis for this new argument rested on work championed by retired Captain Hughes, who was the Chair of the Operations Research Department at the Naval Postgraduate School. The work involved the development of a simple fleet-on-fleet missile salvo model that was first unveiled in Hughes' superb book *Fleet Tactics*, published in 1986. The subsequent analysis that followed the model's development led Hughes to make four important conclusions about fleet and combatant design:[199]

College. For example, Professor Thomas G. Mahnken, said "We've put all our eggs into a few, expensive baskets." See "New Sort of War, New Sort of Navy?" at MarineLog.com, found at http://www.marinelog.com/DOCS/PRINT/mmiocfnav1.html.

196 Vice Admiral A.K. Cebrowski, US Navy, and Captain Wayne P. Hughes, Jr., USN (Ret), "Rebalancing the Fleet," *Proceedings,* November 1999. This article can be found at http://www.usni.org/Proceedings/Articles99.

197 Cebrowski and Hughes, "Rebalancing the Fleet."

198 On civilian expert was quoted as saying "No one wants to say it outright, but *Streetfighter* is a synonym for expendable. That sounds harsh, but war is harsh." Michael Moran, "In the Navy, Size Does Matter," found at http://www.msnbc.com.news/ 546846.asp?0sp=n5b3, p. 4.

199 The four conclusions are drawn from Wayne P. Hughes, Jr., "A Salvo Model of Warships in Missile Combat Used to Evaluate Their Staying Power," a monograph prepared at the naval Postgraduate School, Monterey, California, p. 1. They can also be found in Hughes, *Fleet Tactics and Coastal Combat.*

- "Unstable" tactical circumstances arise as the combat power of a force grows relative to its survivability (where stable means "persistence of victory by the side with the greater combat potential");[200]

- Weak "staying power"—the inability of a ship or force to absorb hits and continue fighting—is likely to be the root cause when tactical instability is observed;

- Staying power is the ship or force design element least affected by the particulars of a battle, including poor tactics; and

- Numerical superiority is the *force* attribute that is consistently most advantageous, since even if one force's *unit* striking power, staying power, and defensive power are all twice that of an opponent's force, the opponent could achieve a "parity of outcome" if it had twice as many units.

As is readily evident, Cebrowski and Hughes chose to pursue the implications of the model's second and fourth conclusions by focusing on the staying power of the *network* in an age of violent missile exchanges. Large numbers of cheap, expendable ships that distributed the fleet's fighting power would both expand the power of the battle network and give it high staying power, allowing it to absorb multiple missile salvos while still preserving its combat punch. As Hughes later wrote, "*Streetfighters* must be designed to lose. If no risk or loss is contemplated, they are a poor design concept because they forgo the economies of scale that are a prominent advantage of Economy A warships."[201]

While this may have been a powerful *analytical* argument within the construct of a distributed battle network, and may have had some merit in political or operational arguments about US casualty averseness, it nevertheless viscerally repelled many in the very naval officer corps that Cebrowski was trying to influence. It is thus now apparent that these arguments were more counter-productive to Cebrowski's powerful call for change than they were helpful.[202] And, in fact, they made no substantive contributions to Cebrowski's original and most evocative five points. If Cebrowski and Hughes had kept the officer corps focused on debating the proper battle network *mix* of large and small combatants rather than trying to convince officers that they

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[200] A concise discussion of "tactical instability" can also be found in Richard Arthur, "Streetfighter is a Viable Response," *Proceedings,* January 2002, pp. 76-77.

[201] Captain Wayne P. Hughes, Jr., USN (Ret.), "22 Questions for *Streetfighter,*" *Proceedings,* February 2000, pp. 46-50.

[202] See for example Vice Admiral Timothy LaFleur's comments in Otto Kreisher, "New Small Ships Debated," *San Diego Union-Tribune,* February 12, 2003, and Rear Admiral Rodney Rempt's comments in Koch, "Littoral Combat Ship Programme Accelerated." This wasn't the first time such a negative reaction against the notion of expendability occurred. In the 1970s, to save money, then-CNO Admiral Elmo Zumwalt introduced the idea of a fleet architecture that included a "high-low" mix of ships. The "low-end" ship turned out to be the *Perry* FFG. Critics charged Admiral Zumwalt with risking Sailors in "inferior" low end ships. See Friedman, *US Destroyers: An Illustrated Design History*.

should build small ships "designed to lose," it seems certain the resulting debate would have been more reasoned and less vitriolic.[203]

This conclusion appears all the more apparent because the Navy had several good counter points to the arguments raised by Cebrowski and Hughes. First, the Navy could argue that Hughes' findings derived from ship-on-ship salvo models might be useful for open ocean fleet-on-fleet engagements, but were less useful for joint littoral warfare where "the battle is not between a missile and a ship, or a submarine and a ship, or a mine and a ship," but between the US joint battle network and the enemy's A2/AD network.[204] Hughes himself acknowledged this point in the second edition of *Fleet Tactics* when he wrote:

> Land-sea missile attacks have added to the already prevalent strikes by aircraft to and from the sea to blur the tactical distinction between sea and land combat….Perhaps the navies of the world should no longer refer to "naval" tactics at all. It is more reasonable to think in terms of littoral tactics that include warships.[205]

In this operational competition, the Navy could rightly argue that salvo models tended to obscure the most important tactical competitions: the battle for information, and the interaction of opposing networks. And in this regard, the interactions between the joint power projection network and an A2/AD network were simply not reducible to a simple model. For example, the model, focusing as it does on exchanges between naval units, does not account for B-2 bombers attacking enemy ships at anchor or joint special operations forces disabling submarines in their berths. Furthermore, although Hughes himself points out the fundamental importance of scouting in the outcome of littoral warfare, the model largely discounts the formidable sensing power of the joint power projection network. As long as the United States maintained a joint scouting advantage and asymmetric joint capabilities advantage in network on network battles, the Navy could assert that it would likely continue to be able to "fire first effectively" and destroy enemy ships before they had an opportunity to attack US forces in turn.[206]

Moreover, the Navy could back up this assertion with real world data. The data Hughes used to support his work included real-world missile exchanges between Indian and Pakistani ships in their 1971 war; Israeli and Egyptian and Syrian missile-armed Fast Attack Craft (FAC) in their 1973 war; Argentinean cruise missile-armed aircraft and British ships in the 1982 Falklands War; missile attacks made by Iraqi and Iranian aircraft and FACs on commercial tankers during

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[203] Perhaps the most reasoned analysis of the expendability argument was made by Greg Jaffe, in "Debate Surrounding Small Ship Poses Fundamental Questions for US Navy." It was the exception to the rule in a heated debate.

[204] Friedman, "Globalization and Anti-Access Strategies," p. 488.

[205] Hughes, *Fleet Tactics and Coastal Combat,* p. 3.

[206] While Hughes recognizes and emphasizes the importance of scouting, he would likely caution that *counting* on a scouting advantage to remedy the fleet's tactical instability would be foolhardy. See Hughes, *Fleet Tactics and Coastal Combat,* p. 11, 99-100, 155, 175-76, and 193-96.

the 1988-89 “tanker war.” Together, the *aggregate* data of all modern anti-ship cruise missile engagements suggested to Hughes that flotillas of small, missile-armed FACs might be able to inflict disproportionate losses on a US fleet consisting of large multi-mission combatants.[207]

However, a different look at the data tells a completely different story. By focusing on the 1986 engagement between a US carrier battle force and Libyan FACs, the 1988 engagement between US surface forces and Iranian combatants in the Persian Gulf (Operation *Praying Mantis*), and the 1991 engagement between the coalition naval battle force and Iraqi FACs during the Battle of Bubiyan Channel, one gets a better sense of the overwhelming advantage enjoyed by joint and naval “combined arms” battle networks. In every one of these instances, the US or US-led forces enjoyed air supremacy, had a decisive littoral scouting advantage, and annihilated the attacking surface forces chiefly by attacking them with missiles fired from jets and armed helicopters. The final tally from these exchanges: US/Coalition forces: 40 FACs destroyed, 2 disabled; Enemy: 0 US or friendly forces hit, much less sunk.[208] This data suggests the weakness in focusing in on a simple fleet-on-fleet salvo model in modern naval combat, primarily because the preferred method of engaging enemy surface targets is now through asymmetric attacks (e.g., aircraft and submarine attacks against surface vessels).[209]

Indeed, the lop-sided results from these types of asymmetric anti-surface warfare attacks led naval analyst Anthony Preston to list Fast Attack Craft as among the world’s worst warship designs since 1860.[210] The Navy could argue, convincingly, that although small missile armed combatants would have to be accounted for, the real threat to a US littoral battle force would come from an enemy’s “battle line” that had been “exported” ashore (e.g., a battle line consisting of land-based over-the-horizon radar, shore-based anti-ship cruise missile batteries, and land based maritime strike aircraft).[211] If this were the case, only US vessels armed with powerful long-range land-attack missiles would make decisive contributions in the littoral naval fight.

Second, in any future confrontation between an advancing naval battle network and the enemy’s shore-based battle-line, the Navy could argue that the fleet had already addressed the subject of risk by greatly distributing its striking power. The post-VLS Navy had already distributed its firepower among 12 carriers, 81 VLS-equipped surface combatants, and some 55 attack submarines. These warships would soon be augmented by four VLS-equipped SSGNs—

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[207] Hughes, *Fleet Tactics and Coastal Combat*, pp. 152-168. For a short history on the development of Fast Attack Craft, see Les Brown, “The Development of Fast Attack Craft,” found at Defense Procurement Analysis Online at http://www.defencepa.com/features/landstroy.epml?features.REF=53&featureType.REF=2.

[208] Anthony Preston, *The World’s Worst Warships* (London, England: Conway Maritime Press, 2002), p. 182.

[209] Friedman, O’Brasky, and Tangredi, “Globalization and Naval Warfare,” p. 374.

[210] Preston, *The World’s Worst Warships*, pp. 177-83.

[211] Hughes, *Fleet Tactics and Coastal Combat*, p. 8.

converted Trident ballistic missile submarines each capable of carrying 154 VLS tubes.[212] Moreover, the Navy could also assert that improved networking initiatives like that of the Cooperative Engagement Capability would make fleet defenses more effective and dense.[213] More dense and effective active defenses would increase the fleet's overall staying power and help to preserve its distributed offensive power without requiring the fleet commanders to send expendable Economy B ships into the fight.[214]

In any case, a single truck carrying four anti-ship cruise missiles hiding in terrain close to the coastline would be, in effect, a "FAC equivalent." As a result, the equivalent enemy "fleet" associated with any capable A2/AD network would likely ***always*** "outnumber" any approaching US battle network by a factor of two or greater. Accordingly, increasing the number of combatants to ensure a "numerical superiority" in fleet size in order to account for the results of the salvo model would likely be a losing proposition. Developing good scouting platforms and techniques and sound joint and naval combined arms, asymmetrical counter-network tactics would likely be a far better approach.

Third, the "large ship faction" could use Hughes' own logic to argue that the large DD-21 was, in fact, the proper direction for next generation surface combatants. As previously discussed, the shift to the carrier era and the development of atomic warfare occurred at roughly the same time. Post-war naval planners concluded that heavy armor and large displacements would not protect surface combatants from the effects of a nuclear explosion, and were therefore superfluous. For this reason, the "staying power" of first- and second-generation carrier era combatants was successively less than that of the inter-era generation—whose designs were influenced most heavily, both literally and figuratively, by those of the by-gone battleship era.[215]

By the 1980s, however, fleet planners began to concern themselves more with ship survivability, which is a broader function than staying power.[216] Ship survivability is the combination of "hit avoidance" and "staying power." The former relies on signature management and control, "soft"

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[212] For discussions about the new SSGN, see Commander Robert Aronson, USN, "SSGN: A 'Second Career' for the Boomer Force," *Undersea Warfare,* Winter 1999, pp. 19-22; Owen R. Cote, Jr., *The Future of the Trident Force: Enabling Access in Access-Constrained Environments* (Boston, MA: MIT Security Studies Program, May 2002).

[213] See for example Robert Wall, "CEC Network to Grow in Capability and Usage," *Aviation Week and Space Technology*, October 7, 2002, p. 64. The Navy is also improving ship point defenses. See the section entitled "Defense in Depth: Protecting Naval Forces," *Surface Warfare*, March/April 1999, pp. 1-14.

[214] Admiral Cebrowski and Captain Hughes might counter that there remains some doubt as to whether the new netted defenses will perform as planned. For example, see Robert Wall, "Hawkeye 2000 Set to Expand Fleet's Eyes: Cooperative Engagement Capability Takes Flight, But Future in Doubt Unless Network Evolves," *Aviation Week and Space Technology,* October 7, 2002, p. 60. See also O'Rourke, *Navy Network-Centric Warfare Concept: Key Programs and Issues for Congress,* p. CRS-2 and 3

[215] Hughes, *Fleet Tactics and Coastal Combat,* pp. 147-48, and Hughes, "A Salvo Model of Warships in Missile Combat Used to Evaluate Their Staying Power," p. 268.

[216] Jim King, "Total Ship Survivability and Surface Stealth," *Wavelengths: An Employee's Digest of Events and Issues, NAVSEA Carderock,* October/November 2002.

defenses such as electronic countermeasures and decoys, and active defenses; the latter on toughness and damage control. The *Burke* DDG—the last of the carrier era's second-generation ships—was a ship in which survivability was an explicit design goal. For hit avoidance it relied on a very low radar cross section, an array of passive and active countermeasures, and dense active defenses. For staying power it was constructed almost entirely of steel; its combat information center was located deep within the ship's hull instead of the more vulnerable deckhouse; and it had the first ship overpressure system designed to keep nuclear, biological, or chemical contaminants out of the interior of the ship. Planned improvements, such as a special sonar to warn of minefields, improved the ship's survivability even more.[217]

Nevertheless, only so much staying power can be designed into a 9,000-10,000 ton hull.[218] Combat data suggests that the amount of ordnance required to sink a ship is correlated closely to the cube root of its displacement. In other words, the larger the ship, the more hits it can take before being sunk.[219] The second and third conclusions of Hughes' work support the argument that high *unit* staying power would help to contribute to high *force* staying power, just as it was thought to have done so in the battleship era. Therefore, a logical approach would be to develop a specialized "littoral battle line," composed of large DD-21s, whose unit staying power would be greatly increased over previous generations of carrier era generation combatants.

The DD-21's increased staying power would come from adopting a much larger hull form than the *Burke's* (nearly 100 percent larger at 15-18,000 tons); adopting much lower ship signatures than the *Burke*; improving the ship's situational awareness by equipping it with a command, control, communications, computer and intelligence, surveillance, and reconnaissance (C4ISR) system equivalent to those found on today's carriers; and by equipping the ship with new damage limitation features such as automated fire suppression and damage control systems. There is a great deal of historical and analytical work that supports this approach, a point that both Admiral Cebrowski and Captain Hughes have publicly acknowledged.[220]

In hindsight, then, at a critical juncture in the debate, both sides of the "big versus little" argument would have greatly benefited by combining their two approaches. In future littoral combat, in which many enemies will likely export their battle lines ashore, and the fleet is compelled to operate close to a contested shoreline, the battleship era's heterogeneous fleet mix of large, intermediate, and small combatants appears to be much more applicable than the carrier

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[217] Polmar, *Ships and Aircraft of the US Fleet,* p. 143-46.

[218] One naval structural engineer with 37 years experience at the Naval Surface Warfare Center believes a ship with the requisite protection necessary for naval combat in the littorals must have at least 12,000 tons displacement. See Ib S. Hansen, "They Must be Sturdy," *Proceedings,* October 2000, pp. 50-54.

[219] Data derived from Beall and reported in Hughes, *Fleet Tactics and Coastal Combat,* p. 161. As Hughes points out, however, there are different interpretations of the relevant data. See the broader discussion of damage considerations, in Hughes, pp. 156-65.

[220] *DD-21 Zumwalt—Program,* found at http://www.globalsecurity.org/military/systems/ship/dd-21-prog.htm; Johnson, "DD-21: A New Way of Doing Business"; and *DD-21 Zumwalt* at http://www.fas.org/man/dod-101/sys/ship/dd-21.htm.

era's homogenous combatant mix of intermediate warships. Accordingly, the debate should have never devolved to arguments over risk averseness or arguments for ***either*** large combatants ***or*** small combatants. Instead, it should have been an argument over which ***network mix*** of large (DD-21), intermediate (second-generation carrier era), and small (*Streetfighter*) combatants gave the battle network the best balance of offensive, defensive, and staying power in high-intensity littoral combat.[221]

THE NAVY OPTS OUT

For their part, Cebrowski and Hughes appeared to be more than willing to engage in an informed and expanded debate. For example, in the February 2000 issue of ***Proceedings***, Wayne Hughes published a follow-on article to "Rebalancing the Fleet" entitled "22 Questions for *Streetfighter*," which was an attempt to more fully explain the concept to a host of doubters.[222] However, partly because of his continued assertion that the reason a navy built small combatants was to be able to employ them more aggressively (and accept higher losses), and partly because of the LCS's potential threat to the DD-21 program, the official Navy response was to opt out, and then ignore, this critically important debate.

One early indication of the Navy's thinking came in November 1999, when it elected not to delay progress toward a DD-21 decision. That month, both the DD-21 "Blue Team" (led by Bath Iron Works with Lockheed-Martin as ship system integrator) and "Gold Team" (led by Ingalls Shipbuilding with Raytheon Systems and United Defense Limited Partnership as team members) were awarded follow-on developmental contracts for their competing designs.[223] One could argue that this decision made sense, because one might expect the outcome of the ongoing debate to affect only the final size of the DD-21 production run, and not whether it should be built at all.

However, it was the Report on Naval Vessel Force Structure Requirements, published just over a month after Wayne Hughes' spirited defense of *Streetfighter,* which made clear where the Navy stood on small combatants. This report was submitted to the Secretary of Defense in response to The National Defense Authorization Act Conference Report for Fiscal Year 2000, which tasked the Department of Defense to report, by February 1, 2000, "…a detailed long-range shipbuilding plan for the Department through fiscal year 2030." As such, the report outlined the Navy's 30-year plan to maintain the approved 1997 QDR Total Fleet Battle Force of some 300 ships, 12 carriers, and 116 surface combatants.[224]

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[221] Rear Admiral George R. Worthington cogently argues this point in "Littoral Warfare Needs a Specific Ship," in *Proceedings*, January 2003, pp. 90-91. This article also usefully outlines how small combatants can augment larger more capable vessels.

[222] Captain Wayne P. Hughes, Jr., USN (Ret.), "22 Questions for *Streetfighter,*" pp. 46-50.

[223] *DD-21 Zumwalt at* www.fas.org and *DD-21 Zumwalt—Program* at www.globalsecurity.org.

[224] Castelli, "Navy Sends 30-Year Shipbuilding Plan to Defense Secretary," p. 18.

The Conference Report directed that the Navy include a "detailed discussion of the risks associated with any deviation from the long-range ship-building plan." The Navy dutifully complied with this request, but also added a section that outlined the risks ***should the fleet be built according to Administration plans!*** In a section inserted by the CNO's staff entitled "Future Force—Reducing the Risk," the Navy explicitly stated that the only way to significantly reduce risk would be to build a much larger fleet than that approved by the QDR. A "reduced risk fleet" would number a total of 360 or more ships, and include 15 carrier battle groups, 14 Amphibious Ready Groups, and 134 surface combatants.[225] In other words, the Navy staff explicitly endorsed Vice Admiral Murphy's interpretation of both the Navy's proper evolutionary path and its associated fleet architecture. The section made clear that the Navy believed that the precepts of the carrier era remained valid over the report's 30-year time horizon, and that "risk averseness" would decline only with greater numbers of carriers and multi-mission combatants.

Had the Navy's report simply outlined the (Clinton) Administration's current shipbuilding plans, its failure to acknowledge the debate over small ships would be understandable. However, it opted to include a discretionary section that argued for a surface fleet made up solely of large and intermediate multi-mission combatants. By making no mention of the debate then raging over the potential contribution of small combatants—much less hedging its bets over the debate's final outcome—Navy leadership made it clear that it rejected the idea of small combatants, and that it wished the ***Streetfighter*** debate would just go away.

This failure of naval leadership to acknowledge the ongoing debate over small combatants was to prove to be as unfortunate a miscalculation as Cebrowski and Hughes' decision to introduce the idea of risk aversion and expendability into the debate over the most appropriate future battle force—and one the Navy is still paying for. The Report on Naval Vessel Force Structure Requirements gave the Congress the strong impression that the debate over large and small combatants had been settled in favor of the former. But as will be seen, this was far from the truth. Had the Navy hedged its bets in the report it would have been better positioned to explain the outcome of a debate that showed no sign of abating. By failing to do so, the Service created the conditions for the high degree of skepticism later evoked by Congressional staffers when the debate prudently resolved itself in favor of a mix of large, intermediate, ***and*** small combatants.[226]

STREETFIGHTER SAILS ON

Despite the Navy's refusal to seriously consider the contributions of small combatants, between the summer of 1999 and the summer of 2000, at least five different and intriguing small combatant operational concepts emerged as the ***Streetfighter*** concept was more fully explored and developed in a variety of different venues:

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[225] Castelli, "Navy Sends 30-Year Shipbuilding Plan to Defense Secretary," p. 20.

[226] The language in the House Armed Services Committee Report for Fiscal Year 2004 makes clear the damage made by this report, when it wrote that "The committee notes that prior to announcing the DD(X) family in November 2001, the Navy had no plans to acquire a smaller combatant like the LCS." In "Littoral Combat Ship," Title II (RDT&E), Other Matters of Interest, Navy, in the House Armed Services Committee Report, 108-106, for the Fiscal Year 2004 Defense Authorization, HR1588, pp. 181-182.

- *Distributed Offense*. This was the original Cebrowski and Hughes conception for small combatants, based on the results of Hughes' fleet-on-fleet missile salvo models. Large numbers of *Streetfighters* would ensure no lesser opponent with a large number of missile-armed fast attack craft could achieve "parity of outcomes" in a littoral missile duel. Two models of the ship were proposed by Hughes: a 300-ton vessel supported by a high-speed "mother ship;" and a self-deploying 1,200-ton model supported by a large destroyer tender. Both would have modular weapons systems that could be changed out according to the threat. Hughes suggested 12 squadrons of eight ships each: two tactical development squadrons; six forward-deployed mother ship-supported squadrons; two forward-deployed tender-based squadrons; and two expeditionary squadrons.[227]

- *Distributed Defense.* This model, first played by members of the CNO's Strategic Studies Group and the NWDC in the aforementioned Global 1999 war game, was an updated version of the century-old battle fleet torpedo boat screening mission. Two different types of *Streetfighter* combatants would screen the Navy's "littoral battle line" from attacks from an enemy's littoral "screening forces." One combatant was a modular ship with a reconfigurable 160-ton *payload* that could perform both littoral anti-submarine warfare and littoral mine countermeasure duties, but only one mission at a time. A second combatant with a 400-ton reconfigurable *payload* was used as a remote missile magazine to extend the fleet's defensive theater air and missile defense envelope. In other words, for this mission both *Streetfighter* combatants were conceived as multi-role, reconfigurable, single-mission warships.[228]

- *Fast Sea Base Support.* This model was also first examined by the CNO's SSG and NWDC in Global 1999. Based on commercial aluminum-hull fast ferries, this model envisioned a high speed (40-50 knot) vessel with a 400-ton *payload* that could support Marine Corps operational maneuver from the sea and the delivery of troops or supplies ashore from a sea base.[229]

- *Delivery of Off-board Weapons and Sensors.* This concept evolved from a project involving the Naval Warfare Development Command, the CNO SSG, and DARPA called *Capabilities for the Navy After Next* (CNAN).[230] The CNAN project explored the

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[227] Hughes, "22 Questions for *Streetfighter*," pp. 47-48.

[228] Navy Warfare Development Command, *Streetfighter*.

[229] Navy Warfare Development Command, *Streetfighter* The NWDC and Admiral Cebrowski had access to fleet after action reports about the fast fleet ferries converted by the Royal Australian Navy to support operations in Eastern Timor. These ferries were capable of transporting nearly 1,000 troops and their equipment at speeds up to 45 knots. These fleet after action reports were used to help develop the first conceptual *Streetfighter*s used during Global war games and subsequent NWDC projects. See Moran, "In the Navy, size does matter," p. 5, and "Streetfighter," at http://www.globalsecurity.org.

[230] *Capabilities for the Navy After Next*, a point paper prepared by the Navy Warfare Development Command outlining the CNAN project, and provided to the author by Commander Al Elkins, USN. See also Lawlor, "Navy Plots Innovative Course."

implications of a Fully Distributed Component System (FDCS) in counter-A2/AD operations. The FDCS would consist of numerous off-board unmanned sensors and weapon components in modular packages designed for seeding throughout a littoral battle space. The early emplacement of the FDCS was expected to provide US naval commanders with superior situational awareness in littoral waters.[231] The off-board systems were to be employed or delivered by fast, flexibly configurable vessels known collectively as Contested Littoral Delivery Systems (CLDSs). One vessel, called the Small Fast Surface Ship (SFSS), had a notional combat payload of 15 metric tons, while the larger Medium Fast Support Ship (MFSS) had a notional combat payload of 500 metric tons. These ships would allow the "risk tolerant deployment" of the FDCS. The influence of Admiral Cebrowski's ideas on sensor reach, seeking a decisive information advantage in future littoral combat, and risk averseness are readily evident in this work. Out of the CNAN project emerged a program now known as the Expeditionary Sensor Grid, or ESG.[232]

- *Distributed Littoral Aviation Support.* Originally dubbed *Corsair*, and unveiled at the Global 2000 War Game, this concept explored the possibility of distributing the equivalent of one carrier air wing over a squadron of seven small aviation support ships. Each ship had a 1,200 ton payload, giving them a notional ability to carry seven Joint Strike Fighters (JSFs) and two armed helicopters. The combined squadron of seven ships carried a total of 49 JSFs and 14 helicopters.[233]

At the Global 2000 War Game, all of these concepts were explored in the main game. Importantly, as is often the case during protracted concept development efforts, the first four operational concepts (*Corsair* being a concept newly introduced during the Global 2000 game itself) started to blend together as concept developers began to mix and match attractive features from different concepts to better flesh out newer and different alternatives. For example, the 15-ton payload SFSS was shelved, and all attention on combatants was focused on "*Streetfighter* 160s" and "*Streetfighter* 400s." Both ships were employed in common single-mission squadrons of 8 ships apiece, consistent with Hughes' conception of their proper employment. And the important influence of the CNAN's work was also evident, since all *Streetfighters* emphasized modular payload stations that carried a range of off-board systems, both manned (i.e., a helicopter) and unmanned (e.g., remote mine-hunting systems).[234]

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[231] The FDCS is now part of a concept known as Expeditionary Pervasive Sensing. See the NWDC homepage at http://www.nwdc.navy.mil/Concepts/EPS.asp.

[232] Navy Warfare Development Command, *Streetfighter.* The Navy and DARPA are collaborating again on a study to help the Navy determine its future littoral naval force architecture. See Malina Brown, "Navy, DARPA Collaborating On Study of Future Littoral Naval Force," *Inside the Navy*, July 14, 2003, p. 1.

[233] Navy Warfare Development Command, *Streetfighter: Background and Issues.* Also see Moran, "In the Navy, size does matter," p. 3.

[234] Navy Warfare Development Command, *Streetfighter: Background and Issues.*

Also explored during the game was a more robust fast transport ship called the Theater Support Vessel, or TSV. The TSV was based on the 500-ton payload MFSS explored during the CNAN project; it supported both Marine maneuvers from a sea base and was used for the intra-theater transport of Army units. Later, after the game, the term TSV was replaced by the more generic term High Speed Vessel (HSV).[235]

By 2000, then, *Streetfighter* concept development efforts had developed into three distinct paths: a small modular combatant; a somewhat larger modular fast transport; and a small distributed aviation ship.[236] It was safe to say that those within the Navy charged with thinking about the future generally agreed with Admiral Cebrowski's vision of a network centric battle fleet and were captured by its broader implications. Unless ordered to stop, they would continue to explore and examine each of the aforementioned paths. The Navy's wish that the *Streetfighter* debate go away was thus a lost hope.

Also working against the Navy was the fact that the press was enamored with the vision of small stealthy ships zipping around the littoral, wrecking havoc on an enemy's "fleet," and articles extolling the virtues of the *Streetfighter* were published throughout 2000. Some press accounts focused on Hughes' fast and stealthy 300-ton displacement craft—a concept never seriously considered in Navy war games. Others focused on high speed catamarans in the theater support role. Still others focused on the *Corsair* concept and its distributed air wing. However, most articles had two things in common: they generally embraced the idea of smaller combatants; and they branded the corporate Navy as being "anti-transformational" because of its steadfast refusal to seriously consider small combatants for its future fleet structure.

Unfortunately, since at any given time during 2000 there were up to five very different *Streetfighter* concepts, press accounts of the *Streetfighter* so blended the different concepts that they actually helped to confuse the overall debate over small combatants. The Office of Naval Research helped to obscure things further by starting a Littoral Support Craft (Experimental), or LSC(X), program, designed to explore the technical aspects associated with small, high-speed, modular-payload littoral combatants.[237] And in September 2000, the NWDC conducted highly publicized high-speed sea base support experiments with a borrowed Australian fast catamaran ferry.[238] Confusion over the direction of combatants associated with the *Streetfighter* concept reigned, both inside and outside the Navy.

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[235] Navy Warfare Development Command, *Streetfighter,* and *Streetfighter: Background and Issues.* The development of the intra-theater sealift mission was welcomed by the Army. See for example Major General Carroll D. Childers, ANG (Ret), "Army Needs Fast Sea Transports," *Proceedings,* August 2003, pp. 78-79.

[236] Navy Warfare Development Command, *Streetfighter: Background and Issues.*

[237] George R. Worthington, "We Have the Craft for Littoral Warfare," *Proceedings,* October 2002, p. 128. Also see O'Rourke, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress,* p. CRS-3.

[238] Navy Warfare Development Command, *Streetfighter;* and Navy Warfare Development Command, *Streetfighter: Background and Issues.*

Despite the confusion evident in both internal and external reports of the "debate that wouldn't die," an increasing number of naval officers and defense analysts were intrigued with Admiral Cebrowski's ideas about distributed battle networks that included a mix of large, intermediate and small manned combatants, and larger numbers of unmanned systems, off-board remote sensors and weapons. Importantly, this appears to have been the position of the 27th Chief of Naval Operations, Admiral Vern Clark, who assumed his new billet in July 2000.

In October 2000, soon after the completion of Global 2000, Admiral Clark directed Rear Admiral Rodney Rempt, the new Director of Surface Warfare on the OPNAV staff, to "study the advantages and disadvantages of *Streetfighter*, to ensure the Navy's surface warfare directorate had a firm footing in the overall debate surrounding the concept."[239] After Admiral Clark's charge, in an accurate but no less damning indictment of the Navy's previous failure to take the debate over small combatants seriously, a Navy source was reported to have said, "We have done more on *Streetfighter* in the last two weeks than we have over the last two years."[240]

Just so. From 1999 through 2000, Admiral Cebrowski and a small group of officers assigned to the Naval War College, NWDC, and the CNO's Strategic Studies Group had worked tirelessly to get the senior Navy leadership to listen to their intriguing concepts. However, because of a series of unfortunate decisions made by both parties to the debate, the discussion had moved quickly from the strategic question of whether or not a new battle fleet era had arrived and the operational question over the best associated fleet operational architecture to a tactical debate over combatant design.

Further, this tactical debate was hamstrung because of the "either-or" approach taken between proponents of DD-21 and the *Streetfighter*, which caused both parties to miss, distort, or ignore their opponent's arguments and reasoning. Said another way, for two years both sides had conducted simultaneous monologues rather than a mutually enriching dialogue. However, because of the intervention of Admiral Clark, the conditions for a mutually enriching dialogue had finally been created, and the debate over the role of small combatants in the TSBF could be decided on the merits of each side's arguments.

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239 Robert Holzer, "US Navy Studies Pros, Cons of Streetfighter Combat Concept," *Defense News*, October 2000, p. 78. Interestingly, both Admirals Clarke and Rempt had commanded small *Asheville*-class Patrol Gunboats early in their careers, giving them important first-hand operational knowledge about small combatants that could be applied to the debate.

240 Holzer, "US Navy Studies Pros, Cons of Streetfighter Combat Concept," p. 78.

IV. THE LCS AS PART OF BROADER TRANSFORMATIONAL CHANGE

2001: THE DEBATE REJOINED

Admiral Clark's ordered reappraisal of the Navy's position and the merits of *Streetfighter* came none too soon. In December 2000, George W. Bush won the national Presidential election. His campaign speeches and the public utterances made by his closest defense advisors made it clear that defense "transformation" would be high on the new President's agenda.[241] Moreover, since Congress had passed a law requiring any incoming Administration to conduct a new Quadrennial Defense Review in its first year in office, every program, regardless of its support or progress, would come under review. Although by this time the DD-21 program was well along—both the DD-21 Blue and Gold Teams submitted their detailed technical and cost proposals for the ship in late 2000—the QDR could not possibly miss the arguments being put forth by advocates of small *Streetfighter* combatants. It behooved the Navy to be prepared for renewed scrutiny of its plans for the next generation of surface combatants.

The review started with an important vote of support for the "small combatant faction." In mid-2000, just as results of the CNAN project were being digested and understood, Admiral Cebrowski had asked the Naval Postgraduate School to "rethink the relative merits of dispersion versus concentration and attendant economies of scale" in littoral combat, and how small combatants might make contributions within the context of a distributed littoral battle network.[242] The tasking was inspired. The project was assigned to eight students in the school's Total Ship Systems Engineering (TSSE) curriculum. The highest ranking member of the TSSE report was a Lieutenant Commander, and the team included two foreign naval officers. This meant their efforts were more likely to be open to non-standard, "out-of-the-box" solutions Distant from the heated passions of Newport and Washington, operating in the unbounded confines of an academic institution, and pressured only by their determination to master their course's academic requirements, the eight students put a fresh eye on the debate over small combatants.

From the Navy staff's point of view, the only possible concern over the students' objectivity was that Wayne Hughes was a prominent faculty advisor for the project, and several of his ideas about risk averseness and fleet design were subsequently adopted by the students. All in all, however, it seems clear that the students were given free rein to approach the problem, and that they strove to produce a balanced and fair assessment of the possible contributions of small combatants within a highly networked littoral battle fleet.

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[241] In 1999, then-candidate George Bush gave an important speech at the Citadel which outlined his vision for a "transformed" military. Mylana Zyla Vickers, "Bush's Missed Opportunity at the Citadel," found at Tech Central Station at http://www.techcentralstation.com/121701A.html.

[242] Commander Richard C. Muldoon, USN et al, *CROSSBOW Executive Summary* (Monterey, CA: US Naval Postgraduate School, March 2002), p. 1.

Their remarkable work—candid, refreshing, and compelling—was published in a 457-page report in January 2001, just as the Bush Administration was arriving in Washington, DC.[243] In the report's Faculty Comments and Promulgation Statement, the NPGS faculty noted that in the ten years since the TSSE curriculum had been established, this report represented the "highest overall quality product, considering the higher 'degree of difficulty' of the initial design problem." The difficulty of the problem arose because the students *"were confronted by a very 'fuzzy' open-ended concept of small, high-speed craft contributing to the concept of Network Centric Warfare in a littoral region, in conjunction with a deployed grid of weapons and sensors"* (emphasis added). This required them to develop a lengthy operational scenario and to develop their own Operational Requirements Document, or ORD, to guide their ship design efforts.[244]

In the end, the students' ORD melded the concept of distributed offense preferred by Cebrowski and Hughes with the concept of delivering off-board weapons and sensors developed during the CNAN project. The final student design, referred to as SEA LANCE (for Seaborne Expeditionary Assets for Littoral Access Necessary for Contested Environments), consisted of a 450-ton wave piercing catamaran combatant towing a 450-ton wave piercing catamaran "grid deployment module," or GDM. The 450-ton combatant/450-ton GDM combination was chosen over a single "medium-hull" option based on the Swedish 600-ton *Visby* corvette,[245] and a "fighter-freighter" combination consisting of a small 250-ton combatant and a larger 800-ton sensor and weapons "truck." Although the high-speed tow approach was considered by the students to be relatively high risk, the advantages of the aggregate combination proved to be the most effective approach to meet the requirements of their derived ORD.[246]

While the SEA LANCE combatant was quite different than their original conception of 300-ton and 1,200-ton offensive warships, it had everything originally envisioned by Cebrowski and Hughes. It was fast (nearly 40 knots), had a shallow draft (10 feet), was lightly manned (13 crew), had a high payload fraction (35 percent), and was powerfully armed (55 missiles and two 30mm cannon). The towed GDM, with no onboard propulsion systems and an impressive 67 percent payload fraction, was an added and clever bonus. It carried a variety of weapons, off-board systems, and sensors that could be laid via a gravity dispensing system or employed directly from the module itself. Moreover, the SEA LANCE was assessed by the students to be

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[243] Lieutenant Howard Markel, USN, Team Leader et al, "*SEA LANCE" Littoral Warfare Combatant System* (Monterey, CA: US Naval Postgraduate School, January 2001). The entire report can be found on the Naval Postgraduate School's website at http://www.nps.navy.mil/tsse/files/2000/report.pdf.

[244] See "Faculty Comments and Promulgation Statement," in Markel et al, "*SEA LANCE" Littoral Warfare Combatant System*, p. iv.

[245] The Swedish *Visby* class "stealth" corvette incorporates an extremely high degree of signature control. For a description of this innovative ship, see http://www.kockums.se/surfacevessels/visby.html.

[246] Markel et al, "*SEA LANCE" Littoral Warfare Combatant System.* For a description of the three option explored, see pp. 27-33.

relatively cheap. Acquisition costs were estimated to be $82-$83 million for the combatant and tow.[247]

The press, which had been covering the *Streetfighter* debate with great interest, published several supportive stories about SEA LANCE from late January through March 2001, just as the preliminary analysis for the 2001 QDR was starting.[248] Whether these reports influenced the incoming Bush defense team or not is unclear. However, what is clear is that on March 1, 2001, the Administration announced that it had delayed its planned selection of a winning DD-21 industry team by two months, to May 2001.[249]

The Navy went on the offensive. As the QDR started to take form, its internal Navy QDR Team worked to cast doubt on small *Streetfighter* combatant concepts and to mount a spirited defense of the DD-21. However, the arguments used against the *Streetfighter* revealed the Team's lack of understanding over how far the concept had matured since late 1999 when the corporate Navy had opted out of the debate over the potential role of small combatants in the Navy's TSBF.

The Navy QDR Team opposed the *Streetfighter* on six key points:

- *The idea of a 400-ton combatant with a 160-ton payload or a 1000-ton combatant with a 400 ton payload was beyond the reach of current technology*. The QDR Team identified these design goals as NWDC's, and argued strenuously that the goals were unrealistic. They reported that Naval Sea Systems (NAVSEA) studies had concluded that a 160-ton payload would equate to a 3-4,000-ton combatant, while a 400-ton payload would equate to a 7-8,000-ton combatant.[250] However, as has been seen, the concept developers never felt the size of a Streetfighter combatant was as important as what it carried to the fight. They focused consistently on the ship's payload, and not on the displacement of the ship itself.

- *The cost of the ships and the accompanying support structure for multi-role, single mission ships had to be compared to that of building small multi-mission ships, which would require far less logistical and operational support.*[251] This was a valid argument, but in presentations the QDR Team focused on the "mother-ship" idea introduced by

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[247] Markel et al, "*SEA LANCE" Littoral Warfare Combatant System.*

[248] See for example Robert Holzer, "Trailer Would Expand Ship's Firepower," *Defense News,* January 29, 2001; Dale Eisman, "Unconventional Ship May Be What Bush Wants," *Virginia Pilot,* February 12, 2001; and Robert Holzer, "US Navy Boosts War College's SEA LANCE Concept," *Defense News,* February 19, 2001. A concise description of SEA LANCE can be found at http://www.globalsecurity.org/militarysystems/ship/sea-lance.htm.

[249] O'Rourke, *Navy DD(X) Future Surface Combatant Program: Background and Issues for Congress,* p. CRS-2.

[250] "Street Fighter Concept," point paper provided to Dr, Andrew Krepinevich, Executive Director, Center for Strategic and Budgetary Assessments, by Rear Admiral Joe Sestak, USN, then-director of the Navy 2001 QDR Team, pp. 1-2.

[251] "Street Fighter Concept," p. 3.

Hughes in early 2000 that had long since been shelved by *Streetfighter* concept developers. In most instances, they considered *Streetfighter* combatants to be "self-deployers." Concept developers left the final question about the ships' endurance and support requirements for later detailed design studies.

- *There were no compelling engineering facets of the concept which balanced cost with combat effectiveness more efficiently (in terms of cost versus combat prowess) than a multi-mission combatant.*[252] While this point was technically true, it was only because of the Navy's steadfast refusal to conduct detailed engineering studies of small combatants. Besides some NAVSEA concept studies, the TSSE project was the closest "engineering study" available.

- *The issue of "expendability" had to be fully understood prior to undertaking such a concept.*[253] This point underscores the lasting damage caused by this argument.

- *Unmanned, distributed off-board sensors could and would be launched from current large multi-mission ships or submarines, obviating any requirement for a small dedicated sensor dispenser*.[254] This argument posited that any future distributed sensor grid could be emplaced using large multi-mission combatants and submarines. This was an assertion of facts not yet in evidence, and one which was later withdrawn by Navy planners.

- *Finally, Streetfighter was a concept before its technological time*. "In the distant future," the Navy's argument went, technology might mature to the point that the idea of smaller combatants with adequate payloads would be worth pursuing.[255] However, several foreign ship designs suggested that small combatants with adequate payloads were well within the reach of current technology.

Despite the arguments developed by the Navy QDR Team, it was increasingly clear that the Navy was fighting a rear guard action. On May 31, 2001, the Navy was again directed by the Secretary of Defense to delay the selection of the winning DD-21 design "to take advantage of the ongoing reviews being conducted within the Department of Defense."[256] Soon thereafter, in June 2001, two QDR advisory panels commissioned by Secretary Rumsfeld reported out.

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[252] "Street Fighter Concept," p. 3.

[253] "Street Fighter Concept," p. 3.

[254] "Street Fighter Concept," p. 3.

[255] "Street Fighter Concept," p. 3. Rear Admiral Sestak also provided Dr. Krepinevich with a similar paper outlining the objections to NWDC's *Corsair* concept.

[256] Department of Defense News Release No. 241-01, "Navy Delays DD21 Source Selection Decision," (Washington, DC: Office of the Secretary of Defense, May 31, 2001).

Remarking on the DD-21, one panel "damned [it] with faint praise," while the second "downright panned [it]."[257]

In one sense, the panel's condemnation of the DD-21 as being marginally "transformational" made sense. After all, the DD-21 was ***re-introducing*** to the fleet something it had long ago valued—high volume offensive and defensive firepower coupled with a high degree of staying power. However, with the ship's high degree of stealth, new integrated electric propulsion and power system, high degree of damage limitation and automated damage control, and small crew—this re-introduction of large combatants promised to have as transformational an impact on the fleet's *operational architecture* as any other system being considered in the 2001 QDR. Upon reflection, it appears that both panels focused on the ship's 155mm guns rather than its broader impact on the fleet's operational architecture or its potential as a revolutionary weapons platform, which suggests a certain shallowness in their conclusions.[258] In any event, the panels seemed to confirm that the Navy's greatest fear was coming true: the either-or nature of the long-running combatant debate was starting to threaten the viability of the DD-21 program itself.

Soon after the two panels denigrated the DD-21, the Global 2001 War Game highlighted the broad range of small network combatant options for future fleet battle networks. These vessels had been refined by NAVSEA naval architects, partly in an effort by NWDC to deflect criticisms that the ships being considered "defied the laws of physics."[259] Ships considered included:

- A 400-ton payload anti-submarine warfare combatant with a displacement between 3,500-4,500 tons that employed 12 medium (11-meter) and five small (7-meter) USVs, two medium UCAVs, and one armed helicopter. Both manned and unmanned off-board systems were supported by 16-person Mission Support Teams that would come aboard the "SF ASW" with the modular mission package.[260]

- A 160-ton payload, 1,600-ton displacement Contested Littoral Delivery Vehicle focused on mine countermeasure (MCM) operations. The "SF MCM" platform employed an array

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[257] Sydney J. Freedberg, Jr., "Navy Nervous About Rumsfeld Review," found at http://www.govexec.com/dailyfed/0701/071701nj.htm.

[258] Freedberg, Jr., "Navy Nervous About Rumsfeld Review." Perhaps reflecting the judgment of the panels, Freedberg writes: "For its new destroyer, [the Navy] rejected a barge-like "arsenal ship"…and it discarded the idea for swarms of small 'Streetfighter' boats that could sneak in close to shore to fire their weapons. Instead it decided in favor of DD-21, which for all its innovations, is about the same size as older destroyers and retains the traditional guns on deck." This reasoning discounts the possibility that the DD(X) might carry more advanced weapons at some point in its 45 year expected service life. See for example Hunter Keeter, "Lasers, Rail Guns Could Be Ready for DD(X) by 2010," *Defense Daily*, April 16, 2003, p. 9.

[259] Maria Zacharias, "Innovative Consultants For the Fleet of the Future," *Sea Power,* September 2001, found at http://www.navyleague.org/seapower_mag/sept2001/navsea.htm.

[260] Navy Warfare Development Command, *ASW Streetfighter 400 Concept of Employment, Global 2001.*

of off-board mine systems and a mine-hunting helicopter that enabled it to operate from over-the-horizon ranges.[261]

- An anti-ship cruise missile defense variant of the SEA LANCE 450-ton combatant/450-ton GDM. This variant carried a large load of Evolved Sea Sparrow Missiles to provide the battle network with increased defense-in-depth against anti-ship cruise missiles.[262]

- And a 400-ton payload High Speed Vessel-Logistics (HSV LOG) that supported Army intra-theater lift; Marine amphibious operations; and employment of the Expeditionary Sensor Grid.[263] The Global 2001 version of the ESG included three different types of UAVs and UCAVs; two different types of USVs; six different types of UUVs; unattended ground sensors; unattended sea sensors; and two different types of deployed acoustic arrays.[264]

After Global 2001, the Naval Warfare Development Command felt confident enough to prepare two different preliminary concepts of employment for small network combatants. The first was a Standardized Concept of Deployment for a "Small Fast Surface Combatant," or SFSC (note: ***not*** a ***Streetfighter***!). The SFSC was an ambitious blending of all previously identified ***Streetfighter*** combatant concepts. It was envisioned as a fast (60 knots!), shallow draft (10 feet) ship at the large end of explored displacement range, with a full load displacement of some 3,500-4,500 tons, and a crew of 106. However, aside from a basic command and control and intelligence, surveillance, and reconnaissance (ISR) suite and a minimal self-defense package, the ship would have a flexible mission architecture that included six modular "mission stations" that could be reconfigured to form specific mission packages.

By appropriately configuring the ship's mission stations, the SFSC would be able to carry out no less then seven different missions: anti-submarine warfare; mine countermeasures; remote theater air and missile defense; maritime patrol/armed recon; area command and control; expeditionary sensor grid tactical deployment component, and logistics. Importantly, the SFSC was explained as part of a broader fleet architecture, since the "Navy After Next should deploy a *mix of forces* that includes a greater number of geographically dispersed platforms that will complement networked, large-hull, multi-mission units" (emphasis added).[265]

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[261] Navy Warfare Development Command, *Concept of Employment—Streetfighter: MCM Capability in a Contested Littoral Environment,* Global 2001.

[262] Navy Warfare Development Command, *SEA LANCE (Anti-ship Missile Defense Variant): Concept of Employment,* Global 2001.

[263] Navy Warfare Development Command, *Individual HSV Variant Application Scenarios/Employment Considerations*, Global 2001.

[264] C4ISR Division, Concepts Development Department, Navy Warfare Development Command, *Enhanced Sensor Capability Concept of Employment,* Global 2001.

[265] Navy Warfare Development Command, *Standardized Concept of Employment for Small Fast Surface Combatant.*

The second concept of operation was for the High Speed Vessel, or HSV. The concept included intra-theater transport of troops and equipment between advanced logistics support sites and support of Marine combat operations. However, the HSV was also thought to be suitable for a variety of additional missions, such as supporting special operations forces; conducting non-combatant evacuation and humanitarian assistance missions; supporting mine countermeasures; and acting as a command and control platform.[266] This draft HSV concept of operations helped to guide later experiments with the *Joint Venture,* HSV-X1, an Australian-built high-speed commercial ferry leased by the Navy in the fall of 2001 as an HSV surrogate.[267]

The *Streetfighter* defense rested. There were obviously many things still left to be fleshed out in the associated concepts, and many aspects left to test and explore. For example, the operational and logistical overhead required to support in-theater reconfigurations of small combatants had not been thoroughly analyzed. However, after six years of intellectual development by the CNO's SSG, as well as two years of hard thought and work on the *Streetfighter* concept, including three Global Wargames, the CNAN project, the SEA LANCE project, and internal work by the NWDC, the "small combatant faction" felt confident they had made their case. It was up to the "jury" to decide.[268]

THE VERDICT COMES IN

Through most of 2001, Admiral Clark was largely absent from the public debate over large and small combatants. After setting up the conditions for a fair and open argument, he appears to have been content to let the debate run its course before committing himself. The announcement on November 1, 2001 thus marked the end of Admiral Clark's year-long deliberations. He decided that the arguments for small network combatants were strong enough to overturn the Navy's long-held aversion to small combatants and to include them within the operational architecture of the future battle force. He replaced the DD-21 Program with DD(X) Future Surface Combatant Program, which would complement the fleet's large legacy force of intermediate size carrier era combatants with a mix of both larger ***and*** smaller combatants.

Ironically—and perhaps appropriately—the announcement was made only three days after Admiral Cebrowski, who had by that time retired from naval service, assumed duties as the first Director of the Office of Force Transformation in the Office of the Secretary of Defense. Although many in the Navy continue to adamantly separate the LCS from the *Streetfighter*, the

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[266] Commander Dean Chase, Navy Warfare Development Command, *Concepts of Operation, High Speed Vessel (HSV).*

[267] Admiral Robert J. Natter, USN, "Meeting the Need for Speed," *Proceedings,* June 2002, pp. 65-67.

[268] Note that the NWDC did not prepare a concept of operation for the *Corsair* distributed aviation concept. This was left to the Naval Postgraduate School TSSE program, which followed up the SEA LANCE project with a study on a distributed aviation ship called "SEA ARCHER." The TSSE team envisioned a small ship with an air wing comprised of eight multi-mission SEA ARROW UCAVs, eight support UAVs, and two MH-60 helicopters. The students envisioned the SEA ARCHER as operating in a littoral battle group that included modified SEA LANCE combatants and SEA QUIVER high-speed combat logistics force ships. See Lieutenant Joe Keller, USN et al, *"SEA ARCHER:" Distributed Aviation Platform* (Monterey, CA: US Naval Postgraduate School, December 2001).

LCS's lineage and pedigree can be clearly traced back to Admiral Cebrowski's original, powerful, and compelling vision outlining a new battle fleet era.[269] Indeed, as will be seen, his broader vision appears to have had a profound impact on the course of the Navy's broader transformational efforts.

Many continue to wonder about Admiral Clark's motivation for reversing the Navy's long-standing position and embracing the idea of small combatants. In this regard, there seem to be three general schools of thought:

- The dogged efforts of the small combatant faction convinced Admiral Clark ***and*** the OPNAV staff ***and*** the surface warfare community ***and*** the Navy's other warfighting communities on the merits of their position. This school sees the LCS program as an honest admission that the Navy's past position on small combatants was wrong, and that the Navy is prudently cutting some analytical corners to make up for lost time;

- Admiral Clark and the OPNAV staff reluctantly accepted the LCS only after it was clear that Secretary Rumsfeld expected the Navy to pursue the program. In this scenario, the Secretary's selection of Admiral Cebrowski to be the Director of Transformation was cause for worry. Better to accept his "Little Crappy Ship" (as opponents derisively called the LCS) than to risk the termination of the large, multi-mission DD-21; or

- Admiral Clark approved the LCS over the objections of his own staff and to the irritation of key portions of the surface, submarine, and aviation communities. If this be the case, the thinking goes, the LCS could be terminated as soon as his tenure is up. This would duplicate the fate of the aforementioned Arsenal Ship after Admiral Boorda's death, and that of the small high-speed patrol missile hydrofoil (PHM) after its champion, Admiral Zumwalt, retired in the mid-1970s.[270]

Perhaps the truth lies somewhere in between all of these possibilities. However, based on a review of the decisions made by or approved by Admiral Clark both before and after November 1, 2001, one cannot doubt that he has a broad vision for the transformation of the Navy and its Total Ship Battle Force, and a clear idea how LCS fits within it.

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[269] See the comments made Navy officials in Truver, "The BIG Question," pp. 25-26.

[270] As CNO, Admiral Zumwalt championed the PHM despite a high degree of skepticism about the craft within the surface warfare community. While he was in office, his reluctant staff dutifully prepared plans for a 30-ship production run. However, as soon as he retired, the program was cancelled and only through the intervention of Congress were even six of the vessels built. In the end, however, the Navy staff was to have the last laugh: the six ships spent the majority of their short service lives conducting counter-drug patrols in the Caribbean. For a sympathetic review of the PHM program, see George Jenkins, "Patrol Combatant Missile (Hydrofoil): PHM History 1973-1993," a paper delivered to the Annual IHS symposium in 1993, and re-published on June 14, 1995.

ADMIRAL CLARK AND NAVY TRANSFORMATION

> When a technology is revolutionary in potential, as the sail was during the age of oars, steam during the age of sail, and the aircraft carrier in the age of the battleship, the new opportunity is exceedingly complicated, even after you know where you want to go. The objective of an orderly phase-in is not to evade the attention of the guardians of the status quo. The Old Guard sees real threats while they are still wisps on the horizon and many threats do not even exist. No, the objective is to solve a monstrous transition problem. If new tactics for new systems are more difficult to develop, tactics that blend the old and the new are even more difficult.[271]

In a May 2003 report entitled ***Meeting the Anti-Access and Area-denial Challenge***, CSBA identified five apparent general objectives associated with the "monstrous transition problem" outlined in Department of the Navy transformation plans. These objectives were determined by reviewing both Navy and Marine Corps transformation documents. They were:

- To expand the TSBF to 375 ships;
- To restructure the Navy and Marine Corps for sustained operations from a sea base (outlined in the concept of *Sea Basing*);
- To reorganize the fleet so as to provide increased global strike coverage (outlined in the concept of *Sea Strike*);
- To embrace an expanded theater air and missile defense mission (outlined in the concept of *Sea Shield*); and
- To create a new special-purpose counter-maritime area-denial force based on the LCS (also outlined in *Sea Shield*).[272]

Four of these five goals still appear to be valid. The fifth—to expand the size of the fleet to 375 ships—may no longer be. Admiral Clark seems not to have repeated his initial public calls for an expansion of the size of the TSBF since April 2003, and no OSD official has publicly endorsed the idea of an expanded fleet.[273] However, in hindsight, by focusing on the goals and ***Sea Power 21's*** concepts of ***Sea Basing, Sea Strike,*** and ***Sea Shield***, the report helped to obscure the

[271] Hughes, *Fleet Tactics and Coastal Combat*, pp. 234-35.

[272] Krepinevich, Watts, and Work, *Meeting the Anti-Access and Area-denial Challenge*, pp. 36-52.

[273] In the December issue of *Sea Power*, Sheila M. McNeil still referred to an April 2003 Naval Academy luncheon in which Admiral Clark called for a fleet of some 375 ships as justification for a larger fleet. The author could find no more recent public statement by Admiral Clark endorsing a fleet of this size. See President's Message: "Sea Power Ambassadors: Building Support for US Fleets," in *Sea Power*, December 2003, p. 3.

sweeping scope of the Navy's current transformation plans. This vision is better revealed by reviewing six key decisions or changes that have occurred since Admiral Clark's appointment as CNO.

First, Admiral Clark and the naval officer corps have embraced Admiral Cebrowski's vision that the Navy's future is all about "guaranteeing delivery of goods and services" in support of joint campaigns, and that the key operational requirement for the fleet is therefore to ***"assure (joint) access"*** *in and from littoral waters.*[274] Since 2001/2002, the Navy appears to have made the final intellectual and cultural transition from the past sea control century to a new joint power projection era. For a "joint-phobic" Navy whose carriers were incapable of receiving Air Tasking Orders generated by Air Force planners in the First Gulf War less than 15 years ago, the embrace of jointness and the assured access mission in littoral waters represents a transformation unto itself. It marks a commitment to joint planners and sister Services that the US Navy is serious about ensuring political and operational access for joint forces under all threat conditions, and making important contributions to joint land campaigns when called upon to do so.[275]

Second, in a related vein, the Navy and the Marine Corps have agreed to explore new ways to wage large scale operations from "enhanced network sea bases" established in close-in littoral waters.[276] Since World War II, the traditional way of conducting amphibious power projection operations has been to establish a lodgment ashore, and then to support inland operations from supply dumps and bases located near the coastline. During the mid- to late 1990s, after developing their concepts of Operational Maneuver From the Sea (OMFTS) and Ship-to-Objective Maneuver (STOM), the Marines began advocating the development of new ships that would allow them to by-pass a beach, to skip the seizure of supply and operational bases ashore, and to conduct operations directly against inland objectives from a "sea base."[277] For a variety of operational, logistical, and fiscal reasons, the Navy resisted early Marine calls for this potentially novel capability.

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[274] For example, *Naval Power 21,* the current Department of the Navy vision statement, states: "We assure access. Assuring sea-based access worldwide for military operations, diplomatic interaction, and humanitarian relief efforts. Our nation counts on us to do this." Secretary of the Navy Gordon England, Admiral Vern Clark, and General James L. Jones, *Naval Power 21,* (Washington, DC: Department of the Navy, October 2002), p. 1.

[275] The Navy's heavy emphasis on joint operations is readily evident in Admiral Vern Clark, USN, "Sea Power 21: Projecting Decisive Joint Capabilities," ***Proceedings***, October 2002, pp. 36-41. ***Sea Power 21*** is Admiral Clark's overarching naval transformation vision. See also Rear Admiral Don Loren, USN, 'Close-in Naval Dominance: Joint, Allied Forces Need Assured Access Throughout the Littoral Regions," ***Armed Forces Journal***, September 2003, pp. 36-42. A through discussion about the Navy's embrace of the access mission can also be found in Krepinevich, Watts, and Work, ***Meeting the Anti-Access and Area-denial Challenge.***

[276] Vice Admiral Charles W. Moore, Jr, USN, and Lieutenant General Edward Hanlon, Jr, USMC, "Sea Basing: Operational Independence for a New Century," ***Proceedings***, January 2003.

[277] General C. C. Krulak, USMC, *Operational Maneuver From the Sea: A Concept for the Projection of Naval Power Ashore* (Washington, DC: Headquarters, US Marine Corps, undated). A copy of this concept can be found at http://www.dtic.mil/jv2010/usmc/omfts.pdf. See also David Vergun, "Marine Corps Sharpens Tactics to End-Run the Enemy," ***Sea Power***, April 2003, pp. 75-77. A complete compilation of current US Marine Corps concepts and doctrine can be found at https://www.doctrine.usmc.mil/Links.htm.

The resistance against sea basing disappeared with Admiral Clark's arrival as CNO. He established an immediate rapport with then-Commandant of the Marine Corps James L. Jones, and together they agreed to pursue capabilities that would improve the ability of both the Navy and Marines to conduct operations from semi-permanent sea bases.[278] Indeed, Admiral Clark has gone as far to say that the sea basing concept provides a valuable tool for prioritizing ***all*** naval programs.[279]

The Navy's commitment to pursue expanded fleet sea basing capabilities along with the Marine Corps represents a renewal of an operational relationship within Department of the Navy (DoN) that had progressively declined since the end of the Pacific Campaign in World War II. The result will likely be improved requirements generation and operational cooperation within the DoN, and likely will lead as well to the development of important new joint capabilities. In this regard, the Navy and Marine Corps are supporting the creation of a multi-service Joint Sea Basing Requirements Office to explore new ways in which the Navy, Marine Corps, and other joint forces will be able to wage large-scale naval and joint operations from a sea base.[280]

Third, senior naval leaders have endorsed Admiral Cebrowski's vision that naval warfare in the Information Age will define a new era in battle fleet operations in which dense networks of distributed sensors and combat power will fundamentally change the course of naval warfare, as well as the Total Ship Battle Force. Consider the words of Rear Admiral Donald Loren, then-Deputy Director of Surface Ships in the Surface Warfare Division on the CNO's staff, when asked to describe the new DD(X) family of ships: "These ships will be built from the keel up as members of a distributed force, netted together…within the total naval and joint information superiority network."[281] In other words, the DD(X) family of ships was to be conceived as *the first-generation combatants of a new battle fleet era*, with characteristics that would readily separate them from battleship and carrier era combatants.

The Navy identifies the defining characteristics of first-generation battle network combatants in a simple but powerful mantra: ***get connected; get modular; get off-board; get unmanned:***[282]

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[278] Current descriptions of "sea basing" and "enhanced network sea basing" can be found at the Navy Warfare Development Command website at http://www.nwdc.navy.mil.

[279] Admiral Vern Clark, USN, "Sea Power 21: Projecting Decisive Joint Capabilities," p. 37.

[280] The establishment of a joint program office was recommended by a Defense Science Board study on sea basing completed in the summer of 2003. Office of the Under Secretary of Defense for Acquisition, *Sea Basing* (Washington, DC: Defense Science Board, August 2003). For information on the Joint Sea basing Office, see Jason Sherman and David Brown, "Pentagon to Create Multi-service Sea Basing Requirements Office," *Defense News*, December 8, 2003, p. 30.

[281] Rear Admiral Loren, USN, "'Close-in' Naval Dominance," p. 40.

[282] This mantra was a derivation of the submarine community's goals of "get connected, get payload, get modular, and get unmanned," developed during the 1990s as a consequence of the diminution of the Soviet submarine threat and the submarine fleet's move into littoral waters. The Navy sometimes shortens this slogan to "get connected; get modular; and get unmanned," as in Rear Admiral H.G. Ulrich III, USN, and Rear Admiral Mark J. Edwards, USN, in "The Next Revolution at Sea," *Proceedings,* October 2003, pp. 65-69. However, the author has chosen to

- *Get connected*: First-generation battle network combatants will be inextricably connected to one another, as well as to an ever-expanding web of off-board sensors, systems and platforms. The current codeword for this dense connectivity is "FORCEnet" a concept and term developed by the CNO's SSG and adopted by Admiral Clark that immediately invokes his intent to network the ***entire*** battle ***force***.[283] Getting connected requires the near term focus on three primary capabilities and systems: the aforementioned Joint Fires Network, Cooperative Engagement Capability, and a new digital data link called Link 16.[284] Moreover, getting connected also has a new combatant design goal: to move to open ship and combat system architectures. One of the nagging problems of second-generation carrier era combatants was that each new flight of ships had software variations of the same "baseline" combat system. However, because earlier generation combatants and combat systems did not have open architecture designs, every new variation made the sharing and transfer of data among ships of different flights more complicated. To address this problem, the combat systems of the first battle network generation of ships would move toward open system architecture designs like the highly successful Advanced Rapid COTS (commercial off-the-shelf) Insertion (A-RCI) program, pioneered by fleet submariners.[285]

- *Get modular*: The Navy has long designed ships for modular construction. However, first-generation battle network combatants would see increased modularity at the ship construction level ***and*** at the mission package level. By being able to rapidly reconfigure ships for different missions in both the shipyard and in forward theaters, the Navy hopes to be able to stay ahead of emerging threats and to optimize the tactical configuration of future battle networks immediately prior to, and throughout, any joint theater campaign. The benefit of this approach, highlighted during ***Streetfighter*** concept development, war gaming, and fleet battle experiments, appeared attractive enough to make increased system modularity a key design goal for next generation combatants.[286]

- *Get off-board*. Consistent with the approach highlighted during ***Streetfighter*** concept development and during the CNAN project, the Navy concluded that first-generation

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incorporate the broader slogan as reported in Rear Admiral Donald Loren, USN, "USN's Big Idea is to Think Small In the Littorals," *Warships International Fleet Review*, August 2003.

283 Vice Admiral Richard W. Mayo, USN, and Vice Admiral John Nathman, USN, "ForceNet: Turning Information Into Power," ***Proceedings***, February 2003, pp. 42-44. See also "FORCEnet: Enabling 21st Century Warfare," in the concept section of the NWDC homepage at http://www.nwdc.navy.mil/Concepts/FORCEnet.asp; Chief of Naval Operations Strategic Studies Group XX, ***FORCEnet and the 21st Century Warrior*** (Newport, RI: CNO Strategic Studies Group, November 2001); and Rear Admiral Zelbor, USN, "'FORCEnet' is the Navy's Future," pp. 48-53.

284 Rear Admiral Loren, USN, "'Close-in' Naval Dominance," p. 42.

285 Captain Richard A. Udicious, USNR (ret), and Captain Michael E. Feely, USN (Ret), "Acoustic Rapid Commercial Off-the-Shelf Insertion: A Model for the Future," ***Proceedings***, January 2004, p. 72-75. See also Hunter C. Keeter, "Navy Plots New Course for Combat Systems Acquisition," ***Sea Power,*** November 2003, pp. 30-32.

286 Rear Admiral Loren, USN, "USN's Big Idea is to Think Small in the Littorals."

battle network combatants should increasingly rely on ”off-board” as opposed to “on-board” systems. The reliance on off-board systems would allow future ships to adjust their range from the shoreline depending on the prevailing enemy threat.[287]

- *Get unmanned.* Also consistent with the ***Streetfighter*** concept development process and the Navy’s new emphasis on off-board systems, first-generation network combatants would employ an array of unmanned systems. These systems would form pieces of expanded heterogeneous fleet battle networks consisting of both manned and unmanned systems. Unmanned systems were thought to be a natural fit with the Navy’s new emphasis on modular mission packages, especially as they become more autonomous in their operations. Autonomous systems will lower the training burden on crew members, who will be able to focus their efforts on the interpretation of data derived from off-board sensors and systems rather than on controlling their operation. Emphasis on unmanned systems also will allow the future battle force—regardless of its final number of manned combatants—to continually distribute network combat power across an increasing number of platforms. Note too that the move toward increased reliance on unmanned systems complements the reduced crew size goals for first-generation battle network combatants.[288]

Fourth, in announcing the DD(X) program, the Navy and surface warfare community rejected the carrier era’s homogenous fleet architecture of intermediate multi-mission surface combatants. The future surface combatant fleet will be more reminiscent of the battleship era’s TSBF in that it will include a “re-balanced” mix of large network combatants (DD(X) and CG(X)); intermediate legacy combatants (second-generation carrier era combatants); and small network combatants (the LCS and HSV).[289]

Each ship in the TSBF family will perform different network roles, either simultaneously (i.e., multi-mission network combatants) or one at a time (i.e., multi-role, single-mission network combatants), consistent with their inherent designs. However, all will be operated as part of distributed battle networks configured and employed to maximize their individual strengths, mask their individual weaknesses, and bring home as many of their Sailors as possible. In other

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[287] Rear Admiral Loren, USN, “USN’s Big Idea is to Think Small in the Littorals.”

[288] Rear Admiral Loren, USN, “USN’s Big Idea is to Think Small in the Littorals.”

[289] While it seems apparent the Navy officer corps has embraced the idea of a mix of warships, they remain understandably split over the *proper* mix of large, intermediate, and small combatants in the future Navy. In late 2002, the Naval War College sponsored a study of officer views toward DoD and Navy transformation efforts. When asked if the Navy would transition from a fleet that was predominately made up of large combatants to one dominated by small combatants, 42 percent agreed and 40 percent disagreed. As reported to the author by Professor Tom Mahnken, Professor at the Naval War College.

words, current Navy transformation plans emphasize all combatants in the Total Ship Battle Force—regardless of size—will be ***battle network capable***.[290]

Within the framework of a distributed battle network fighting in close-in littoral waters, the surface warfare community concluded that large and intermediate multi-mission battle network combatants will focus their considerable sensing, striking, and defensive power **to the landward side of the littoral**. In a world where many coastal navies will likely export their "battle lines" ashore, large and intermediate multi-mission network combatants are best tasked with three broad missions: destroying the enemy's littoral battle line, wherever it may be found; protecting the battle network in general, and high-value network nodes (i.e., the carriers) in particular, from attacks from the enemy's battle line; and, once the enemy battle line is destroyed, providing long-range supporting fires—both offensive ***and*** defensive—for joint land forces operating ashore. These broad missions are outlined in the Navy's ***Sea Strike*** concept, which highlights the fleet's role in providing sustained precision strike throughout the depth of an enemy's territory, and its *Sea Shield* initiative, which emphasizes the new fleet role of projecting defensive fires far inland.[291] Both concepts will demand the high-volume payload capacity inherent in large ship hulls.

Similarly, the surface warfare community concluded that small network combatants should focus their attention **to the seaward side of the littoral**. As large and intermediate multi-mission network combatants focus their attention on the enemy's inland battle line and joint forces operating ashore, they themselves will require protection from an enemy's "screening" forces operating in littoral waters—consisting of submarines, mines, and small craft and boats. Even the indomitable battleship, designed to absorb enormous punishment in a gun duel with an enemy's battle line, required a destroyer screen to protect it from close-in torpedo attack. In a similar way, future large and intermediate multi-mission ships engaged in littoral combat will rely on smaller units for their close-in protection.

Moreover, once the enemy's shore-based battle line is destroyed or crippled and a distributed fleet battle network has established control in the littoral seas, the network will reconfigure itself to serve as an operational sea base supporting both the Marines and other joint forces ashore. As suggested above, the ***Sea Basing*** concept aims to guarantee the delivery of physical goods and services (e.g., troops, equipment, supplies, and fires) ashore in support of joint campaigns. By their very nature, however, enhanced network sea bases must operate very close to shore, and they will require continued screening from underwater and surface attack—a role best served by small combatants with shallow drafts that can interpose themselves between the coastline and the sea base. Additionally, to increase the velocity of goods from sea to shore, the sea base will

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[290] The best explanation of this approach is provided by Rear Admiral H.G. Ulrich III, USN, and Rear Admiral Mark J. Edwards, USN, in "The Next Revolution at Sea," ***Proceedings,*** October 2003, pp. 65-69. The term "battle network capable" is the author's.

[291] Vice Admiral Cutler Dawson, USN, and Vice Admiral John Nathman, USN, "Sea Strike: Projecting Persistent, Responsive, and Precise Power," ***Proceedings,*** December 2002; Vice Admiral Mike Bucchi, USN, and Vice Admiral Mike Mullen, USN, "Sea Shield: Projecting Global Defensive Assurance," ***Proceedings,*** November 2002.

require new means for high-speed ship-to-shore movement of equipment, supplies, and combat units.

This reasoning helps to explain the Navy's decision to pursue two different classes of small battle network combatants: a combatant optimized for battle network screening and support (now known as the LCS); and a high-speed transport (now known as either the High Speed Vessel or Theater Support Vessel).[292] In the future, technology might allow a single ship class to perform both the combatant and high speed transport missions. In the meantime, to speed their development and to minimize near-term costs, the Navy has concluded it will require two different ship classes.[293] The Flight 0 LCS will be an operational prototype designed to combatant standards and focused on littoral anti-submarine warfare, littoral mine warfare, and close-in anti-surface warfare. HSVs and TSVs most likely will be a leased or derived version of a foreign fast-ferry design.[294]

Fifth, the Navy has concluded that networking and distributing combat power will help enable a new distributed fleet operational architecture.[295] Fully integrated and networked ships, aircraft, and unmanned systems will afford smaller task groups capabilities that rival those of previous large task organizations. As a result, the Navy is reorganizing its TSBF into 37 independent striking groups. The "Global Concept of Operations (ConOps) Navy," as it is known, will consist of:[296]

- 12 Carrier Strike Groups (CSGs), each consisting of one carrier accompanied by three VLS-equipped combatants and an attack submarine;

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[292] The current usage is to refer to vessels dedicated for fast sea base support and support of Marine operations as HSVs, and those dedicated to the intra-theater transport of Army forces as TSVs.

[293] One of the initial six ship concepts, developed by the Northrop Grumman team, actually had a small combatant based on the very stealthy Swedish *Visby* corvette (but about three times larger) ***and*** a larger "mobility variant" focused on the high speed transport mission. While this approach was quite consistent with the conceptual development of *Streetfighter*, the Navy apparently wanted to keep the two ship types separate. Northrop Grumman's dual approach did not survive the initial "down-select" to three final ship designs. For a good explanation why Northrop Grumman approached the problem the way they did, see Adam Siegel, "Take More Than a Truck to the Fight," *Defense News,* May 5, 2003.

[294] Navy and Marine Corps procurement targets for HSVs have not yet been set. In November 2002, the Army leased the *Spearhead,* TSV-1X, crewed entirely by Army personnel. *Spearhead* is part of the advanced concept technology demonstration program within DoD. The Army has validated the requirement for 12 TSVs (capable of transporting an entire Stryker Brigade Combat Team), and press reports indicate a world-wide requirement for 17 TSVs. The US Army Tank Automotive and Armaments Command recently published a RFP for seven TSVs. See Lieutenant General Charles S. Mahan, Jr., "Sustainment of the Army Depends on Continuous Logistics Transformation," *Army Magazine,* April 2003; "Austral Throws Down the Gauntlet for US Army Theater Support Vessel Program," *Jane's International Defense Review,* July 2003, p. 6; and William Cole, "Navy, Army Explore Uses For High-Speed Catamaran," *Honolulu Advertiser,* October 6, 2003.

[295] Rear Admiral Zelbor, USN, "'FORCEnet' is Navy's Future," p. 53.

[296] Vice Admiral Mike Mullen, USN, "Global Concept of Operations," *Proceedings,* April 2003.

- 12 Expeditionary Strike Groups (ESGs), each consisting of a three-ship Amphibious Ready Group carrying a Marine Expeditionary Unit, three surface combatants (at least two VLS-equipped), and an attack submarine;[297]

- Nine independent Surface Action Groups (SAGs) each consisting of three VLS-equipped combatants; and

- Four large *Ohio*-class strategic ballistic missile submarines converted into covert strike/special operations platforms called SSGNs.[298]

The evolution toward a battle fleet that so widely distributes its sensing, striking, and defensive power is easy to track. Recall that the battleship era had one concentrated battle line. In the early part of the carrier era, the fleet could put together four or five independent task groups including approximately four carriers per group. In the final stages of the Cold War, the fleet operated 12 independent strike groups (seven 2-carrier groups; one 1-carrier group; and four battleship SAGs). And in the 1990s—as the power of precision intelligence and weapons increased individual carrier strike power and as the VLS system was reaching widespread fleet service—the fleet could muster 19 strike groups (twelve 1-carrier groups and seven 3-ship VLS SAGs). In the emerging distributed battle network era, the power of information, precision, networking, and the VLS will allow a still smaller fleet to employ 37 strike groups, a near doubling of the maximum number of strike forces found in the carrier era.

Sixth, as in the past, the transition to a new battle fleet era and a new battle fleet operational architecture suggested the need for a new fleet deployment pattern. In the battleship era, the fleet was generally concentrated in home waters, both to train as a single warfighting entity and to surge forward to meet approaching threats. In the carrier era, the Navy aimed to keep a carrier battle group deployed first in two (Western Pacific and the Mediterranean) and later three (North Atlantic/Mediterranean, Southwest Asia/Persian Gulf, and Western Pacific) forward fleet operating areas. From this dispersed deployment pattern, the Navy could quickly respond to any emerging crisis with forward-deployed carrier strike forces, and reinforce them with carriers operating in home waters, if necessary. This deployment pattern largely defined the Navy throughout the Cold War/carrier era, and after forty years it became so ingrained in the Navy's consciousness that it continued, without much thought, throughout the 1990s.[299]

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[297] Captain Kendall King, USN, and Commander Tom Holmes, USN, "Expeditionary Strike Group!" ***Proceedings***, March 2003, pp. 90-93; James W. Crawley, "7-Ship Flotilla Aims to Enhance Military's Power and Versatility," ***San Diego Union-Tribune***, August 22, 2003; and Tony Perry, "US Launching New-Look Military Strike Force," ***Los Angeles Times***, August 22, 2003.

[298] Because of their inherent stealth characteristics, these SSGNs—each of which can carry up to 154 Tomahawk missiles and 102 special operations forces—require no escorts, making each of them an extremely cost effective, independent strike group.

[299] In a similar way, the Navy and Marine Corps strove to keep three Amphibious Ready Groups and an embarked Marine Expeditionary Unit constantly deployed.

However, in keeping with the other changes being pursued by the Navy, Admiral Clark recently approved the adoption of a new fleet deployment plan now known as the Fleet Readiness Plan, or FRP.[300] In essence, the FRP maintains the distributed battle fleet's forward ***strike group*** presence. However, since carriers will make up a lower percentage of future deployable strike groups (12/37 = 32 percent, as opposed to 1990 carrier era metrics of 12/19 = 63 percent), the overall level of deployed ***carrier*** presence will decrease slightly. This decrease in carrier presence will, in turn, enable the carrier force to better conduct surge operations, with up to six immediately ready carriers. These six carriers can be augmented, if necessary, by two additional "emergency surge" carriers within 60 days.[301] By building in more unpredictability in carrier presence and flexibility in carrier availability, the future Navy will be able to quickly configure its battle networks around the heavy sensor, strike and defensive power resident in their carrier air wings.[302]

Having an ability to respond rapidly to emerging global or regional threats by flexibly assembling these powerful fleet battle networks—including up to eight carriers—will be a powerful tool for dissuasion, deterrence, and warfighting. However, the combination of the new global CONOPS fleet architecture and the flexible deployment pattern outlined above suggests that while carriers remain the single most important ships in the Navy's battle force, the carrier era is passing.[303] The new "capital ship" in the emerging era will be powerful, distributed fleet battle networks consisting of a ***mix*** aircraft carriers; large, intermediate, and small surface combatants; submarines; aircraft; and unmanned systems. The best evidence for this is that Admiral Clark is the first CNO in recent memory who is publicly content with a force structure of 12 carriers, and no more.

Just as important from the Navy's perspective is that the combination of standing mission-focused combined arms naval task groupings (the aforementioned CSGs, ESGs, and SAGs) with the new FRP, which includes a comprehensive maintenance approach, means that groups of ships will be associated together for long periods and be maintained together. This, in turn, will mean that groups of Sailors—and Sailors and Marines—will routinely train together. The likely

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[300] James W. Crawley, "Navy Boosting Emphasis on Strike Group Readiness," ***San Diego Union-Tribune,*** January 5, 2004. The FRP has also been referred to by Navy officials as the "Fleet Response Plan."

[301] Hunter Keeter, "Navy Strives for Eight Carrier Battle Groups Ready to Roll," ***Sea Power,*** December 2003, pp. 7-8; Crawley, "Navy Boosting Emphasis on Strike Group Readiness."

[302] On the subject of injecting unpredictability into carrier deployment patterns, see comments by Vice Admiral Philip Balisle in Truver, "USN LCS Program Moves Out." For comments about increased deployment flexibility, see Michael Fabey: "Navy May Deploy Groups for Shorter Spans," ***Newport News Daily Press,*** October 29, 2003.

[303] The role of the carrier will remain central to future US battle networks. See Scott C. Truver, "Sea Bases: Carriers Will Remain the Centerpiece of Transformed Navy," ***Armed Forces Journal,*** August 2003, pp. 49-53; Bill Sweetman, "Carriers Playing With a Full Deck," ***Jane's International Defense Review***, December 2003, pp. 48-51.

result will be the development of a fleet-wide “combined arms mindset” that can only help to speed the passing of the carrier era, and to improve future battle network operations.[304]

It would be unwise to surmise that these six key changes were made as part of some grand Navy Transformation Plan. As history suggests, the transition to a new battle fleet model is an uneven process in which new fleet organizations, operational architectures, and ship designs reveal themselves only after a period of debate, reflection, and operational experimentation. Nevertheless, these changes all appear to have been informed by a single guiding conceptual vision of naval warfare in the Information Age, and, as a result, each is internally consistent and all of them are mutually supporting.

The consistency in Navy transformation plans is also evident in recently announced surface warfare “recapitalization” priorities.[305] At the top of the list is the LCS. Second are “tactical unmanned systems, many of which are expected to act as LCS payloads.” In this regard, “autonomous vehicle operations show tremendous promise for the future and should be pursued.” Third on the list is the large DD(X), “with emphasis on risk reduction for [its] key technologies.” Fourth is the LPD-17, a new amphibious ship that is a key component of the future littoral sea base. And fifth comes the combat logistics force so critical to the support and sustainment of widely dispersed and distributed fleet operations. Although some might still argue that the LCS was forced upon a reluctant Navy, these priorities appear right in line with the Navy’s overall transformational vision.

Likewise, recent Navy resource allocation decisions also highlight the consistency in Navy transformation plans. In short, Admiral Clark is putting his money where his vision is. He has initiated a process called *Sea Enterprise* that looks first within the Navy for the reallocation of dollars necessary to move from vision toward concrete fleet capabilities. This has resulted in some cancelled programs and some reallocations of overall Navy budget within each of its major warfighting communities.[306]

Despite these welcome moves, the cost of the Navy’s sweeping agenda for change will be one of Admiral Clark’s biggest obstacles, because it seems clear that *Sea Enterprise* cannot hope to find all the money needed to implement the agenda within existing or forecasted Navy budgets. For example, two recent Congressional Budget Office (CBO) reports expressed doubt that all components of the Navy’s transformation plans would be fiscally achievable within existing or

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304 Fabey, “Navy May Deploy Groups for Shorter Spans.” The idea of the long association of groups leading to a naval combined arms mindset comes from an email to the author from James (Jim) S. O’Brasky, a former senior operations research analyst at Naval Surface Warfare Center, Dahlgren Division and now a naval consultant with Basic Commerce and Industries, dated January 7, 2004. This and subsequent cites reflect Mr. O’Brasky’s personal opinions.

305 Jason Sherman, “US Navy Outlines Surface Force Priorities,” *Defense News,* November 17, 2003, p. 6.

306 Admiral Michael G. Mullen, USN, “Sea Enterprise: Resourcing Tomorrow’s Fleet,” *Proceedings,* January 2004, pp. 60-63, and Koch, “Personnel Cuts Head USN Strategy to Boost Fleet.” See also the comments made by Vice Admiral Mullen in Nathan Hodge, “Navy Acquisition Boss: DD(X) Not Just a ‘Test Bed’,” *Defense Week,* April 1, 2002, p. 16.

planned budgets.[307] A recent Government Electronics and Information Technology Association Vision Conference echoed the CBO's skepticism. During the conference, a team of four naval and shipbuilding analysts painted a sobering picture of the burgeoning costs of Navy transformation plans.[308]

Indeed, in the aforementioned CSBA report published in May 2003, the fiscal risk associated with the Navy's transformation plans was highlighted as the most severe risk to the achievement of Navy goals, and much higher than the associated path, operational, and technological risks. The recent rejection by the Office of Management and Budget of Navy plans to split funding for ships and submarines across budget years and Admiral Clark's recent direction to his programmers and budgeteers to free up or find an additional $10 ***billion*** per year to support Navy recapitalization efforts, merely put exclamation points on concerns over the transformation plan's total costs.[309]

Moreover, Admiral Clark's ready willingness to reallocate fleet dollars in lean budget times to fund his sweeping transformation agenda may help to awaken the most powerful force against his transformation plans: the Navy itself. For example, an anonymous retired admiral was recently quoted as saying, "The surface and aviation people think LCS is one of the dumbest ideas that has come down the road. If you buy LCS, you're not going to [be able to afford] something else. But I don't see what LCS does."[310] The most insidious danger to Admiral Clark's and the Navy's overall plans will come from those communities inside the Service that stand to lose budget share or prestige as the Navy shifts to a new battle fleet era, and pursues a new operational model and fleet architecture.

The recent announcement that Admiral Clark has been reappointed as CNO for an additional two years provides some hope that these internal attacks can be blunted, and that his larger vision can be successfully pursued. History has proved that stability in top leadership has been a key feature in past successful transformation efforts. These two extra years could spell the difference in whether the major components of the current plan survive.

These extra two years, in addition to buying Admiral Clark time to help speed the Navy's along the path toward a new battle fleet era and operational architecture, may also allow him to pursue

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[307] Congressional Budget Office, ***Budgeting for Naval Forces: Structuring Tomorrow's Navy at Today's Funding Level*** (Washington, DC: Congressional Budget Office, October 2000), and Congressional Budget Office, ***Transforming the Navy's Surface Combatant Force*** (Washington, DC: Congressional Budget Office, March 2003). A concise summary of the most recent report can be found in Eric J. Labs, "Three Options for Change for the Navy's Surface Force," ***Sea Power***, September 2003, pp. 23-26.

[308] Adam Siegel, Deborah Danish, John Socha, and Fred Sulmer, "United States Navy Ships," a presentation to the GEIA Vision Conference 2003, provided to the author by Adam Siegel, Northrop Grumman Analysis Center. For additional points see "Shipbuilding Shortfalls: The Most Intractable Problem," ***Sea Power,*** March 2003, p. 19.

[309] "Pentagon Approaching Decisions for Navy FY-05 Shipbuilding Plan," ***Inside the Air Force***, December 22, 2003; Hodge, "Navy Acquisition Boss: DD(X) Not Just 'Test Bed'," p.16.

[310] Morgan, "Proposed Ship Speeds Into Gathering Storm."

one thing that appears to be missing from the Navy's transformation plans: new metrics for measuring the fleet's "network combat power." Instead of measuring the fleet's combat power as was done during the battleship and carrier eras by counting battleships or carriers or number of surface combatants in the Total Ship Battle Force, a transition to a new era would suggest that the Navy needs a new way to measure its latent combat potential. Until these new metrics are developed, many adherents to past fleet models will fight against change simply because the number of ships in the TSBF is shrinking.[311]

New fleet metrics for a distributed, networked battle fleet would help to counter these simple-minded arguments. For example, one new measurement might be the maximum number of multi-mission and single mission platforms in the ***Total Force Battle Network*** (TFBN), where both ships and unmanned systems and platforms count as network platforms. Yet another might be an adoption of a Wayne Hughes-inspired metric called "net delivered combat power over the effective life of the network."[312] The attractiveness of such a metric is that it implicitly includes the network's overall survivability. Whatever the new metrics may turn out to be, it seems a safe bet to predict that they will be different from those from the past, and will help to define a different future in which distributed naval battle networks represent the new "capital ship" of Information Age, network centric naval warfare.

In summary, the fleet transformation occurring under Admiral Clark's leadership represents as sweeping a transformation of the Navy's Total Ship Battle Force as the shift from a dispersed and independent cruiser model to a concentrated battle fleet model, and the shift from the battleship to carrier eras. To paraphrase a comment made in the Executive Overview of the 2003-2004 edition of *Jane's Fighting Ships*:

> Overall, Admiral Clark's new vision cleverly adapts the inherent qualities of naval forces to cope with a wide spectrum of future scenarios and, in so doing, pulls together all of the strands of current US Navy development in a clear and imaginative way.[313]

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[311] See for example James W. Crawley, "Navy Has Fewest Ships Since Before World War I," ***San Diego Union-Tribune,*** October 2, 2003.

[312] Hughes, *Fleet Tactics and Coastal Combat,* p. 165.

[313] See *Jane's Fighting Ships 2003-2004,* Executive Overview, p. 1.

V. Small Network Combatants in the 21st Century "Assured Access Navy"

The previous three chapters explain the Navy's reversal over small combatants, and help to better understand and the LCS's place within the Navy's broader transformation plans. In the process, two things become clear. First, scrutiny should focus less on the Navy's reversal over the inclusion of small combatants in its Total Ship Battle Force, and more on the Service's original obstinate decision to exclude small combatants in the first place. Second, the Navy's broader transformation vision appears to be one well worth pursuing—including the LCS and the HSV/TSV. A review of arguments on both side of the small combatant debate appears to firmly support the inclusion of small combatants in a battle fleet organized and trained to fight in distributed fleet battle networks.

That said, assigning such a prominent fleet role to small combatants in general, and to the LCS in particular, is still a controversial move. Recall that in the very same ***Jane's*** Executive Overview that spoke glowingly of Admiral Clark's overall transformation plans, the LCS was deemed "a ship in search of a capability, rather than a capability in search of a ship." Recall also the anonymous admiral who "(didn't) see what LCS does." Retired Navy Vice Admiral Hank Giffin and retired Coast Guard Rear Admiral John Tozzi were right when they wrote in the January 2003 issue of ***Proceedings***, "There is no consensus as to what this ship will be."[314] As a result, there are key audiences—both internal and external to the Navy—that remain unconvinced over the program's merits.[315] Unquestionably, then, the Navy still has many issues to resolve before the LCS takes its place in the 21st century TFBN.[316]

The next four chapters therefore aim to examine issues and arguments more directly related to the role of small combatants in general, and to the LCS in particular, in an era of distributed fleet battle networks that conduct assured access operations in and from the world's "narrow seas." This particular chapter will address three questions. First, what role might small combatants play in a 21st century Assured Access Navy? Second, what missions have small combatants performed for the US Navy in the past, and do these missions retain their relevance in the

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[314] Vice Admiral Hank Giffin, USN (Ret), and Rear Admiral John Tozzi, USCG (Ret), "'C' in LCS Stands for Combat," ***Proceedings***, January 2003, pp. 88-89.

[315] Three examples of spirited defenses of large ships sprinkled with a liberal dose of skepticism over the advantages of small combatants can be found in Stephen C. Audrand, "Blue-Water Power," ***Proceedings***, September 2001, pp. 42-44; Commander Stephen H. Kelley, USN, "Small Ships and Future Missions," ***Proceedings***, September 2002, pp. 42-44; and Lieutenant Commander Richard Brawley, USN, "Streetfighter Cannot Do the Job," ***Proceedings***, October 2002, pp. 66-69.

[316] Adam B. Siegel nicely summed up the range of uncertainty in the LCS program in a presentation entitled "Parsing the Littoral Combat Ship and Musings on its Implications for Naval Transformation," given at the Naval War College in May 2003. See also Norman Friedman, "New Roles for Littoral Combat Ships," in World Naval Developments, ***Proceedings***, January 2003, p. 4, and Friedman, O'Brasky, and Tangredi, in the section entitled ***Streetfighter, the Littoral Combat Ship, and the Case for Smaller Warships,*** in "Globalization and Surface Warfare," pp. 382-84.

emerging era? And third, to what degree have small combatant numbers contributed to past fleet counts, and what clues might this analysis suggest about the future Total Force Battle Network?

HOW SMALL IS SMALL?

As discussed in the previous chapter, the surface combatant fleet of the distributed battle network era promises to be more like the battleship era's heterogeneous mixture of large, intermediate, and small combatants, and less like the homogenous mixture of intermediate ships characteristic of the carrier era. Before proceeding further, it would be helpful to explicitly define these general ship groupings.

During the battleship era, large ships were typified by a small number of ship types (e.g., battleships, battlecruisers, armored cruisers, and heavy cruisers), larger numbers of ship classes within each type (e.g., *North Carolina*-class and *Iowa*-class battleships), and extremely large displacement ranges. For example, the first true US battleships, the ***Indiana***-class, had full load displacements on the order of 11,000 tons.[317] By World War II, the ***Iowa***-class battleship boasted a displacement of over 57,000 tons, and the giant Japanese ***Yamatos*** came in at 70,000 tons. The growth of armored cruisers to heavy cruisers was less dramatic, increasing from the early 7,180-ton ***Maine***-class armored cruisers to the superb, World War II-designed, 20,950-ton ***Des Moines***-class heavy cruisers.

Intermediate combatants also had a relatively small number of ships types (e.g., protected cruisers, peace cruisers, scout cruisers, light cruisers, and large gunboats) and larger numbers of ship classes, but with lighter displacements and much narrower displacement ranges. These ships' narrow range of lighter displacements ensured that they were substantially cheaper than large combatants, and that they could be built in relatively high numbers during wartime. Like the large combatants, intermediate combatants grew over time, culminating in the famous World War II 11,890-ton light cruisers of the *Cleveland* class.[318] For the purposes of this paper, then, the break point in displacement between intermediate and large combatants occurs at approximately 12,000 tons.

During the battleship era, small combatants generally fell into two categories: those that performed the battle force screening mission, and those that performed the wide variety of remaining escort and lesser naval missions. Small combatants that screened the battle force generally became part of the destroyer family, whose first ships were designed to destroy any non-battle line threat to the fleet's battleships and armored cruisers, allowing the "big boys" to concentrate their focus and firepower on the enemy's battle line. Thus, the early torpedo boat threat was handled by the torpedo boat destroyer, later shortened to destroyer, with a type

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[317] Displacements are drawn from either Friedman's *Illustrated Design History* series, the Naval Vessel Registry, or http://www.hazegray.org/navhist. All displacements are when the ship is at full load.

[318] The unique post-war ***Worchester***-class "light" cruiser had a design displacement of over 17,000 tons, greater than the wartime ***Baltimore***-class "heavy" cruiser. However, because the ships carried 6-inch guns instead of 8-inch guns, they were still classified as light cruisers. They proved to be impractical ships and were decommissioned less than a year after their commissioning. Friedman, *US Cruisers: An Illustrated Design History*, pp. 349-52 and 356-57.

designation of DD. Destroyers next confronted the emerging submarine threat, which was at first nothing more than a submersible torpedo boat. Finally, the threat of mines to a fast-moving battle line was ultimately handled by the fast destroyer minesweeper, or DMS.[319]

In 1905, a board convened at the direction of then-President Theodore Roosevelt outlined what was to become the standard Navy view of desirable destroyer characteristics.[320] In the board's view, high speed was less important than sustained battle force speed. Indeed, since the requirement for high speed tended to favor smaller and lighter ships, high speed defeated the purpose of the destroyer since it inevitably led to a smaller, less seaworthy ship. This judgment was made explicit when the board wrote that "a proper destroyer should first of all be capable of accompanying the armored fleet without detracting from its mobility in any except the worst weather." As a result, the Board concluded that s*ea speed* and *sea keeping* should be the primary design consideration for fleet destroyers, followed closely behind by good endurance expressed by a large radius of action.

During the battleship era, these characteristics initially meant that fleet destroyers had to maintain a sustained speed of approximately 21 knots in most weather conditions and have an unrefueled steaming radius greater than 2,000 miles.[321] The destroyer's top speed was dictated by a requirement to have a 70 percent speed margin over the battle line, to enable it to maneuver freely about the battle line when it was drawn up for battle.[322] The fleet requirement for a good sea-keeping boat with a sustained speed of 21 knots, a "battle speed" of 35 knots, and a large radius of action saw the displacement of early destroyers climb rapidly, from the 630-ton full load displacement of DD1 to the ultimate pre-War II destroyer—the *Gleaves* class—with a designed full load displacement of 2,060 tons.[323]

During World War II, destroyers added the destruction of aircraft attacking the fleet to their battle force screening mission. The requirement to carry large numbers of anti-aircraft weapons helped spur another big jump in inter-era generation destroyer displacements. The famous World War II *Fletcher*-class DDs came in at 2,700-2,800 tons, and they were soon followed by even

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[319] Friedman, *US Destroyers: An Illustrated Design History,* Chapters 1 and 2. For a discussion of early destroyer anti-submarine warfare tactics, see Chapter 4. The DMS conversion is discussed on pp. 50-51.

[320] A long excerpt from the report can be found in Friedman, *US Destroyers: An Illustrated Design History,* pp. 22-24. The quotations and information in this paragraph follows are drawn from these excerpts. The 1905 board results were endorsed by the General Board in 1910. See Friedman, p. 28.

[321] The requirement for the destroyer's unrefueled radius of action grew rapidly throughout the interwar years. See for example Friedman, *US Destroyers: An Illustrated Design History, pp. 128-129.*

[322] Friedman, *US Destroyers: An Illustrated Design History,* p. 129.

[323] Friedman, *US Destroyers: An Illustrated Design History,* Data Tables.

larger destroyers. The ultimate wartime destroyers were the 3,160-ton *Gearing* class DDs, although they were introduced in 1945, too late for widespread World War II service.[324]

Because of their large size, after the war the *Gearings* could be modernized and upgraded to combat new Soviet fast submarines. As a result, they ably performed the battle group ASW mission into the 1970s. At the same time, even larger guided missile destroyers and frigates were introduced for the anti-aircraft mission. Meanwhile, the smaller, lighter, *Fletcher*s were laid up after the war. Later, several were converted to less capable escort destroyers, or DDEs, which "would be able to detect and track a submarine, but would have to combine with other ships in order to make an effective attack." The Korean War saw some 60 of these ships returned to service and modestly upgraded to serve as austere escort vessels and gunfire support ships. However, the *Fletchers* simply did not have the room or weight margins necessary to carry the heavier, more sophisticated weapons needed for modern battle force defense.[325]

Thus, for the purposes of this paper, the break point in displacement between intermediate and small combatants was set immediately after World War II at approximately 3,000 tons. Moreover, since the *Fletcher*-class destroyer was the last small combatant that routinely operated with carrier strike forces, 3,000 tons also represents the lowest practical displacement limit for a battle force capable ship—at least since World War II.

Of course, as has been previously discussed, not all intermediate size ships are battle force capable. Only those capable of sustained battle force speeds and in excess of 30 knots and of carrying relatively large war loads earn that title. Accordingly, a *Spruance* DD is an intermediate size, battle force capable, multi-mission combatant at the upper end of the group's displacement range, while the *Perry* FFG is an intermediate size, non-battle force capable, multi-mission combatant at the lower end of the group's displacement range.

In summary, then, for the purpose of this paper a *small network combatant* is any warship with a displacement of 3,000 tons or less that is designed to function as part of a distributed fleet battle network. When designing a combatant with such a small hull, past designers have most often been forced to focus the ship's role and combat systems on a particular mission, such as anti-submarine warfare, mine warfare, or torpedo attack. And because each of these different missions demand different design attributes and characteristics, past small combatants have been typified by a very large number of different ship types and classes exhibiting a wide variety of hull forms and combat systems. As will soon be seen, however, the hope is that the LCS will break this pattern when it becomes part of the Navy's 21st century Total Force Battle Network.

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[324] Chapter 6, "To the Big Destroyers, 1941-1945," in Friedman, *US Destroyers: An Illustrated Design History,* pp. 137-164.

[325] See Friedman, *US Destroyers: An Illustrated Design History,* pp. 258-261, and 284-290.

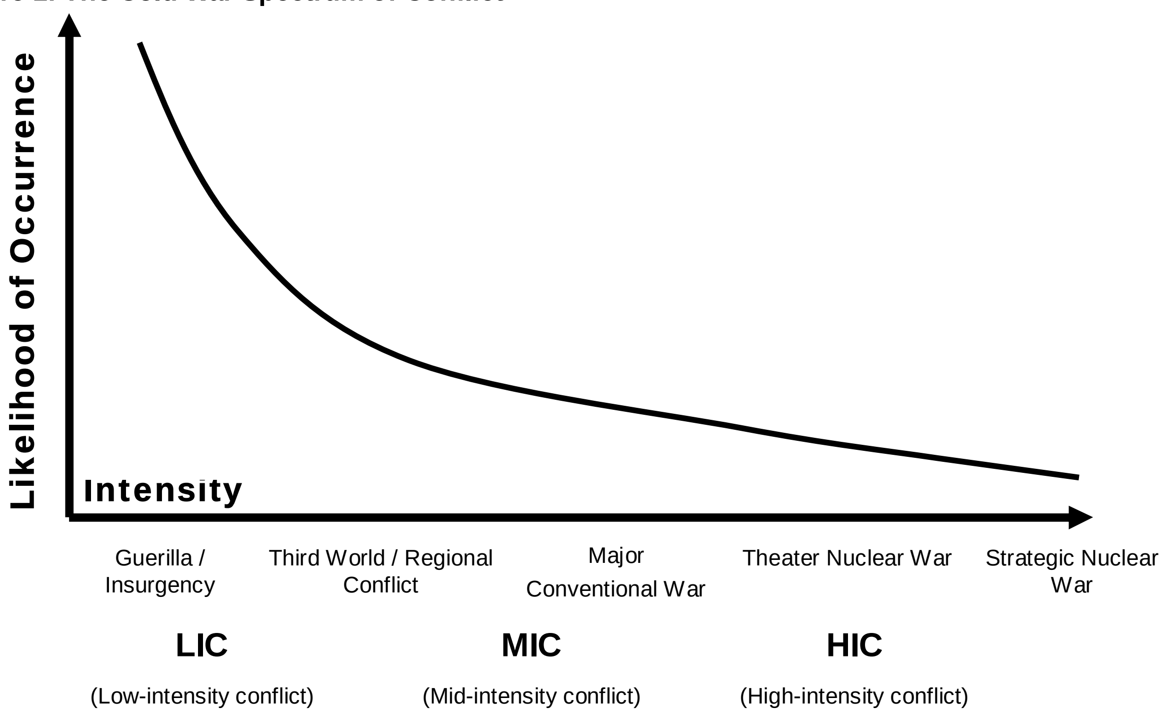
"ASSURED ACCESS" IN THE 21ST CENTURY

How, then, might small network combatants contribute to the 21st century TFBN? Before directly answering this question, one must understand the general operational and tactical conditions under which future battle networks will operate.

As implied above, the sea control century was characterized by threat-based naval planning. The US Navy would count the numbers, types and classes of its most likely (and even most unlikely) opponents, study their doctrine, and then build a TSBF with superior numbers and/or capabilities to ensure a comfortable margin of naval superiority. The threat-based wartime fleet was the same fleet used to perform peacetime naval tasks and naval crisis response missions in circumstances short of war.

Taking the Cold War as an example, the probability that the Navy would conduct routine presence deployments and participate in low-intensity conflict was much higher than the probability that it would fight in a mid-intensity regional conflict. In a like way, it was more likely that the Navy would fight in mid-intensity conflict than in a general war with the Soviet Union (see Figure 1).[326] However, the stakes of the least likely alternative were so high as to dictate overall TSBF design; given the size and capability of the Soviet fleet, every ship in the US TSBF had to be able to defeat any potential Soviet threat associated with its designed mission tasking.

Figure 1: The Cold War Spectrum of Conflict



[326] Drawn from Adam B. Siegel, Northrop Grumman Analysis Center, "Parsing the Littoral Combat Ship and Musings on its Implications for Naval Transformation."

One consequence of a TSBF design focus on the least likely, but most stressing operational scenario was that the US Navy gradually got out of the small combatant business and began to emphasize expensive, intermediate size, multi-mission combatants. As will be discussed in greater detail shortly, during the Cold War, NATO navies provided the allied maritime coalition with the lion's share of small combatants. As a result, 8,000-ton *Spruance* DDs designed primarily for open-ocean ASW and land attack were routinely used during peacetime for such mundane naval missions as maritime interdiction operations—a mission far better suited for smaller warships. The inefficiency of using billion-dollar warships with crews of over 300 for traditional small combatant missions was the price paid for maintaining a large fleet of intermediate combatants at high readiness for a possible war with the Soviet Union.[327]

With the fall of the Soviet empire, and as the Navy transitions from a focus on sea control to a focus on littoral power projection, circumstances are fundamentally different. The battle force can no longer be designed with a particular naval opponent in mind since there is no credible naval opponent on the horizon. The Navy must therefore embrace the idea of planning for a range of prospective contingencies. This is in keeping with Secretary Rumsfeld's charge to the four Services to move away from planning based on a known threat and toward planning based on a range of plausible contingencies. In today's jargon, the Navy, along with the other Services, is thus shifting from "threat-based" to "capabilities-based" planning.[328]

With these new strategic realities in mind, the future Total Force Battle Network must have an adaptable mix of capabilities to allow it to guarantee safe delivery of goods and services through littoral waters in support of joint campaigns regardless of the threat presented by an opposing coastal navy. In other words, the 21st century Navy must have the necessary capabilities to achieve "assured access"—an ***end state*** in littoral waters analogous to air supremacy—under any and all threat conditions.

Even if the precise future naval opponent is as yet unknown, future fleet battle networks will have to achieve assured access in any one of four basic threat conditions:

- *Unimpeded Access*. In this case, the opponent has no coastal navy and no capability to threaten US forces operating at sea. This was the case during Operation Enduring Freedom, the joint campaign against the Taliban regime in Afghanistan. In cases of unimpeded access, battle network combatants can maximize the range of their weapons by operating as close to a nearby coast as is prudent, and the fleet can assemble an enhanced networked sea base as quickly as possible and as close to the shore as feasible. This threat condition also holds true for the majority of peacetime operations, such as sanctions enforcement, counter-drug patrols, and humanitarian assistance and disaster relief operations.

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[327] Truver, "The BIG Question," p. 24.

[328] *Quadrennial Defense Review Report* (Washington, DC: Office of the Secretary of Defense, September 30, 2001), p. 13.

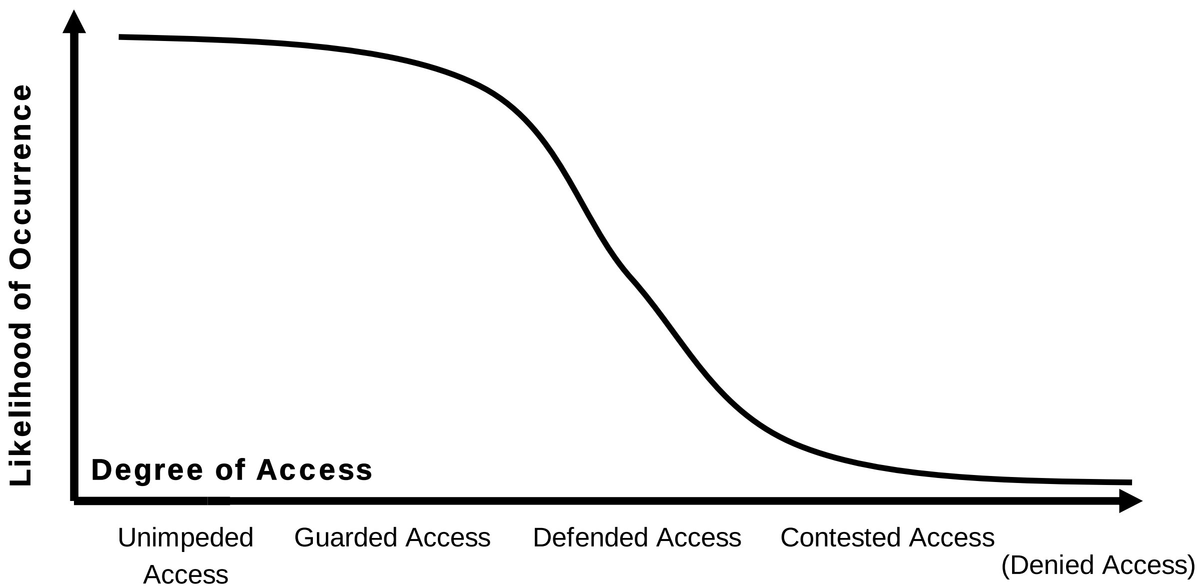
- *Guarded Access.* There are two variations of this category. In the first case, the opponent has a coast guard—a modest coastal fleet designed mainly for maritime domain awareness and defensive maritime interdiction mission. Its fleet consists of patrol combatants armed primarily with guns, perhaps augmented by a modest number of maritime patrol aircraft. These assets perform a maritime guard role in peacetime, and an early warning function in wartime; they pose no serious naval threat. In the second case, the early warning function is performed by an irregular naval force, perhaps using fishing boats and simple communication architectures involving line-of-sight radios or even cell phones. In both instances, should the US be poised to conduct power projection operations, the primary role of the enemy's naval guard force would be to give its leadership and land-based forces time to disperse before being subject to US long-range precision attack. Under this threat condition, like that of unimpeded access, battle network combatants and the fleet sea base can operate close to the coastline as soon as they arrive in the operating area.

- *Defended Access.* Again, there are two variations to this category. In the first case, the opponent has a small but modern navy capable of conducting ***limited naval attacks in one or several operational dimensions*** (air, surface, sub-surface). In the second case, a state or non-state group without a proper navy might plan on surreptitious mining or swarming boat attacks, including suicide attacks. Since neither threat would likely deter US joint operations or succeed in defeating a warned and prepared US battle network, the intent here would be to bloody the nose of US naval forces and to give US military and political leaders pause. Thus, the biggest danger in this case is a surprise attack against an isolated or unprepared network combatant, or an attack against an isolated and un-alerted component of a larger battle network. In cases of defended access, US naval forces might expect to be able to establish their sea base at or just beyond optimal offshore ranges after a period of relatively intense combat, although continued attention to battle network and sea base screening would be required.

- *Contested Access*. This condition represents the most severe threat a US fleet battle network might face. In this condition the US Navy seeks to guarantee safe delivery of joint goods and services through littoral waters, and a capable, determined enemy seeks to deny their ability to do so. In this situation, the opponent has a modern distributed naval anti-access/area-denial network, capable of long-range over-the-horizon sensing and ***intense, sustained multi-dimensional attacks*** to ***the limits of its sensor range***. Some close-in littoral waters may be so capably instrumented and defended by the enemy as to be considered denied to US naval forces. In these circumstances, superior scouting, an information advantage, and sound joint asymmetrical counter-network planning and tactics will likely determine the outcome. Few network combatants and no components of an enhanced networked sea base would venture into contested littoral waters until the enemy's A2/AD network had been significantly degraded, and even then great attention would be placed on battle network and sea base screening and defense.

Borrowing from the previous Cold War discussion, one can describe a similar general probability curve for these four access conditions, in which the likelihood of unimpeded and guarded access is higher than that of defended access, which is itself higher than that of contested access. While the exact shape of the curve may change and "flatten out" over time as naval capabilities and A2/AD systems proliferate, the general "S-shaped" curve depicted in Figure 2 now seems to be generally accurate. For example, in a survey of global purchases of naval A2/AD systems, naval analyst Norman Freidman concluded that there is no compelling evidence to suggest that capable A2/AD networks are being broadly pursued. While this circumstance may change over time, for the moment the Navy still finds itself with few serious littoral challengers.[329]

Figure 2: 21st Century Access Spectrum



Implicit in the "access curve" is an opposing curve which describes the threat to US naval battle networks in terms of range and enemy capabilities. In this regard, the Israeli definition of the littoral battle space is the most applicable: "the area of the sea adjacent to an enemy coast protected by detection and weapon systems *based on land, ships, and aircraft within the area"* (emphasis added).[330] The key difference between this definition and one based on geography (e.g., the area from the continental shelf shoreward) is that it focuses on the capabilities of the potential maritime opponent and not those of an advancing US battle network.[331] It therefore implicitly recognizes the disadvantages faced by a naval battle network approaching a defended or contested coastline, and is in keeping with the admonition attributed to Lord Nelson that "a

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[329] Norman Friedman, "Globalization of Anti-Access Strategies?" Chapter 26, in *Globalization and Maritime Power,* Sam J. Tangredi, editor (Washington, DC: National Defense University Press, 2002), pp. 487-501.

[330] Captain Opher Doron, Israel Navy (Ret), "The Israelis Know Littoral Warfare," *Proceedings,* March 2003, p. 67.

[331] "The littoral is not a fixed geographic area, but rather an increase in threat level as you near the shore and become more affected by elements operating under its wing…The near you come, the more diverse the enemy's weapons become and the better his targeting." Doron, "The Israelis Know Littoral Warfare," p. 67.

ship's a fool to fight a fort."[332] It also compels naval battle network commanders to develop the general tactics and weapons appropriate for all access scenarios, even though they know that they will have to modify these tactics when confronted by a specific threat.

Also implicit in the access curve is an opposing curve that describes the time required for a US naval battle network to achieve "assured access." In unimpeded and guarded scenarios, assured access is a given; in defended and contested scenarios, it is not. Enemy A2/AD forces will try to maximize the amount of time before US joint power projection operations can count on the guaranteed delivery of joint goods and services through its coastal seas; the job of a US battle network is to minimize it. This time-based access competition will thus help in no small way to determine the pace and outcome of the joint campaign ashore. This will be especially true in a potential reinforcement scenarios, such as a US joint response to a North Korean invasion of South Korea.[333]

The access curve helps to identify the capabilities required of an Assured Access Navy, and gives hints about how its Total Force Battle Network must evolve. Unlike during the Cold War, when the ***entire*** fleet was designed to prevail in the least likely, but most stressing operational scenario, there is no compelling reason to design the ***entire*** TFBN to operate under the least likely threat condition. In the early stages of the 21st century, the Navy faces no dominant naval opponent and current anti-access and area denial networks are in a nascent state. As a result, fleet planners and have the luxury of building special purpose ***components*** that can be assembled into distributed fleet battle networks tailored especially for a particular access condition. In other words, strategic circumstances and the increasingly evident power of joint and naval battle networks provide fleet planners with a higher degree of design freedom than in the immediate past.

Until more pressing threats reveal themselves or A2/AD capabilities begin to proliferate more widely, naval planners need only to design a component of the TFBN that is capable of overcoming any near- to mid-term A2/AD network, and to continue to develop the tactics and weapons necessary to defeat any networks that emerge over the longer-term. This specialized counter-A2/AD component would be designed to operate inside an enemy's battle network with relative impunity, and trained to roll back the enemy's A2/AD network so that the bulk of the US and allied fleets can close with an enemy's coast and lend their support to inland operations as soon as possible.

Said another way, the Navy's counter-A2/AD component would be responsible for the initial, risky littoral penetration mission that aims to unhinge and collapse the enemy's A2/AD network. In the near- to mid-term, this component might include stand-off electronic and information warfare systems that can probe, deceive, and attack the enemy network's information and sensor systems; stealthy, intermediate-range naval aircraft launched from US aircraft carriers that can

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[332] Hughes, *Fleet Tactics and Coastal Combat*, p. 26, 36-39; Doron, "The Israelis Know Littoral Warfare," p. 67.

[333] The time dimension of the access curve was pointed out to the author by James S. O'Brasky.

strike key enemy network targets (e.g., the future Joint Strike Fighter armed with the Joint Air-to Surface Stealthy Missile (JASSM)); long- and intermediate-range stealthy and non-stealthy land attack missiles fired against key enemy network nodes from combatants located far over the horizon; stealthy attack submarines that can covertly sanitize the littoral undersea environment; and stealthy SSGNs that can provide covert volume strike and special operations support. Of course, when conducting littoral penetration operations, these naval counter-access forces would also receive direct support from joint counter-A2/AD forces, such as Air Force long-range bombers and Army special operations forces. Over the mid- and long-term, both the joint and naval counter-access forces will increasingly rely upon a host of unmanned air, sea, and sub-sea systems that would provide information about the enemy's network and attack its key components.

The only crewed surface vessels that should actually penetrate into contested littoral waters are special purpose, extremely stealthy vessels, or stealthy combatants with extremely high staying power. The only systems that would venture into denied littoral waters are unmanned systems.

Indeed, the access curve suggests is that that the "sweet spot" for TFBN ship design appears to be those capabilities that allow a ship to operate as part of a distributed fleet battle network approaching a defended coastline, and to overmatch any threat in guarded and unimpeded waters. These ships would require far less stealth and staying power than those designed for operations in a hotly contested littoral. However, as an enemy's A2/AD network is degraded, ships designed to operate in a defended littoral would form the "second operational echelon" of the naval battle network, exploiting fissures in the enemy's network as it is progressively rolled back by the joint counter-access forces.

With this in mind, during the first two decades of the 21st century the core of surface combatant fleet will consist of 84 modernized second-generation carrier era combatants that, if astutely employed as part of a distributed fleet battle network, appear more than capable of confronting defended littoral access threats in the near- to mid-term.[334] This seems especially true if the fleet battle network is surged from home waters and has its defenses up and "fangs out" when entering a potentially hostile littoral operating area. Importantly, this powerful core of 84 ships, each designed for high-intensity sea control warfare and equipped with the AEGIS combat system and VLS batteries with 90 or more individual missile cells, also serve to dissuade would-be competitors from pursuing an open-ocean naval competition with the US Navy.

The role of the DD(X), and that of the follow-on CG(X), is also relatively clear. The CNO has stated in public that the DD(X) will have a radar cross section "smaller than a fishing boat" and an acoustical signature "quieter than a submarine's."[335] This high degree of stealth, coupled with the ship's extensive electronic warfare systems, advanced underwater warfare suite, new multi-function phased array radar, and dense anti-missile defense should help the ship to achieve a high

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334 The Navy plans to modernize the 22 VLS-equipped *Ticonderoga* guided missile cruisers, and halt production of the Burke DDG after 62 units.

335 Koch, "DD(X) Moves Ahead," p. 2.

degree of hit avoidance. DD(X) will also have the higher staying power inherent in a large 14,000 ton hull, augmented by advanced damage limitation features and next generation fire suppression and damage control systems. The Navy expects the DD(X)'s high degrees of hit avoidance and staying power to make them suitable for employment in even contested access scenarios.[336] The Navy expects the same of the follow-on CG(X), which will have many of the same design features.[337]

Over time, evolving threats may make the employment of even these ships in close-in waters covered by an intact, high end A2/AD network problematic. Should this prove to be the case, in the second and third decades of the 21st century, as the second generation carrier era combatants start to reach the end of their service lives, they would become the core of the surface fleet designed for battle network operations in defended littorals.

The key questions that remain, then, are:

- What roles have small combatants traditionally performed in battle fleet operations?
- Are these roles still valid for the 21st century Assured Access Navy and its Total Force Battle Network?[338]

EXPENDABILITY REVISITED

It seems clear that the idea of designing small expendable combatants primarily to reduce the fleet's "risk tolerance" in contested access scenarios still lingers—an unfortunate holdover of the early ***Streetfighter*** debates. For example, one of the missions still being considered for the Littoral Combat Ship is the deployment of the Navy's Expeditionary Sensor Grid in contested littorals scenarios.[339] Presumably, the loss of the ships and their crews would be well worth it if they could successfully employ battle network sensors before being sunk, thereby increasing the odds that the overall battle network would prevail against a capable littoral foe.

This paper takes the position that while sacrifices are often required and made in war, the idea of "designing ships to lose" or asking a single component of a force to make disproportionate

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[336] One of the best current descriptions of DD(X) can be found in Captain Chuck Goddard, USN, and Captain Al Haggerty, "DD(X) Program Overview for Defense Daily," a PowerPoint briefing dated November 6, 2003.

[337] Interestingly, the Navy decided not to pursue a common hull for the DD(X) and CG(X), which was a key design goal in both the original SC-21 and DD(X) programs. See Malina Brown, "Navy Officials Back Off From Plans to Use Same Hull for DD(X) Family," ***Inside the Navy,*** July 23, 2003, p. 1.

[338] Again, as Sam J. Tangredi points out, these broader strategic-level questions are far more important than questions about LCS speed and hull design. Tangredi, "Rebalancing the Fleet: Round 2," p. 36.

[339] From author interviews with officers on the OPNAV staff conducted during October and November 2003. All of the officers interviewed preferred to state their opinions off-the-record.

sacrifices so that the fleet may prevail in battle is a preposterous proposition and one unworthy of a great Navy.

The fact is that the US Navy has never—*ever*—designed *any* ship to be expendable. Traditional naval combat is the epitome of attrition warfare. The goal is to "fire effectively first," and to sink as many enemy ships or to destroy as many land targets as possible.[340] For as long as the Navy has gone to sea, and particularly since 1889, the Navy has built fleet architectures including mixtures of large, intermediate, and small combatants that have been optimized to achieve this goal, and to perform the wide variety of missions expected of a global navy. For as long as the Navy has gone to sea, it has also been implicitly understood that ships and their crews might be compelled by desperate or unlucky circumstances to attempt missions that would normally be assigned to larger, more capable ships, and that their losses and casualties in these undesirable circumstances might be severe. But at no time have there been any fleet ***plans*** to consider specific ship types and their crews to be "combat consumables"[341] or to build a fleet component explicitly designed to absorb a disproportionate number of fleet casualties.

Some might point to the famous World War II Patrol Torpedo (PT) boats to support the notion that the Navy has, in fact, built expendable littoral combat ships. These diminutive attack craft were originally designed to attack larger surface ships in coastal waters, and the possible "exchange" of one of these plywood boats for an enemy destroyer, cruiser, or battleship was undoubtedly an alluring one for fleet operational planners. However, throughout World War II, the Navy operated some 426 PT boats, of which only 42 were lost to enemy action.[342] A ten percent loss rate hardly supports the claim that the Navy employed these boats any more callously than other fleet units. Moreover, the preferred torpedo tactics employed by the PT boats indicate clearly that their crews never considered themselves to be expendable. Unlike the high speed torpedo runs popularized in movies, the crews employed ambush attacks at night while running at slow speed on muffled engines. If not discovered prior to torpedo release they would retire, again at slow speed, on a different heading. Only if discovered and taken under fire would they rely on the PT boat's acceleration, maneuverability and speed to escape, evade, and (hopefully) survive.[343]

Like any ship, if a PT boat found itself in a situation in which it was overmatched, it suffered. But no more so than overmatched US destroyers and cruisers that in 1942 squared off against Japanese opponents better trained for close-in night actions and armed with the fearsome Long

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[340] "Fire effectively first" was coined first by Wayne Hughes in the first edition of *Fleet Tactics*. It is the first sentence in the second edition. Hughes, *Fleet Tactics and Coastal Combat*, p. xviii.

[341] A term coined by Admiral Cebrowski. See *Fleet Tactics and Coastal Combat*, p. xix.

[342] Norman Friedman, *US Small Combatants: An Illustrated Design History* (Annapolis, MD: Naval Institute Press, 1987), pp. 157-58.

[343] For a thorough discussion of wartime PT boat tactics and operations, see Chapter 6, "The Wartime PT," in Friedman, *US Small Combatants: An Illustrated Design History.* Specific comments on the PT's reliance on stealth can be found on p. 156 and 178.

Lance torpedo.[344] And no more so than the destroyers, destroyer escorts and escort carriers that found themselves staring down the gun barrels of Japanese battleships and heavy cruisers in the 1944 Battle of Samar.[345] The historical evidence appears to be quite clear: the Navy builds ships and trains crews for missions in which they have a better than even chance of success. Moreover, when an envisioned ship proves incapable of conducting its designed mission—because of either inadequate or faulty planning or a design flaw—the Navy works hard to find the ship a useful and tactically appropriate mission before discarding it. Thus, the PT boats in the Southwest Pacific and Mediterranean theaters were gradually assigned to an important "barge-busting" mission in which they excelled.[346]

Neither does the highlighting of past fleet components that suffered disproportionate casualties support the notion of expendability. Consider the case of the US World War II submarine force. The superb *Gato* and *Balao* class fleet submarines, with crews of 65-80 officers and Sailors, were the best undersea weapons the Navy could design and build, and arguably the best in the world at what they were designed to do: sink enemy ships.[347] However, of the 263 submarines and 16,000 Sailors that went on war patrols in the Pacific, 52 boats (20 percent) and 3,617 Sailors (22 percent) never returned—casualties far higher than any other World War II battle fleet component.[348]

Despite these sobering figures, there was never any hint that the subs and their crews were considered expendable. Instead, the Navy recognized that in the early years of World War II, the submarine fleet found itself in a desperate situation for which they were unprepared and unsupported. Admiral Chester Nimitz, the top naval commander in the Pacific, made this clear when he said: "We shall never forget that it was our submarines that held the lines against the enemy while our fleets replaced losses and repaired wounds."[349] Indeed, it is hard to imagine the continued high wartime esprit and morale of American submariners if they thought for one moment that their senior commanders considered them to be fleet "cannon fodder."

A more sophisticated argument used by those who support the notion of expendable ships is that small combatants would be ideally suited to perform the maritime equivalent of the "Wild Weasel" suppression of enemy air defense (SEAD) mission. But again, the analogy is strained.

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344 For a compelling recapitulation of the first night surface actions between US and Japanese naval forces in World War II, see Hughes, *Fleet Tactics and Coastal Combat,* pp. 133-37.

345 In this case, only heroic suicide runs by the US destroyers kept the situation from disaster. See Hagan, *The People's Navy,* pp. 325-26; Beach, *The United States Navy,* p. 475.

346 Again, see Chapter 6, "The Wartime PT," in Friedman, *US Small Combatants: An Illustrated Design History,* particularly p. 156.

347 See "*Gato, Balao,* and *Tench* Classes," at http://www.battlebelow.com/gato.htm.

348 From "What They Did," on the Submarine Veterans of World War II website at http://www.submarinevets.com/~subvetsww2/theydid.html.

349 Submarine Veterans of World War II website at http://www.submarinevets.com/~subvetsww2/theydid.html.

The Wild Weasel mission and the specialized force that performed it came about in 1966 when the introduction of Soviet built SA-2 surface-to-air missiles by the Vietnamese armed forces surprised the Air Force and caused the loss rate of US combat aircraft to climb abruptly. In response, the Air Force modified several F-100F ***Super Sabers*** with equipment to see if they could identify and locate SA-2 guidance radars, which could then be attacked by other aircraft. Operational testing proved successful, and the Air Force hurriedly fielded and dispatched Wild Weasel squadrons to theater to assure access for American fighter-bombers over the skies of Vietnam.[350]

The name Wild Weasel came from the two types of specialized aircraft and crews that originally flew these dangerous missions: those that flew into a target area at low altitude to "weasel" their way into enemy territory, locate the SA-2 radars, and mark them for attack; and the "wild" aircraft that would conduct one-on-one duels with the SAM batteries themselves.[351] Later, the missions of Wild Weasel aircrews evolved into either Iron Hand suppression missions, or Wild Weasel hunter-killer missions.[352] The danger associated with both of these missions is easily inferred from the Wild Weasel's proud motto: "First in, last out."[353]

Importantly, the aircraft that were and are still used for the Wild Weasel mission were not cheaper, less capable, "expendable" versions of the fighter-bombers they were designed to screen and protect. They were instead specially modified versions of the same planes. If anything, the planes were ***more*** expensive than the basic fighter-bomber version from which they were derived. At no times were they ever intended to be "expendable."[354]

That said, because of the inherent dangers of the mission, the loss rates of these early Wild Weasel efforts were appalling: almost 50 percent of the early aircraft and their crews were lost in action. These rates were simply not sustainable, no matter how brave the crews or how high the importance of maintaining tactical aviation access over Vietnam. This spurred constant tinkering with tactics and weapons that improved both the effectiveness of the mission as well as the odds of crew and aircraft survival.[355] Indeed, since Vietnam, the loss rates for planes flying SAM suppression missions have been no higher than that of other tactical aircraft.

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[350] See the "History of the Wild Weasel," at http://wildweasels.org/history.htm.

[351] Colonel Harold E. Johnson, "Of Bears, Weasels, Ferrets, and Eagles," found in the ***Airpower*** magazine archives at http:// www.airpower.maxwell.af.mil/airchronicles/aureview/1892/jan-feb.

[352] "Iron Hand SAM Suppression," at http://www.wpafb.af.mil/museum/history/vietnam/469th.

[353] Jason Tudor, "Seek, Attack, Destroy: Spangdahelm Wild Weasels Gouge Enemy Eyes," found on the web at http://www.findarticles.com/cf_dls/m0IBP/7_46/89646662/pl.

[354] The first Wild Weasel aircraft were modified versions of the F-100 Super Sabre. Later aircraft were specially modified F-105 Thunderchiefs and F-4 Phantoms. Current SAM suppression aircraft are the "CJ" version of the F-16. "History of the Wild Weasel" at http://wildweasels.org/history.htm.

[355] Johnson, "Of Bears, Weasels, Ferrets, and Eagles."

As implied by this discussion, one sure way to mitigate risk in combat is to adopt specialized tactics and weapons to counter specialized threats. The Navy, for example, opted not to follow the Air Force example and decided not to train and equip specialized Wild Weasel SAM suppression squadrons. Instead, they modified their radar jamming aircraft and their strike fighters so that every airplane in a strike package could fire a high speed anti-radiation missile, and they emphasized preemptive suppression firing of these missiles at all radiating radars for the duration of an attack. This distributed approach to the SAM suppression mission proved to be just as effective as the Air Force's specialized approach.[356]

The historical evidence thus suggests that the risk tolerant laying of fixed sensor grids and the suppression of enemy littoral defenses in contested littorals are the wrong missions for first generation battle network combatants. For both of these missions, the Navy should count less on the planned sacrifice of small ships and brave crews and more on specially designed platforms and weapons, and on contested sensor emplacement tactics designed to accomplish the mission with the lowest risk to life and equipment.

In this regard, the Navy could pursue any of the following platform alternatives: submarines; stealthy unmanned grid dispensers; semi-submersible sensor dispensers; extremely stealthy manned sensor dispensers, perhaps designed along the lines of the Navy's Sea Shadow stealth demonstrator;[357] or even a "G-(grid) ship"—a US containership modified to covertly lay grid sensors along an enemy's continental shelf long before hostilities begin. These new platforms would be used in combination with new fleet suppression of enemy littoral defenses (SELD) tactics that aim for the heavy and sustained electronic and kinetic suppression of enemy shore-based sensors and weapons for the entire duration of the grid insertion operation. As is the trend for suppression of enemy air defense tactics, SELD tactics would most likely emphasize unmanned systems over time.

Under no circumstances should a small, non-stealthy, lightly armed, crewed surface combatant be the first choice for either the grid insertion mission or the suppression of enemy defenses in a hotly contested littoral. The same line of reasoning holds true for any mission that might count on the *planned* disproportionate sacrifice of any particular ship type and their crews.

The foregoing discussion might prompt some veterans of the early ***Streetfighter*** debates and the Capabilities for the Navy After Next project to ask the following question: if you don't build small combatants to be expendable or to lay a sensor grid in a contested littoral, why would you build them at all? What other possible roles could small combatants play in 21st century naval warfare?

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356 The Navy's SAM suppression approach, while effective, burns through ordnance at very high rates. Navy SEAD operations expend far higher numbers of High-speed Anti-Radiation missiles (HARMs) than do Air Force operations. From conversations with Adam Siegel, Senior Analyst at the Northrop Grumman Analysis Center.

357 See "Sea Shadow" in the US Navy Fact File at http://www.chinfo.navy.mil/navpalib/factfile/ships/ship-sea.html. See also JO1 (SW) Jason McKnight, "'Sea Shadow' Premier Test Platform for Stealth," *The Waterline*, January 9, 2004, at http://www.dcmilitary.com/navy/seaservices/9_01/national_news/26900-1.html.

If history gives any indication, quite a few.

TRADITIONAL COMBAT ROLES FOR SMALL COMBATANTS

A review of the historical record since 1889 reveals ten broad small combatant missions that have made consistent and vital contributions to battle fleet operations.

Battle force screening was a priority wartime mission for small combatants in the post-1889 Navy. The cost and resources devoted to the capital ships that made up the early battle line and the later carrier task forces ensured that only a relatively small number could be built. During the battleship era, the US battle line rarely exceeded 15 modern battleships, and only during World War II has the number of carriers exceeded that number. As a result, smaller combatants were initially built in large numbers to protect the relatively small number of "high value units" from enemy attack.

Recall that the key requirement for a battle force screening unit was that it be capable of operating with the battle line under all but the most difficult sea conditions, which demanded a large radius of actions and a minimum sustained speed of approximately 21 knots during most of the battleship era, and approximately 30 knots during the carrier era. The requirement for sustained speeds in all weather while carrying a useful weapons load saw battle force screening units continually grow in size since 1889. The demands of anti-air, anti-submarine, and anti-surface warfare in the jet, missile, and fast submarine era gradually made small combatants ill-suited for the battle force screening mission. As a result, the ***Fletcher-class*** DD was the last ***small*** combatant that was considered to be battle force capable.[358]

Of course, the attributes required for the ***defensive*** battle line screening mission—high tactical speed, acceleration, and maneuverability—made these ships also suitable for ***offensive*** action against an opposing battle line, primarily by torpedo attack and offensive mining. Thus, in addition to the quick-firing guns that destroyers carried to repel opposing fast torpedo craft, and the depth charges to destroy submarines, early destroyers carried batteries of anti-ship torpedoes capable of putting the largest ships out of action.[359]

Importantly, however, the offensive side of the battle force screening mission has always been subordinate to the defensive side in the US naval planning calculations. From the early twentieth century to this day, fleet planners and operational architects have conceived of the battle fleet as the Navy's primary offensive arm, and the capital ships (first battleships and later carriers) as the arbiter of naval battle. Thus, even as destroyers evolved into more capable warships and their commanders demanded increased offensive capabilities, fleet planners consistently refused to

[358] As previously noted in Friedman, *US Destroyers: An Illustrated Design History*.

[359] Friedman, *US Destroyers: An Illustrated Design History,* p. 1-33.

emphasize small combatant offensive anti-surface (torpedo and anti-ship cruise missiles) armament over their defensive gun and missile batteries.[360]

The second small combatant mission, with a lineage that can be traced to the early 1900s, is ***mine warfare***. Over time, mine warfare combatants were divided into two distinct families of ships. One family had the speed to keep pace with the battle forces, giving the battle force an organic capability to hunt for, sweep, and lay mines. These ships included the aforementioned destroyer mine sweepers (DMSs) and fast destroyer mine layers (DMs). As is evident by their names, these ships were specially modified battle force destroyers. The second family of combatants were dedicated, purpose-built mine warfare ships, including relatively larger ocean minesweepers, or MSOs; smaller coastal mine hunters, or MHCs; even smaller yard minesweepers, or YMSs; and smaller still mine sweeping boats, or MSBs. None of the ships in this family of mine warfare ships could steam much faster than 10-15 knots.[361]

Mines are a very potent threat in shallow water. In fact, since World War II, fourteen US Navy ships have either been sunk or damaged by mines in littoral seas—three times the number damaged by air or missile attack—and naval commanders have been wary of operating in mine-infested waters.[362] However, during the Cold War, the surging US battle fleet could count on numerous allied mine countermeasure ships already deployed in the most likely forward theaters of operation. As a result, fast mine countermeasure craft disappeared from fleet service, and the Navy's dedicated mine countermeasures fleet was gradually reduced. The 14 *Avenger*-class mine countermeasure warfare ships (MCMs) and 12 *Cardinal*-class MHCs remain the only dedicated mine warfare ships in the Navy's current battle force. While very capable ships, their slow speeds (14 and 11 knots, respectively) make them unsuitable for fleet surge operations. As a consequence, the Navy forward bases small numbers of both types ships in both the Persian Gulf and in Japan.[363]

The third small combatant mission, ***protection of shipping***, can trace its lineage to World War I. In this mission, small combatants have escorted merchant ships and screened them from surface, sub-surface, and aerial attack. One of the first small US combatant of this type was the 110-foot, wooden-hulled subchaser (SC) built in numbers during World War I. These small ASW vessels also played an important role during World War II, along with larger 173-foot, steel-hulled patrol coastal anti-submarine combatants, or PCs. The demands of the World War II Atlantic campaign

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[360] Some early naval enthusiasts, President Theodore Roosevelt among them, viewed the destroyer's offensive role as predominant, much like the German Navy did at the time. However, after the Spanish American War, fleet planners opted to follow the British Royal Navy practice of emphasizing the ship's defensive battle force screening role, always opting for a heavy gun armament rather than torpedo armament. This preference continued up until the development of the VLS. ***US Destroyers: An Illustrated Design History,*** pp. 27-33, and 93.

[361] The Army operated mine warfare vessels after 1900 in the coastal defense role. The first US Navy mine warfare vessels appeared in the fleet in 1911. In 1955, the Navy recognized 12 distinct types of mine warfare craft. See "History of Mine Warfare Vessel Classifications" at http://battle.netgate.net/nma/history.htm.

[362] Admiral Robert J. Natter, "Access is Not Assured," ***Proceedings,*** January 2003, p. 39.

[363] See Polmar, ***Ships and Aircraft of the US Fleet,*** 17th edition, pp. 216-25.

saw these diminutive ASW combatants augmented by larger ocean escorts that screened slow-moving convoys, amphibious task forces, and underway replenishment groups from submarine attack. These ships included anti-submarine patrol frigates, or PFs; reverse lend-lease corvettes; and austere anti-submarine destroyers incapable of keeping up with the battle line, referred to as destroyer escorts, or DEs.[364]

Throughout the Second World War, the relatively slow speed of these small ASW combatants (15-20 knots) was not a hindrance because it was more than fast enough to allow the ships to maintain station with World War II-era convoys and amphibious task forces, and it gave the ships a healthy speed margin over any submerged diesel submarine. However, with the post-war appearance of fast nuclear attack submarines, long-range maritime strike aircraft armed with anti-ship cruise missiles, and 20-knot amphibious task forces and combat logistics force ships, ocean escort speed and armament needed to be substantially improved.[365] This helps to explain the big jump in displacements that occurred in first-generation carrier era ocean escort ships, which ultimately led to the 4,000-ton *Knox*-class frigate. By the end of the carrier era, the protection of shipping mission generally demanded an intermediate-size, missile armed ship.[366]

During the age of sail, small, swift combatants were long used to perform the ***battle fleet scouting*** mission in support of the larger, more ponderous ships-of-the-line. As navies shifted to steam-powered warships, most navies began to assign this mission to relatively large cruisers. These cruisers performed either strategic scouting or tactical scouting. The former aimed at determining whether or not an enemy fleet had departed from its base or was on its way to a contested area of operations; the latter aimed to contact the outer elements of an advancing enemy fleet and to ascertain details about the size and disposition of its forces.[367]

Throughout the battleship era the US Navy was relatively "cruiser poor," and used small combatants—generally destroyers—for both scouting missions. This was especially true during the interwar era, when the US possessed the largest destroyer component of any of the world's navies, and when cruiser construction was limited by naval treaties.[368] The battle force scouting mission meant that US destroyers had to have great endurance—independent steaming range—which tended to favor larger combatants. This contributed in no small way to the continual rise in destroyer displacements throughout the interwar period.

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[364] For a thorough discussion of small ASW combatants in World War I and II, see Friedman, *US Small Combatants: An Illustrated Design History,* Chapters 2 and 3.

[365] For the history behind the development of the post-World War II fast amphibious force, see Norman Friedman, *US Amphibious Ships and Craft: An Illustrated Design History* (Annapolis, MD: Naval Institute Press, 2002), Chapter 11.

[366] Friedman, *US Small Combatants: An Illustrated Design History,* Chapter 8; and Friedman, *US Destroyers, An Illustrated Design History,* Chapters 15 and 16.

[367] Freidman, *US Cruisers: An Illustrated Design History,* pp. 1-5.

[368] Freidman, *US Cruisers: An Illustrated Design History,* pp. 1-5; Friedman, *US Destroyers, An Illustrated Design History,* Chapter 5.

However, during the latter part of the battleship era and throughout the carrier era both the strategic and tactical scouting roles were gradually taken over by aircraft and fleet submarines. In turn, both were later augmented by space-based surveillance. As a result, post-World War II cruisers and destroyers were designed primarily for the battle force screening mission, and the small battle force surface scout disappeared from fleet service.

The fifth small combatant mission is ***anti-surface warfare (ASuW) and offensive maritime interdiction***. This mission is distinct from the offensive battle force screening role in which small combatants operating with the battle force threatened opposing naval units when the fleets were in close contact. This mission emphasizes small combatants performing *unsupported* offensive attacks against opposing enemy ships or coastal surface traffic. The aforementioned patrol torpedo boats, or PT boats, were originally designed for offensive surface action against much larger enemy combatants operating in coastal waters. However, as has been discussed, this mission ultimately proved less important than offensive maritime interdiction, referred to as "barge busting" during World War II. As a result, as the war progressed, these small combatants came to rely less on torpedoes as their primary armament and more on machine guns, rapid fire cannon, rockets and mortars.[369]

Indeed, in addition to its large PT boat fleet, during and after World War II the Navy operated numerous classes of small combatants in the offensive maritime interdiction role. For example, the Vietnam-era Fast Patrol Boats (PTFs)—based on a Norwegian PT boat design—ranged the coast of Vietnam in support of Operation Market Time—the interdiction of North Vietnamese and Viet Cong coastal traffic. The *Asheville*-class Patrol Gunboats (PGs), originally designed in the 1960s to counter Soviet-supplied Cuban missile-armed Fast Attack Craft (FAC) operating in the Caribbean, also made their biggest contributions during Operation Market Time.[370] And the 13 ships of the *Cyclone*-class Coastal Patrol Ships (PCs) commissioned during the 1990s were earmarked to perform coastal patrol, surveillance, and interdiction.[371]

As implied in the previous paragraph, the development of small, powerful anti-ship cruise missiles spurred many navies to revive the small combatant anti-surface warfare mission with various types of small and fast missile-armed FACs. The Navy briefly toyed with following suit. During the 1970s, it first armed the aforementioned *Ashevilles* with surface-to-surface missiles to serve as "expendable tattletales" of Soviet naval formations in the Mediterranean Sea, and then considered a class of 30 small, 231-ton Patrol Hydrofoil Missiles (PHMs), which were originally envisioned as counter-FAC platforms in the Mediterranean and Baltic Seas, and later as "low value trailers of high value Soviet surface units."[372] However, neither the ships' anti-surface

[369] Friedman, *US Small Combatants: An Illustrated Design History,* Chapter 7.

[370] Friedman, *US Small Combatants: An Illustrated Design History,* Chapters 10 and 12.

[371] "Navy Ships," in the *Almanac of Sea Power 2004* (Arlington, VA: Navy League of the United States, January 2004), p. 31.

[372] Friedman, *US Small Combatants: An Illustrated Design History,* pp. 271-72, and Vice Admiral Jerry Miller, USN (Ret), "re: The Need for Speed," *Proceedings,* April 2001, pp. 28-32.

mission nor the implication of their expendability survived serious scrutiny. During the carrier era, anti-surface warfare was more effectively accomplished by submarine, aircraft, and armed helicopters, and with less risk to their crews.[373] As a result, the few small combatants the US actually built for the anti-surface role inevitably spent the majority of their service lives performing offensive maritime interdiction duties.[374]

US small combatants have therefore long emphasized the offensive maritime interdiction role over the anti-surface warfare role. The Navy was rightly never beguiled by the 1970s "FAC revolution," which was "in reality only the second resurrection of the ***poussiere navale*** (naval dust) theories associated with the French Navy's ***Jeune Ecole*** a century earlier."[375] Like the "torpedo boat revolution" associated with the New School's naval dust theories a century before it, the FAC Revolution proved to be a false one.

The sixth small combatant mission—***amphibious/sea base support***—also emerged during World War II. Combatants for this mission performed two key services. They either augmented the intermediate-size amphibious ships that made up the fleet's mobile amphibious sea base, or were designed specifically to transfer men and equipment from the sea base to the shore. The larger types of combatants in this group combined both missions. Ships like the Landing Ships Medium (LSMs) and the Landing Craft, Infantry (LCIs) were ocean-going ships that could sail with the sea base and then beach themselves to disgorge their cargos. Craft at the middle to lower end of the group's displacement range were incapable of long-range independent sailing with the sea base, and instead were focused on the ship-to-shore transfer mission. They were designed to be "off-board systems," carried on-board or inside the well decks of amphibious ships to be craned or discharged into the water once in an amphibious operations area to conduct their mission. These craft ranged in size from the relatively large Landing Craft Utility (LCU), to the Landing Craft Medium (LCM), to many smaller landing craft.[376]

After the war, with the creation of the 20-knot amphibious task force, the small, slower sea base augmentation ships merged with newly designed intermediate-size Landing Ships Tanks (LSTs) and disappeared from fleet service. This left only the "off-board" ship-to-shore transfer mission and, as a result, only craft like the LCU and LCM survive today, augmented by the new Landing Craft Air Cushion, or LCAC.[377]

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[373] Friedman, ***US Small Combatants: An Illustrated Design History,*** Chapter 15.

[374] For a good description of US small combatants in the offensive interdiction role, see James J. Bloom, "History of the American Gunboat Navy," ***Sea Classics,*** May 1975.

[375] Preston, ***The World's Worst Warships,*** p. 181.

[376] Friedman, ***US Amphibious Ships and Craft: An Illustrated Design History***, Chapters 4, 5, and 7.

[377] Polmar, ***Ships and Aircraft of the US Fleet,*** pp. 192-99. The LCAC is being upgraded in a service life extension program, or SLEP, while the LCU is to be replaced by a new LCU(R), the "R" standing for replacement. The LCU(R) will be close to the capability of an independent sea base augmentation ship, with a load well over 200 tons, a range of 1,200 miles, and endurance of 10 days, and an average speed of 15 knots. See David Foxwell, "Novel Hullforms, Propulsors for New US Landing Craft," ***Jane's Defence Weekly,*** October 29, 2003, pp. 29-30.

The seventh small combatant mission also made its appearance during the hard-fought World War II amphibious assaults. *Close-in fire support* was conducted by a variety of special craft which escorted the lightly armed sea base ships capable of beaching themselves and the ship-to-shore landing craft right up to the waterline. As a result, these tough little ships were generally modified versions of the smaller ocean-going sea base augmentation ships and landing craft. They included, among others, the Landing Ship Medium, Rocket (LSM(R)); the Landing Craft Infantry, Gun (LCI(G)); the Landing Craft Support, Large (LCS(L)); the Landing Craft, Gun (LC(G)), the Landing Craft, Flak (LC(F)); and the Landing Craft Support, Small (LCS(S)). Ton-for-ton, they were among the most heavily armed combatants in US Navy history, carrying numerous cannon, rapid fire cannon, mortars, and rockets. However, they suffered the same fate as the slow sea base augmentation ships. Unable to keep up with the post-war 20-knot amphibious convoys, and too heavy for internal transport on amphibious ships, they disappeared from fleet service.[378]

Riverine warfare—the eighth small combatant mission—was performed by an entirely new family of craft and vessels designed especially for operations along the shallow coasts of Vietnam and on the numerous rivers and tributaries that crossed that county's southern delta. These extremely shallow-draft craft performed every one of the aforementioned small combatant missions except anti-submarine warfare. They included craft to interdict coastal and river traffic and to take on armed junks, such as the famous Swift boats (PCFs) and River Patrol Boats (PBRs); River Minesweepers (MSRs) and Minesweeping Boats; specialized river infantry transport craft such as the Armored Troop/Cargo craft (ATC), which themselves were modified versions of the Landing Craft Medium; close-in fire support vessels such as the Monitor; and special river fire support/minesweeping/patrol boats (ASPBs), a multi-purpose vessel capable of performing several different missions, depending on the tactical circumstances.[379] To this day, the US Navy retains a small riverine capability in its reserve.[380]

The riverine fleet also revived an old small combatant mission, *support for naval special operations forces (SOF)*. Small combatants provided extensive support for naval "special operations forces" during World War II. Over 100 small destroyers and destroy escorts were converted to serve as fast destroyer transports, or APDs, which carried specially configured Marine reconnaissance companies and naval underwater demolition teams that conducted clandestine advance force operations before amphibious landings. Moreover, several PT boat squadrons were converted into "beach-jumper units," which were designed to conduct amphibious feints and deceptions. However, these special purpose craft largely disappeared after World War II.[381]

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[378] Friedman, *US Amphibious Ships and Craft: An Illustrated Design History,* Chapter 8.

[379] Friedman, *US Small Combatants: An Illustrated Design History,* Chapter 13.

[380] Polmar, *Ships and Aircraft of the US Fleet*, pp. 212-213.

[381] For discussions on the APD see Freidman, *US Destroyers: An Illustrated Design History,* pp. 60-62;, and 155-57; discussions of the "beach-jumper" mission see Friedman, *US Small Combatants, An Illustrated Design History*, Chapter 6 and p. 191.

During the 1960s, small combatant support for naval special operations forces was revived in a big way as the Navy's newly formed Sea, Air, and Land (SEAL) teams conducted extensive operations along rivers and tributaries of Vietnam. SOF support vessels were often converted landing craft or small special purpose vessels such as the Large SEAL Support Craft (LSSC); the Medium SEAL Support Craft (MSSC); and the SEAL Team Assault Boat (STAB).[382]

More capable SOF support combatants came into their own after the Vietnam war, and remain important to this day. Examples of this group include the Special Warfare Craft, Light (SWCL, also known as the *Seafox*); the Mark III Patrol Boat, or *Sea Spectre*; and the contemporary high-speed Mark V Special Operations Craft.[383] The aforementioned *Cyclone*-class Patrol Coastal ships, although designed for primarily for coastal interdiction, had an important secondary role supporting naval special operations during the 1990s.[384]

The tenth small combatant mission is ***maritime domain awareness and maritime patrol and security***. Small combatants have often been used for a variety of patrol missions during peacetime, in crisis short of war, and during wartime. Indeed, this has proved to be the most important and enduring small combatant mission during peacetime, which includes such tasks as monitoring straights and important sea lines of communication, sanctions enforcement, anti-piracy patrol, counter-drug patrols, interdiction of illegal immigration and contraband, and shadowing important targets of interest. Indeed, since the end of the Cold War, maritime embargoes and sanction enforcement—and countering transnational threats such as maritime terrorism—have placed increasing demands on Navy attention and operations.[385] For these missions, large numbers of combatants with shallow drafts and small crews are extremely attractive. They free up larger combatants for more critical duties, allow fleet operations to extend extremely close to shore (thereby denying illegal or hostile forces any operational sanctuary), and perform the missions far more cheaply than larger, more capable warships.[386]

A special variant of this mission is ***US maritime domain awareness and defensive maritime interdiction***. The US Navy has irregularly performed this mission, especially since 1889 when it turned its focus away from defense of the US coasts and toward defeating enemy fleets operating overseas. In both world wars the Navy commandeered yachts, designating them as Patrol Yachts

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382 Friedman, *US Small Combatants: An Illustrated Design History,* Chapter 14.

383 Friedman, *US Small Combatants: An Illustrated Design History,* Chapter 16; Polmar, *Ships and Aircraft of the US Fleet,* Chapter 20.

384 "Navy Ships," in the *Almanac of Sea Power 2004,* p. 31.

385 See Kimberly L. Thachuk and Sam J. Tangredi, Chapter 4, "Transnational Threats and Maritime Responses," and Donna J. Nincic, Chapter 8, "Sea Lane Security and US Maritime Trade: Chokepoints as Scarce Resources," in *Globalization and Maritime Power,* edited by Sam J Tangredi (Washington, DC: National Defense University Press, 2002).

386 See for example Hunter Keeter, "Balisle: LCS Concept Based on Sound Reasoning," *Defense Daily,* January 22, 2003, p. 2.

(PYs) and coastal Patrol Yachts (PYcs), to improve maritime domain awareness off US coasts.[387] In the 1950s, it converted several radar pickets (DDRs and DERs) as part of the continental air defense early warning network.[388] And since the 1980s, the Navy has assigned combatants to drug interdiction patrols in the Caribbean.

The reason for the Navy's apparent half-hearted approach to US maritime domain awareness and defensive maritime interdiction is that this mission has long been one of the primary jobs of the Nation's second navy: the US Coast Guard (USCG).[389] Indeed, the mission was performed by the Coast Guard's most distant predecessor—the Revenue Marine, which was established in 1790. The modern US Coast Guard, the nation's fifth armed service, is in essence ***a small combatant coastal navy*** that concentrates on US maritime domain awareness and defensive maritime interdiction.[390] The ***largest*** vessels in its fleet are the twelve intermediate-size 3,300-ton ***Hamilton***-class High Endurance Cutters. Below the ***Hamiltons*** the Coast Guard operates 30 smaller cutters, over 100 patrol boats, and approximately 1,500 smaller boats.[391]

The seamen of the Coast Guard are thus the United States' premier small combatant sailors, and their relationship with the Navy is quite close. During wartime, the Coast Guard can come under the operational control of the Navy, as it did in both World War I and World War II. Moreover, because of their long experience in defensive maritime interdiction in US coastal waters, "Coasties" are also experts in ***offensive*** littoral maritime interdiction, and often augment US Navy efforts in forward theaters. For example, five Coast Guard high endurance cutters and 26, 82-foot patrol boats participated in Operation Market Time during the Vietnam War.[392] And during Operation Iraqi Freedom, the Coast Guard deployed a high endurance cutter, a 225-foot buoy tender, four 110-foot patrol boats, two law enforcement detachments, two port security units, and a harbor defense command unit. These forces performed maritime force protection, coastal and terminal security, maritime interception, and marine environmental response operations in support of the maritime coalition force.[393]

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[387] Friedman, ***US Small Combatants: An Illustrated Design History,*** Appendix B.

[388] Freidman, ***US Destroyers: An Illustrated Design History***, pp. 227-33.

[389] The Navy has been much more involved in homeland defense than these few examples attest. See Peter M. Swartz, ***The US Navy and Homeland Defense*** (Alexandria, VA: Center for Naval Analysis, 2002).

[390] See ***The United States Coast Guard: The Shield of Freedom*** (Tampa, FL: Government Services Group, 2003).

[391] See the "The Ships and Aircraft of the US Coast Guard," in ***The United States Coast Guard: The Shield of Freedom,*** 154-171, and "Coast Guard Brings Order to Varied Fleet of 1,500 Boats," ***Sea Power***, August 2003, p. 35.

[392] See "The Coast Guard at War," in ***The United States Coast Guard: America's Lifesaver and Guardian of the Seas*** (Tampa, FL: Government Services Group, 2002), pp. 140-149.

[393] Elaine De Valle, "Coast Guard 'Busy' Aiding War Effort," ***Miami Herald,*** April 16, 2003.

Since September 11, 2001, homeland security has jumped in emphasis for both the Coast Guard and the Navy, and both Services appear to be improving their operational links.[394] The tragic events of 9/11 have also given impetus to Coast Guard recapitalization plans.[395] The Integrated Deepwater System is designed to recapitalize the entirety of the Coast Guard's aging capital stock and to improve the Coast Guard's ability to conduct US maritime domain awareness and defensive maritime interdiction. Indeed, its similarities to Navy's distributed fleet battle networks are striking, emphasizing as it does widely distributed and networked capabilities and off-board, unmanned systems.[396] When Deepwater is completed, the Coast Guard should operate a small number of intermediate-size, 3,886-ton National Security Cutters; more numerous small 2,921-ton Offshore Patrol Cutters; and even more numerous 198-ton Fast Response Cutters.[397]

These cutters will be augmented by a host of smaller craft, ranging from the 170-ton ocean patrol boat (WPB); a Long-range Interceptor (LRI) patterned on an 11-meter rubber hull inflatable boat (RHIB); and a Short-range Prosecutor (SRP) patterned on a 7-meter RHIB. Both RHIBs are hosted on the larger boats and cutters. The LRI can be armed with one .50cal heavy machine gun and either a 7.62mm medium machine gun or a 40mm automatic grenade launcher. It has a 200-mile (over-the-horizon) range when traveling at 33 knots. The SRP, a smaller version, would normally operate closer to its host vessel. In addition to these manned off-board systems, all cutters and boats will be augmented by a variety of additional manned and unmanned off-board systems, including helicopters, UAVs, and possibly USVs.[398]

In addition to the aforementioned ten small combatant missions well grounded in past fleet history an eleventh mission must be added: *battle network sensor emplacement.* This mission was highlighted repeatedly throughout the *Streetfighter* concept development process and the CNAN project: Given the Navy's emphasis on achieving a dominant advantage in the information domain, the emplacement of remote and unattended off-board sensors certainly appears to be appropriate mission for small combatants, especially in shallow waters.

In summary, since 1889, small combatants have provided the Navy with invaluable service by performing ten key missions: *battle force screening; mine warfare*; *protection of shipping*; *battle fleet scouting; anti-surface warfare/offensive maritime interdiction*; *amphibious/sea base*

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[394] Harold Kennedy, "Coast Guard Adapts to Larger Homeland Security Mission," *National Defense*, August 2003, p. 58. See also Rear Admiral Donald Loren, USN, and Captain Richard Kelly, USCG, "Old shipmates, new goals: Navy, Coast Guard team up to develop 'National Fleet'," *Armed Forces Journal,* March 2003, pp. 42.

[395] Calvin Biesecker, "RAND Finds That Coast Guard Needs More Assets to Meet Post-9/11 Missions, Official Says, *Defense Daily,* January 6, 2004, p. 4.

[396] Scott R. Gourley, "Deepwater," in *The United States Coast Guard: The Shield of Freedom,* pp. 48-58, and Patrick M. Stillman, "Need for Deepwater Rises as CG Workload Expands," *Sea Power,* August 2003, pp. 23-25.

[397] See the NSC & OPC and FRC sections at the US Coast Guard Integrated Deepwater System website at http://www.uscg.mil/deepwater/solution.

[398] See the SRP & LRI section at the US Coast Guard Integrated Deepwater System website at http://www.uscg.mil/deepwater/solution.

support; *close-in fire support; riverine warfare; support for naval special operations forces; maritime domain awareness and maritime patrol and security (and US maritime domain awareness and defensive maritime interdiction)*. The emerging array of off-board sensor systems also suggests small combatants may play a heavy role in *battle network sensor emplacement*. [399]

SMALL COULD BE BIG IN THE FUTURE TSBF

Upon considering the foregoing review of small combatant missions, one might ask the following question. If small combatants have proven to be so useful, why have they not fared well in past Navy Total Ship Battle Forces? This is a fair question, especially considering the gradual disappearance of small combatants in US Navy service since World War II, and the Navy's apparent rejection of small combatants in 2000. However, a review of history provides the simple, compelling answer: *since 1889, small combatants have consistently dominated the TSBF during times of war.*

In World War I, for example, the US Navy deployed eight battleships and three scout cruisers in European waters; the rest of the Navy's large and intermediate combatants remained in US home waters.[400] By comparison, the US Navy operated 36 destroyers in European waters in support of allied ASW efforts. In addition, the US built 550 small 80-foot motor launches for the Royal Navy, which used them for coastal ASW, minelaying, and minesweeping, and 440 of the aforementioned 110-foot wooden-hulled subchasers designed for littoral ASW. Though small, the SCs were considered to be "self-deployers;" at least 235 crossed the Atlantic under their own power, 100 destined for duty with the French Navy, and 135 to perform forward deployed US Navy ASW operations. The remainder conducted ASW patrols along the eastern seaboard of the US, escorting convoys as far as Bermuda.[401]

Too late for the war were 60 steel-hulled, 200-foot long Eagle boats (PE), a relatively unsuccessful attempt to design an austere, mass-production ASW patrol ship. Far more successful were the World War I "flush-deck" destroyers, known primarily by their distinguishing set of four smoke stacks. Two-hundred and seventy-three of these 1,100-ton destroyers were ordered during the war. Although only 36 were completed before the Armistice, all but seven of the 273 ordered were eventually completed, giving the US the largest destroyer fleet in the world, by far. Indeed, so massive was the production run that it depressed US cruiser

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[399] For another take on the list of small combatant missions, see Lieutenant Commander Dave Weeks, USNR, "The Combatant for the Littorals," *Proceedings,* November 1999, p. 27. Commander Weeks listed the following missions: littoral battlespace domination; maritime embargo; precision engagement; surface and subsurface surveillance and choke point traffic control; interdiction of littoral traffic; special forces delivery and extraction; and protection of the amphibious assault lines of communication.

[400] Beach, *The United States Navy,* pp. 415-16.

[401] Freidman, *US Small Combatants: An Illustrated Design History,* Chapter 2. Not all of the subchasers were completed before the war's end, with the class production run ending on February 1, 1919. Hagan reports that 406 were completed by the end of the war. Hagan, *The People's Navy,* p. 255.

building throughout the interwar period.[402] As a result, small combatants dominated the Navy's TSBF throughout the interwar period.

The dominance of small combatants in the TSBF continued throughout World War II, when the Navy operated globally and supported contested joint power projection operations in three major theaters (Europe and North Africa; the Southwest Pacific; and the Central Pacific). 25 years later the Navy supported uncontested joint power projection operations along the coasts of Vietnam. Using the displacement break points previously outlined (3,000+ tons displacement for intermediate combatants, and 12,000+ tons displacement for large combatants), the approximate ratio of large to intermediate to small combatants in the 1945 TSBF was on the order of 1:9:90. The comparable TSBF ratio in Vietnam was approximately 1:20:150.[403]

When comparing the TSBF ratios during World War II and Vietnam, wars that saw extensive action in unimpeded, guarded, defended, and contested access scenarios, two things stand out. First is the extent to which small combatants have dominated wartime battle fleets. Second is the readily apparent shift in TSBF emphasis from large to intermediate combatants that occurred between the battleship and carrier eras.

Those in the Navy who argued during the *Streetfighter* debates for a fleet composed primarily of 116 intermediate and large combatants could try to make the case that the need for small combatants passed away after Vietnam as the carrier era evolved. But once again, they would be on the wrong side of the data. During the hot peace of the four-decade long Cold War, the US Navy led a vast allied naval coalition against the Soviet and Warsaw Pact. By the end of the Cold War, the NATO TSBF included approximately 1,250 ships, with a ratio of large to intermediate to small combatants of 1:30:126 (note the continued move from large to intermediate combatants).[404] In other words, during the Cold War, the US Navy still relied heavily on small combatants in its wartime plans. It simply counted on its allies to provide them.

As a result, ***only when the Navy fought a war with minimal allied naval support, such as it did off the coast of Vietnam in the midst of the broader Cold War, was it compelled to purchase large numbers of its own small combatants.*** In fact, the Vietnam War may be a harbinger of circumstances in the emerging littoral century. Absent the unifying Soviet threat, the US Navy must be prepared to act immediately in support of American strategic interests and, if need be, without allied naval support. For this reason alone, and given the historical record, it would be wise for the Navy to re-examine its combatant mix and consider "rebalancing" the fleet.

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[402] The Washington Naval Treaty also helped to depress US cruiser construction. Freidman, *US Small Combatants: An Illustrated Design History,* Chapter 2; and *US Destroyers: An Illustrated Design History,* Chapter 3.

[403] These ratios are rough order measures of magnitude only. Tracking ships by displacement is not a common data approach. The data for this paper is derived by compiling input primarily from Freidman's series of illustrated design histories of US combatants, augmented by supporting sources when necessary. The Vietnam War ratio was derived from 1968 TSBF figures, the fleet high point during the Vietnam War.

[404] This data was derived from the force levels listed in Captain Richard Sharpe, RN, editor, *Jane's Fighting Ships, 1990-91* (Surrey, UK: Jane's Information Group, 1990).

Re-thinking the role of US small combatants is also warranted for another reason. As NATO and allied navies shift their attention to "out-of-area operations," they are finding—as did the US Navy long ago—that small combatants are far less attractive than larger, more capable intermediate-size ships. As a consequence, throughout the 1990s the trend in major Western ocean-going navies has been towards fewer, intermediate, and more capable multi-mission ships.[405] The Japanese ***Kongo***-class multi-mission "guided missile destroyer" (9,485 tons) is the largest of the foreign combatants; it is joined by numerous others: the British ***Type 45*** multi-mission "destroyer" (7,350 tons); the Franco-Italian Horizon multi-mission "frigate" (6,700 tons); the Dutch ***De Zeven Provincien*** multi-mission "frigate" (6,050 tons), the German F124 multi-mission "frigate" (5,600 tons); the Spanish F100 multi-mission "frigate" (5,800 tons); and the Korean multi-mission KDX "destroyer" family (ranging from 3,800 tons for the KDX-I to 7,000+ tons for the KDX-III). Indeed, most NATO and allied navies are discarding many of their small fast attack craft for larger, more capable small combatants like the 1,900-ton MEKO A-100 "corvette" that can operate in both coastal and open-ocean environments.[406] Even coastal navies that do not routinely go out of area are opting to build larger ships. For example, the Israeli Navy is pursuing a 2,800 ton multi-mission "corvette" equipped with AEGIS and VLS.[407] As a result, future allied naval coalitions projecting power in distant littorals may find their combined battle network to be unbalanced and short of the types of small combatants that have proven so useful in the past.

In light of potential future naval challenges, the requirement for unilateral freedom of action and the changing nature of allied fleet contributions provide two compelling reasons for the Navy to re-consider its own mix of large, intermediate, and small combatants. In this regard, and restating the originally posed questions about the role of small combatants in the 21st century Assured Access Navy, the two key questions confronting TFBN architects are: ***Is there any evidence that any of the aforementioned small combatant missions will be less important in the 21st century, or that intermediate and large combatants would better perform them?***

The answer on both counts would appear to be no, for three primary reasons:

- First, precedence. Whenever a fleet battle network or enhanced networked sea base closes on a defended enemy coastline, its intermediate and large combatants focus on enemy threats to the landward side of the littoral. While doing so, they rely upon smaller combatants to protect them from mines and attacks mounted by the enemy's littoral screening forces, and to conduct offensive interdiction of enemy coastal traffic. These roles are among the oldest missions assigned to small combatants, and they assume increasing importance whenever the fleet operates close to shore. As in the past, when

[405] Freidman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," pp. 384-85.

[406] A.D. Baker III, "World Navies in Review," ***Proceedings,*** March 2003, pp. 48-56; Norman Freidman, "The Corvettes and Frigates New Wave," ***Armada International,*** February 2003.

[407] Arieh O'Sullivan, "Navy Seeks Larger, More Powerful Ships," ***Jerusalem Post,*** November 28, 2003. See also Alon Ben-David, "Israel Navy Seeks to Bolster Surface Fleet," ***Jane's Defence Weekly,*** December 3, 2003, p. 5.

performing this role, future small network combatants would themselves rely on the larger combatants for protection against over-matching threats.

- Second, utility. For the foreseeable future, the Navy will likely operate most often operate in unimpeded and guarded access scenarios. In these conditions, small combatants capable of performing protection of shipping, battle force scouting, amphibious/sea base support, support to naval special operations, and maritime domain awareness and maritime patrol and security tasks will be in extremely high demand. Indeed, a force of small combatants that can reliably and cost-effectively perform the myriad naval tasks associated with domain awareness and maritime patrol and security duties—sanctions enforcement, patrolling choke points, conducting anti-piracy, drug, and terrorism patrols, and participating in humanitarian assistance and disaster relief operations—would be a valuable component of the 21st century TFBN.[408] This will be especially true if during the early years of the 21st century the need for maritime domain awareness and maritime patrol and security duties increases while budgets decrease.[409] Since small combatants can be afforded in much greater numbers than larger and more capable combatants and can be more widely deployed, they would allow the Navy to greatly expand its global battle network coverage, and "give the Navy an opportunity to carry out certain forward operations with a cheaper platform and with far fewer personnel than [is] possible in today's Navy."[410]

- Third, efficiency. Because these traditional small combatant missions will most often take place in unimpeded and guarded scenarios, the Navy can use small combatants in these cases to free up the fewer, more expensive and more capable combatants for more pressing duties without appreciably increasing either overall operational risk or individual ship risk—provided the small combatants built are capable of sensing over-matching threats and carry a capable self-defense suite. As one surface warfare admiral stated:

> We already know…that a multi-mission warship like the Arleigh Burke AEGIS guided missile destroyer can carry out 'other than war' tasks like maritime intercept operations. What we need to ask ourselves is whether this is an appropriate and cost-effective task for DDG-51s with their

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[408] One naval officer wrote that 75% of his deployed time was spent on these three types of operations. See Commander John P. Cordle, USN, "High Speed is the Future," *Proceedings,* June 2003, p. 54. For other spirited calls for more small ships, see Lieutenant Richard D. Butler, USN, "A Big Navy Needs Little Ships," *Proceedings,* October 2003, pp. 99-100, and Andrew Willis, "Smaller Ships or Bigger Ships," published on September 16, 2002 on Suite101.com, at http://suite101.com/article.cfm/us_navy/95127.

[409] Freidman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," pp. 377-78. Maritime domain awareness and security continues to demand increasing attention and resources from the world's navies. See for example Phillip Day, "Countries Keep Squabbling Over Security in Key Strait," *Wall Street Journal*, June 13, 2003; Luke Hill, "Heightened Patrols in Gibraltar Strait Greatly Enhance Security," *Jane's Defence Weekly,* August 27, 2003, p. 5; and Mansoor Ijaz, "The Maritime Threat From Al Qaeda," *London Financial Times*, October 20, 2003.

[410] Otis Port and Stan Crock, "Guerilla Ships for A New Kind of War," *Business Week*, January 27, 2003. See also Norman Polmar, "Getting the LCS to Sea, Quickly," *Proceedings,* April 2003, p. 106.

> crews of 359, and, if the answer is 'not really, what are the alternatives?[411]

In other words, a historical review of small combatant missions and the logic of the access curve supports the view that the future Total Force Battle Network should include a balanced mix of large combatants for high-intensity combat in contested littorals; intermediate sea control combatants for strategic dissuasion, combat in defended littorals, and long-range support during littoral penetration operations; and small vessels designed to perform the broad range of traditional and emerging small combatant missions primarily in defended, guarded, and unimpeded access scenarios.[412]

A family of small warships that can perform the full range of small combatant missions in these three less stressful access scenarios would appear to be a valuable addition to the future TFBN—*even if its ship provides little additive value in contested access scenarios.* If the family of small network combatants also provides combat value in contested littoral penetration operations, it would be an even more valuable addition.

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[411] Truver, "The BIG Question," p. 24. The theme that the LCS is an economy of force platform for a globally deployed Navy is one that is made repeatedly by Navy officials and analysts. See for example Hunter Keeter, "Balisle: LCS Concept Based on Sound Reasoning," *Defense Daily*, January 22, 2003, p.2; Kreisher, "New Small Navy Ships Debated;" and Willis, "Smaller Ships or Bigger Ships."

[412] For a different logical, as opposed to analytical, argument that supports small network combatants in the 21st century TFBN, see Tangredi, "Rebalancing the Fleet: Round 2."

VI. THE LCS IN THE 21ST CENTURY TOTAL FORCE BATTLE NETWORK

To put it in the simplest of terms, *it appears that because of the changing strategic environment and the flexibility now enjoyed by fleet operational architects, the role of small combatants might once again gain prominence in the Navy's 21st century Total Force Battle Network*.[413] If this judgment is accurate, the Navy's Littoral Combat Ship and High Speed Vessel are the logical first two choices for the first generation of small network combatants. Both appear to be attuned to the emerging needs of the 21st century Assured Access Navy.

AMPHIBIOUS/SEA BASE SUPPORT AND THE HSV

The High Speed Vessel marks the return of the small sea base augmentation ships like the LSM and the LCI that proved so effective in World War II mobile sea base operations.[414] For a Navy now thinking of expanding the fleet's sea basing capabilities and a Marine Corps now contemplating fighting from a sea base rather than moving mountains of supplies ashore, the appearance of a *high speed* sea base augmentation ship that can both carry useful combat loads and improve the velocity of the ship-to-shore movement would be most welcome.[415]

Previous sea base augmentation ships were a "one-shot weapon." That is to say, once they beached and disgorged their passengers and equipment, they provided no more support for the sea base. Future HSVs promise to be able to deliver a useful combat load over operationally useful ranges—at speeds equal or superior to the 20-knot amphibious sea base and the new 24-knot large, medium-speed roll-on roll-off (LMSR) sealift ships,. Then, once delivering their initial combat loads, they can lend their assistance to the high-speed transfer of supplies and equipment from other sea base ships to shore. Indeed, because of their modular design, HSVs will be able to lend their support to the sea base in different ways, such as augmenting its mine countermeasure forces.[416]

The aforementioned *Joint Venture*, HSV-X1, gives a hint about how future HSVs might contribute to the operations or an enhanced network sea base. It is a catamaran with a semi-planing wave-piercing hull and a top speed of 45 knots. It can carry a combat load of approximately the 400-500 tons (note: the same payload identified during *Streetfighter* concept

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[413] For another logical (as opposed to analytical) argument for small combatants, see Sam J. Tangredi, "Rebalancing the Fleet: Round 2," *Proceedings,* May 2003, pp. 36-39.

[414] This section does not address the Army purchased and crewed Theater Support Vessel.

[415] The most recent description of US Navy thinking on the HSV can be found at "High Speed Vessel: Adaptability, Modularity and Flexibility for the Joint Force," at the Navy Warfare Development Command website at http://www.nwdc.navy.mil/HSV/ConceptHSV.asp.

[416] For an expanded list of possible HSV missions, see Admiral Natter, "Meeting the Need for Speed," p. 66.

development) over 3,000 nautical miles at sustained speeds of 35 knots. Although it cannot beach itself like the earlier generation of sea base augmentation ships, its shallow draft and stern and side ramps allow it to offload its cargo in austere ports, and may allow the at-sea transfer of equipment from large and intermediate sea base support ships for transfer ashore. In addition, the vessel's 41,000 square feet of open storage space allows the HSV-X1 to change its mission configuration "in a matter of hours."[417] As a result, the *Joint Venture* is truly a multi-purpose sea base support vessel, capable of performing a variety of littoral combat support and combat service support missions. It was tested in both the special operations support and mine warfare roles, and deployed to the Persian Gulf in support of Operations Iraqi Freedom.[418]

Indeed, the success of the *Joint Venture* prompted the Navy to lease its first purpose-built HSV—the *Swift*, or HSV-2 (note the lack of an "X" designator)—to serve as an interim mine countermeasure command and control vessel. Appropriately, the *Swift* carries the name of a minesweeper that saw service off the Normandy beaches, off Formosa and Japan, and later Korea. Her lease is for one year with an option for four more.[419]

As she was accepted in August 2003, the *Swift* is 98 meters long with a light displacement of 1,131 tons, and a full load displacement of 1,800 tons. She has a maximum speed of 42 knots and an operational speed of 35 knots, and at full load her operating draft is approximately 11 feet. Additionally, she has two rotating 40-man crews, giving the ship a high operational availability. Although leased to perform the mine warfare command and control role, the *Swift* has a reconfigurable mission bay with 15,500 square feet of vehicle and module space, and 16 feet of headroom. She has a motion compensating winch system that can launch and recover boats, USVs, and UUVs, and an articulated vehicle ramp. She is therefore capable of being used in a variety of other battle network roles.[420]

Time precludes a more thorough examination of the HSV, except to say that its demonstrated missions of fast sea base support and mine warfare are historically grounded small combatant missions that have been appropriately updated for the 21st century. Five outstanding issues that need to be further examined for the HSV are:

- The ship's ability to perform at-sea transfer of equipment from other ships in the sea base;

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[417] Harold Kennedy, "US Services Test Aussie-Built Catamaran," *National Defense,* April 2002, p. 30.

[418] Kennedy, "US Services Test Aussie-Built Catamaran," p. 31, and "Fast Catamaran Deploys to Gulf for War-Related Ops," Critical Intelligence, in *Inside the Pentagon,* April 4, 2002, p. 7.

[419] Rear Admiral Paul J. Ryan, US Navy (Ret), and Captain David Grimland, USN, "High Speed Is Here," *Proceedings,* November 2003, pp. 72-73, and William O'Neil, "If They Can't be Big, It Needs to be Novel," *Proceedings,* December 2003, p. 49.

[420] Rear Admiral Ryan and Captain Grimland, "High Speed Is Here," pp. 72-73.

- The ships' suitability for other small combatant missions (e.g., Can the ship support special operations forces or perform littoral ASW?);

- The tradeoffs between the ship's speed, payload, and endurance (e.g., If the supported sea base has a speed of advance of only 20 knots, might the ship's high top speed be better traded for more payload and/or endurance?);

- The threat conditions under which the ships can prudently; and

- The extent to which an HSV can serve as an operating base for long-range, unmanned, off-board vehicles.

As three of these five questions imply, the more mission flexibility built into fleet HSVs, the better.

REQUIREMENTS FOR A LITTORAL COMBAT SHIP

The focus on mission flexibility helps to bring attention to the principal subject of this chapter—the second ship of the Navy's new small network combatant family, the Littoral Combat Ship. This ship is to be a multi-role but focused mission ship, capable of being reconfigured to perform either littoral ASW, littoral mine warfare, or counter-boat missions as part of a distributed naval battle network. For a maximum price of $220 million, ***not*** including the government furnished mission modules, helicopters, or boats,[421] the LCS must have: [422]

- A hull service life of 20 ("threshold," or minimum acceptable requirement) to 30 ("objective," the true desired target) years;

- A draft not more than 20 feet, with a preferred target of 10 feet; and a sprint speed of 40 to 50 knots in sea state 3;[423]

- A "mission module payload" of 180 to 210 metric tons, which includes both the "mission package" and "mission package fuel";

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[421] The original guidance to contractors was that the LCS "sea frame"—the basic ship without mission modules installed—should have a threshold cost of $220 million, and an objective cost of $160 million. See Hunter Keeter, "Navy Sets LCS Unit Cost Objective: $160 million," *Defense Daily*, February 21, 2003, p. 1. More recently, the Navy has asked contractors to provide the most capable sea frame for $220 million.

[422] These requirements are drawn from ***Preliminary Design Interim Requirements Document, serial number N763F-S03-026, for Littoral Combat Ship (LCS) Flight 0, Pre-ACAT.*** Another good description of the requirements can be found in Mark Hewish, "Navies Ask: Is the Coast Clear?" ***Jane's International Defense Review,*** October 2003, pp. 42-51.

[423] Sea states reflect a combination of wind and wave heights. Sea state 3, for example, denotes "slight" wind and wave motion. For a thorough description of sea states, see the Sea State and Wind Force Table found on the web at http://www.seathree.demon.co.uk/seastate/.

- An ability to "swap out" any complete mission package in one to four days (including the system checks for operational functioning);

- A range of 1,000 to 1,500 nautical miles with full payload at sprint speed and a range of 3,500 to 4,300 miles at economical speed (18 to 20 knots) while carrying 14 to 21 days of provisions;

- A maximum of 75 crew members, of which 15-50 can be "core" crew members (those permanently assigned to the ship) and 25-60 mission package crew members (those temporarily assigned for the mission); and

- An ability to hanger and operate a MH-60 class helicopter and vertically launched UAVs in sea state four to five; and store, launch, and recover 11-meter RHIBs to 40-foot high speed boats in sea state 3 and 4.

Note that, consistent with the approach taken by concept development officers during the *Streetfighter* development process, the requirement does not dictate any particular displacement or hull type for the ship. The focus is on what the ship can bring to the fight, not the size or shape of it hull. However, all three of the surviving competitive designs come in somewhere between 2,000 and 2,800 equivalent tons at full load (adjusting for the composite hull of one of the competing designs)—smaller than the 4,000-ton *Perry* FFG, but much larger than the 300-1,200 ton vessels postulated early in *Streetfighter* combatant concept development.[424]

The relatively large size of the small LCS may surprise those who followed the early *Streetfighter* debates, but given US operational requirements, it shouldn't. Although many navies have long used small combatants for defensive naval tasks, in this role the ships have the advantage of operating from in-country bases and being able to trade endurance and crew habitability for quick-strike capabilities. While the LCS is in large measure a mirror image of coastal defense craft, it must operate at great distances from its primary bases.[425] As one expert on ship design explains:

> US Navy warships must deploy halfway around the globe, transit and operate with fast strike groups without replenishing too frequently, keep the sea for weeks or even months, operate effectively in high seas, and get their voyage repairs accomplished in local commercial shipyards…A conventional destroyer-like steel ship able to meet these needs could not be much smaller than 3,000 tons at full load.[426]

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[424] For a description of all three remaining ships designs, see RDML Charlie Hamilton, Program Executive Officer for Ships, "Littoral Combat Ship Presentation to Surface Navy Association," given on October 14, 2003. This was the Navy's most complete and polished Navy presentation on the LCS to that date.

[425] Hewish, "Navies Ask: Is the Coast Clear?" p. 42.

[426] O'Neil, "If It Can't Be Big, It Needs to be Novel," p. 51.

There are some who remain unmoved by this rationale and who continue to argue that a smaller combatant along the lines of the 450-ton SEA LANCE or the Swedish 600-ton *Visby*-class stealth corvette would best meet US Navy requirements. However, those that do should consider the experience of the Royal Danish Navy (RDN). The RDN, a navy that has traditionally valued and operated small combatants, concluded after conducting extended out-of-area NATO operations in the late 1990s and early 2000s that the ***minimum*** size for an ocean-going small combatant was approximately three times the size of the *Visby* corvette (i.e., 1,800 tons).[427]

The size of the ship aside, three things stand out about the new ship's design requirements.

- First, the LCS has an extremely high stipulated "sprint speed." A sprint speed greater than 40 knots is not unprecedented for a small combatant; World War II PT boats could exceed 40 knots, and the aforementioned *Asheville* PGs nearly could. However, these were both relative small craft; the heaviest wartime PT boats had a full load displacement of just over 60 tons, and the *Ashevilles* came in at around 242 tons.[428] A 2,000+ ton vessel with such high top-end speed is a demanding design requirement. For comparison, the comparatively-sized World War II *Fletcher*-class destroyer had a design top speed of 38 knots, although in service it rarely exceeded 35.[429]

- Second, the LCS will have the sustained speed necessary for it to be able to run with either 30+ knot Carrier Strike Forces or 20+ knot Expeditionary Strike Forces, although at higher speeds its endurance will apparently fall off rather dramatically. As such, it will be the first small combatant since the aforementioned *Fletcher*-class DD capable of operating with high speed naval task forces.

- Third, the ship must be able to swap out complete mission packages and be reconfigured and ready for an entirely new mission in just one to four days (including the system checks for operational functioning). To accomplish such a task, the LCS will have to achieve a degree of modularity that is without US or foreign naval precedent.

THE LURE OF MODULARITY

The US Navy has long built ships using modular construction techniques. For example, the *Spruance* DD was built using extensive modular design concepts, both to facilitate its construction and its later mid-life modernization.[430] The *Perry* FFG utilized modular techniques

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[427] Freidman, "The Corvettes and Frigates New Wave," p. 60. In support of this conclusion, the smallest remaining LCS design is the 1,800-ton composite surface effects ship from Raytheon. For the purpose of this paper, this ship has a displacement equivalent to a steel ship of approximately 2,500-2,700 tons. From conversations with Adam Siegel, Senior Analyst at the Northrop Grumman Analysis Center.

[428] Freidman, *US Small Combatants, an Illustrated Design History,* p. 173, 277.

[429] Freidman, *US Destroyers: An Illustrated Design History,* p. 118.

[430] Freidman, *US Destroyers: An Illustrated Design History,* pp. 374-77.

to facilitate its rapid wartime production.[431] And the *Virginia*-class attack submarine now in serial production embodies an entire design philosophy based on computer-designed, modular construction.[432]

This type of *construction modularity* affords a navy two key advantages. It helps to reduce class construction costs, and it allows different yards to simultaneously perform work on the hull and different modules for the same ship. For example, the Australian and New Zealand navies are assembling warships using 12 major modules built at three different sites in both countries.[433] Moreover, many of the ship's modules are small enough so that they can be constructed inside specially-designed construction bays, minimizing the effects of weather on their assembly process. Once completed, the modules are then shipped to a single integrating construction yard. As is evident, this type of construction modularity allows a navy (or navies) to maintain a viable, diversified shipbuilding base even when building a relatively small number of ships.

Configuration modularity takes construction modularity to a higher level. Much of a ship's equipment is either containerized or palletized, and installed inside larger hull modules at the appropriate stage in the construction process. Moreover, the ships are designed to accept standardized weapon, electronic, and combat system "modules." All components needed to run any specific ship or combat system are incorporated into a single functional module, which can be connected to the ship's power supply, air conditioning and ventilation system, and data network through a series of standardized ship interfaces. These functional modules can be integrated and tested before they are mated to other modules, minimizing any subsequent delays in ship system testing. Obviously, the key to achieving configuration modularity is to clearly define the ship/module interface requirements and to carefully delineate responsibilities for integration between module builders and the overall ship integrator.[434]

The Blohm and Voss MEKO®-class ships are perhaps the best known contemporary examples of ships built with a high degree of configuration modularity. Choosing from a set of baseline hulls (e.g., A-100 multi-purpose corvette or A-200 multi-purpose frigate), potential customers can customize new construction ships to meet their own particular mission requirements. Additionally, when the ships need a mid-life modernization or when their mission requirements

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[431] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, p. 161.

[432] Norman Friedman and Scott C. Truver, "It's What's Inside That Counts," *Proceedings,* February 1997, pp. 41-43; William H. Kowenhoven and Frederick J. Harris, "The NSSN: A 21st Century Design," *Proceedings,* June 1997, pp. 36-38; John S. Heffron, "The Virginia Attack Boat Brings New Potency to the Fleet," *Sea Power,* July 2003, pp. 27-29; Andrew Koch, "Structural Redesign to Give Virginia Subs More Punch," *Jane's Defence Weekly,* December 4, 2002, p. 5.

[433] See "The ANZAC Ship Project" at http://www.defense.gov.au/dmo/msd/sea1348/sea1348p2.cfm.

[434] See "The Blohm and Voss MEKO® Design Concept: Modularity," at http://www.blohmvoss.com; and "The ANZAC Ship Project" at http://www.defense.gov.au/dmo/msd/sea1348/sea1348p2.cfm.

change for whatever reason, navies with these ships can upgrade/modernize them relatively easily, quickly, and cheaply.[435]

The US Navy can point to one of its own past small combatants to highlight the attractiveness of configuration modularity. The World War I four-stack, flush deck destroyers were 314 feet long, with a displacement of 1,215 tons, and a shallow draft of less than 10 feet. They were built with "modular" machinery spaces that were designed so that their boilers and stacks could be easily removed. Moreover, on their main decks, both amidships and aft, the ships had what would be referred to today as four "mission module stations." The stations were originally designed to hold four large triple torpedo tubes, two to each side of the ship, outboard along the deck edge instead of along the ship's centerline as found on most destroyers. When the torpedo tubes were removed, these large "mission module stations" could accept a variety of weapons and systems that could be bolted directly onto the deck without causing any ship stability problems. As a result, these ships could, and did, perform a variety of missions.[436]

For example, by removing one boiler and substituting a fuel tank, the US Navy and the Royal Navy gained a long-range ocean escort with an additional 1,100 miles of operating range. By installing the appropriate mine warfare systems in the destroyer's mission module stations, the US Navy gained both a high-speed minesweeper (DMS) and a light minelayer (DM). By installing cranes and equipment containers, the Navy gained a light seaplane tender (AVD). In World War II, with modernized weapons such as hedgehog ASW mortars, these older destroyers continued to effectively perform the protection of shipping mission. And by removing two boilers, adding additional berthing spaces, and substituting four landing craft in the space vacated by the four torpedo tubes, the ship became a fast destroyer transport (APD), capable of supporting a Marine rifle company and underwater demolition teams trained for raids and amphibious advance force operations.[437]

These modifications—including boiler replacements—took no longer than four to five weeks to accomplish. By designing modular machinery spaces and modular weapons stations consisting of little more than usable storage space, the Navy built a ship with a high degree of configuration modularity, and "with a record of role changes…unmatched by any other class of ships in the US or any other Navy."[438] The ship's high degree of modularity also allowed the class to make important battle fleet contributions for the duration of its service life. The last of these ships were decommissioned in 1947, 30 years after the first of the class were designed and built.[439]

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[435] "The Blohm and Voss MEKO® Design Concept: Modularity," at http://www.blohmvoss.com.

[436] Philip Sims, *Lightweight, High-speed, Modular Multi-mission Warships (1919-1945),* a monograph provided to the author by Don Nalchajian, Naval Sea Systems Command (NAVSEA).

[437] Sims, *Lightweight, High-speed, Modular Multi-mission Warships (1919-1945).*

[438] Sims, *Lightweight, High-speed, Modular Multi-mission Warships (1919-1945).*

[439] A thorough discussion about the World War I destroyer can also be found in Freidman, *US Destroyers: An Illustrated Design History,* Chapter 3.

Indeed, the longevity of the flush deck destroyers stands in marked contrast to the life spans of small single-mission Navy ships with displacements of 2,500 tons or less since World War II. In fleet service, the capabilities of these small ships often proved too limited to have broad fleet utility in peacetime service, and their cheap operating costs were often offset by their higher overall support costs. As a result, during the carrier era, small combatants generally operated in fleet service no longer than 15 years.[440]

Both the US World War I flush-deck destroyer and the contemporary MEKO® ships highlight the attractiveness of configuration modularity. It gives a navy a wide range of choice in the initial selection of a ship's on-board systems, and allows them to quickly modernize a ship, to easily upgrade ship systems to keep pace with emerging threats, or even to change a ships' primary mission focus during relatively short yard periods or rapid overhauls. Mission changes can be accomplished in times measured in weeks and months. Of course, shipboard mission reconfiguration does not include any retraining required of the crew, which could take much longer.

Mission modularity, a third level in modular ship design, dramatically shortens the time required between ship mission reconfigurations. The best contemporary example of mission modularity is found in the Royal Danish Navy's Standard Flex, or StanFlex, combatant. The origins of this combatant's design can be traced to the 1980s, when the RDN was considering how to replace 22 small combatants—six PT boats, eight patrol boats, and eight minesweepers—on a budget that precluded a one-for-one replacement of ships. Their solution was to design a single 320-ton vessel (called the SF-300) to accept interchangeable combinations of containerized equipment, with one container position forward and three aft. Depending on the particular "mission package"—mine sweeping, mine laying, anti-surface warfare, or anti-submarine warfare—the full load displacement of the ship could exceed 500 tons (note: this implies a "mission payload" of approximately 180 tons).[441]

Although at first uneasy over this budget-induced design approach, the Royal Danish Navy pursued the concept and built what are now known as the *Flyvefisken*-class of Standard Flex 300 multi-role vessels. The RDN found that by accepting some compromises in the ability of the SF-300s to conduct any specific mission, their fleet gained enormous flexibility in operational planning and execution. In practice, SF-300 modules are easily removed and installed using a 15-ton mobile crane. A single module can be installed within 30 minutes and "op-checked" within hours. This high degree of modularity allows a SF-300 to be completely reconfigured for a new mission in days instead of weeks or months. After some study, the RDN concluded that a force consisting of 16 multi-role, focused mission combatants and 33 mission packages (10 ASuW,

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[440] O'Neil, "If It Can't Be Big, It Needs to be Novel," p. 51.

[441] Richard Scott, "Flexing a Snap-to-fit Fleet," *Jane's Defence Weekly*, December 7, 2001, pp. 22-27. For a good description of the different roles performed by this ship, visit the Standard Flex 300 section at the Naval Team Denmark website at http://www.navalteam.dk/300.htm.

five mine sweeping, 14 minelaying, and four ASW—amounting to a 2.1:1 mission package-to-hull ratio) could offer the equivalent capability of 22 standard single-mission combatants.[442]

While budget pressures limited the *Flyvefisken*-class to 14 combatants (resulting in a 2.4:1 mission package-to-hull ratio), mission modularity proved to be so attractive that the RDN is incorporating the same design concepts on its next generation of larger combatants. The RDN must replace 17 fleet ships by 2011 (three corvettes, four large minelayers, and 10 FACs), and once again budget limitations will prevent their one-for-one replacement. As a result, these 17 ships will be replaced by six to eight new modular ships, divided among two types: a Flexible Support Ship (FS) and the Patrol Ship (PS). Both will have displacements greater than 3,000 tons, placing them in the intermediate size ship class.[443]

With the LCS, the Navy aims to take the RDN's StanFlex mission modularity one step further. Instead of emphasizing "container stations" for ***deck-mounted on-board systems,*** the LCS will emphasize "mission module stations" for ***off-board systems, sensors, and weapons.*** By designing the ship around open spaces and volume, and "separating capability from hull form,"[444] the Navy is aiming for a much more rapid, "roll-on, roll-off" mission reconfiguration process that would require minimal facilities support to accomplish.[445]

The pursuit of a combatant designed primarily to employ off-board systems is quite significant for the Navy's surface warfare community. Because the aircraft carrier is, in essence, simply a large carrier of off-board systems (i.e., its aircraft), the naval aviation community has long accepted the concept. Such has not been the case for the Navy's surface warriors.

SURFACE WARRIORS AND OFF-BOARD SYSTEMS

The surface warfare community's less than enthusiastic embrace of off-board systems is somewhat surprising considering that ocean-going sailing ships have long carried boats—in essence, "manned surface vessels"—designed for off-board roles. These off-board "MSVs" have performed a variety of utility missions: transfer of personnel and equipment between ships at sea and between the ship and the shore; support of small raiding parties; and as life boats. The World War II landing craft carried on the decks or in the well decks of World War II amphibious ships were a special type of MSV designed specifically for the efficient ship-to-shore transfer of men and equipment during an amphibious assault.

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[442] Scott, "Flexing a Snap-to-fit Fleet," pp. 22-27.

[443] A description of both vessels can be found at the Naval Team Denmark website at http://www.navalteam.dk. At this time, two FSs and two PSs have been approved. Scott, "Flexing a Snap-to-fit Fleet," pp. 22-27.

[444] Truver, "USN LCS Program Moves Out."

[445] Norman Friedman, "Navy League Show Highlights LCS," in World Naval Developments, *Proceedings*, July 2003, p. 4.

The World War II success of special-purpose MSVs spurred the amphibious fleet to begin exploring new roles for manned off-board systems. For example, soon after the end of World War II, the Navy started to consider the future place of small PT boats in the new carrier era TSBF. During this process, the amphibious and surface warfare communities began to think of the PT boat as a defensive MSV for amphibious operations. Under this concept, the PT boats would be transported to distant theaters onboard 20-knot amphibious ships, whereupon they would be craned over the side to screen the amphibious sea base from small boat attacks. As a result of this early thinking, the PT's post-war displacement was limited to 75 tons—the weight limit of the typical crane onboard the Navy's large amphibious ships.[446]

Similarly, the new post-war 20-knot amphibious convoys could outrun the Navy's fleet of slow ocean-going minesweepers, and the fast destroyer minesweepers passed from fleet service. As a result, the post-war mine sweeping boat (MSB) was conceived of as a small mine warfare MSV, to be carried onboard amphibious ships overseas and released into the water to sweep localized amphibious operating areas for mines.

Neither of these off-board MSV concepts survived. The post-war PT boats evolved into the Vietnam-era Fast Patrol Boats (PTFs), used for the offensive maritime interdiction and support of naval special operations off the coasts of Vietnam, and the small MSBs were used by the riverine navy for minesweeping along Vietnamese rivers.[447]

Attempts at using *unmanned* off-board systems from surface combatants proved to be no more successful. Not counting long-range autonomous weapons, the first widely deployed unmanned off-board system used by the surface warfare community was the Drone Anti-Submarine Helicopter (DASH), a small vertically-launched UAV designed during the 1950s and introduced into fleet service in the 1960s. The DASH was designed to drop either one Mk-46 or two Mk-44 air-dropped torpedoes, or a single nuclear depth charge, on a hostile submarine contact at ranges up to 28 miles from the controlling ship (although the drone controlling system was effective only to some 15,000 yards). Some 100 ships were eventually converted to employ the DASH. However, in fleet service the small helicopter proved difficult to control; of the 746 built, over half crashed into the sea or onboard ships! By the 1970s, the surface combatant fleet replaced the DASH with its first helicopter, the Light Airborne Multi-Purpose System (LAMPS)—a "manned aerial vehicle"—which was small enough to operate off of a modified DASH landing pad but large enough to carry a useful sensor and weapons load.[448]

Within the surface warfare community, the failure of the DASH helped to "seal the deal" against unmanned off-board systems through the end of the Cold War. With the exception of a small number of river minesweeping drones used during Vietnam by the riverine navy (USVs), a few unmanned aerial vehicles used to spot for battleship long-range gunfire (UAVs), and a handful of

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[446] Friedman, *US Small Combatants: An Illustrated Design History,* p. 149, 178.

[447] Polmar, *Ships and Aircraft of the US Fleet,* 14th edition, pp. 241-42.

[448] Friedman, *US Destroyers: An Illustrated Design History,* pp. 280-83.

unmanned underwater mine neutralization vehicles used by the mine countermeasures force (UUVs), the Cold War ended with a surface Navy that clearly preferred either onboard systems or ***manned*** off-board systems (i.e., boats and helicopters) in its naval operations and tactics.[449]

To be sure, given the level of technical maturity and reliability of unmanned off-board systems through the end of the Cold War (or, more accurately, the lack thereof), this preference was perfectly justified. However, as was previously discussed, improvements in the capabilities and reliability of USVs, UAVs, and UUVs operating on, over, and under the sea were quite dramatic during the 1990s. This motivated the Navy to pursue them more aggressively. Indeed, the LCS provides perhaps the most compelling evidence of the surface community's new willingness to experiment with and pursue a range of off-board systems.

THE LCS AND BATTLE MODULARITY

As was discussed in Chapter IV, the Navy's design goals for the first generation of surface ships in its 21st century Total Force Battle Network are: ***get connected; get modular; get off-board; get unmanned***. The LCS is the physical embodiment of these four design goals. Along the lines of the aforementioned flush-deck destroyer, the LCS is basically designed around mission module stations defined only by the amount of open space and volume required (indicated by length, width, and height in meters), as well as a number of associated containerized ***storage*** spaces. Together these stations and storage spaces are capable of carrying an aggregate payload weight of 180-210 metric tons. As Vice Admiral Philip Balisle, Commander of Naval Sea Systems Command has said, the "main battery" of the LCS is its payload and volume.[450]

The basic LCS *sea frame* must carry a minimum of 20 mission module stations, divided into seven different types:[451]

- Two large *Sea Type 1 stations*, measuring 12.2 by 3.5 meters, each designed to hold either a crewed 11-meter RHIB like the Coast Guard's Long-Range Interceptor, a large UUV, or a reconfigurable 11-meter unmanned surface vehicle, like the SPARTAN USV jointly developed by the Navy and DARPA.[452] The 11-meter SPARTAN is designed to

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[449] Portmann, Cooper, Norton and Newborn, "Unmanned Surface Vehicles: Past, Present, and Future."

[450] Author interview with Vice Admiral Philip Balisle, Commander of Naval Sea Systems Command, June 10, 2003.

[451] The seven stations are outlined well in Todd Tompkins, "Clarified Seaframe and Mission Package Definition," a powerpoint presentation presented at the Naval Sea Systems Command Third MSSIT-Industry Working Meeting on November 6, 2003.

[452] Rear Admiral James Stavridis, "The Next Kitty Hawk: ACTD Program Sped Spartan Scout Tests," *Defense News,* November 17, 2003, p. 37.

operate for up to 48 hours at ranges of up to 1,000 nautical miles from the controlling platform, carrying payloads between 2,600 to 5,000 pounds;[453]

- Two smaller *Sea Type 2 stations*, measuring 7.1 by 2.6 meters, each designed to hold either a crewed 7-meter RHIB like the Coast Guard's Short-range Prosecutor, a 7-meter SPARTAN unmanned surface vehicle, a WLD-1 Remote Minehunting System (RMS),[454] or a small UUV like the Battlespace Preparation Underwater Vehicle (BPAUV) or the Remote Environmental Monitoring Unit System (REMUS);[455]

- Two large *Aviation Type 1 stations*, measuring 13.1 by 3.4 meters, each capable of storing either a single MH-60 class helicopter[456] or three vertically-launched tactical UAVs (VTUAVs) such as the Northrop Grumman Fire Scout or the Bell Helicopter Eagle Eye.[457] The space associated with these large aviation stations would also allow future LCSs to carry and employ much more numerous "micro" air vehicles like the DARPA Wasp.[458]

- One *sensor station,* the dimensions for which are currently undefined (or classified). This station is most likely sized to carry heavy fixed off-board grid sensors like the Advanced Deployable System.[459]

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[453] See Nick Brown, "Not Just a Remote Possibility: USVs Enter the Fray," ***Jane's Navy International***, January/February 2004, pp. 17-18; Roxana Tiron, "High-Speed Unmanned Craft Eyed for Surveillance Role," ***National Defense,*** May 2002; and David Vergun, "Spartan Unmanned Surface Vehicle Envisioned for Array of High Risk Missions," ***Sea Power,*** May 2003, p. 23.

[454] The RMS straddles the line between a USV and a UUV. It consists of a diesel-powered semi-submersible that tows the AQS-20 variable depth side-scanning mine hunting sonar. See Brown, "Not Just a Remote Possibility: USVs Enter the Fray," pp. 18-19; Polmar, ***Ships and Aircraft of the US Fleet***, 17th edition, pp. 228-29.

[455] Mike Antoine, "Bluefin Tested in Waters Around Naval Station Ingleside," Navy Newsstand, at www.news.navy.mil; Jack Coleman, "Undersea Drones Pull Duty in Iraq Hunting Mines," at the CyberDiver News Network at http://www.cdnn.info/industry/i030402a/i030402a.html.

[456] The MH-60 helicopter plays a prominent role in US Navy aviation plans, and will provide a substantial part of the LCS's combat capability. For a good discussion about versatility of naval helicopters, see Joris Janssen Lok and Mark Hewish, "Naval Helicopter Sensors and Weapons Systems," ***Jane's International Defense Review***, September 2003, pp. 62-72. For more focused discussions on US Navy helicopter plans, see Richard R. Burgess, "Navy Maps Out Transition Plan for New Helicopters," ***Sea Power,*** November 2003, pp. 33-34; and Richard R. Burgess, "MH-60 Romeo, Sierra Rack Up Successes," ***Sea Power,*** June 2003, pp. 26-27. See also Lieutenant Commander Mario Mifsud, USN, "Knighthawks Change Helo Support in the Gulf," ***Proceedings,*** August 2003, pp. 76-78.

[457] Jefferson Morris, "Eagle Eye UAV May Have Future on Littoral Combat Ship, Cohen Says," ***Aerospace Daily,*** December 8, 2003.

[458] Jefferson Morris, "Navy to Use Wasp Micro Air Vehicle to Conduct Littoral Surveillance," ***Aerospace Daily,*** December 8, 2003.

[459] Nick Brown, "USN Undertakes Quiet Submarine Tripwire Trials," ***Jane's Navy International***, January/February 2004, p. 7.

- Three *onboard weapon stations* more similar to the modular weapon stations designed by Blohm and Voss. Measuring 4.9 by 4.3 by (a minimum) 1.45 meters, these stations are designed to accept small vertical-launched missile modules. The current hope is that these stations will accept the platform independent Container/Launch Units (CLUs) developed for NetFires, a joint DARPA/Army effort to develop a small, next-generation precision guided missile system. The NetFires CLU is currently being designed to fire two types of small, 7-inch diameter, 100-pound missiles: the Precision Attack Missile, or PAM, designed for long-range (40 kilometer +) precision attack of hard targets such as tanks or armored command and control vehicles; and the Loitering Attack Missile, or LAM, a surveillance and attack missile capable of 45 minute flights. The LAM's endurance allows it either to execute a maximum range engagement against a fixed, known target at 200 kilometers, or to loiter at lesser ranges and await targets of opportunity. The hope is that with minor modifications, future PAM- and LAM-like missiles could be used by the LCS against boats and small surface craft, as well as for naval surface fire support for troops maneuvering ashore.[460] The CLUs, each carrying 15 missiles, are projected to measure 1.21 by 1.21 by 1.45 meters, meaning each LCS weapon station could carry a theoretical maximum of 12 CLUs and 180 missiles. With three fully loaded weapons stations, the ship would have a theoretical maximum of 36 CLUs and 540 assorted Netfire missiles—a formidable war load by any measure.

- Nine *Support Type 1 stations*, measuring 6.1 by 2.44 meters, and capable of holding a single standard 8x8x20 foot International Shipping Organization (ISO) container. Unlike on the StanFlex design where the weapon systems themselves are designed on pallets or in containers, however, these containers will serve primarily to store "pack up kits" for the different off-board systems, including such things as their test kits, tools, repair parts, spares, and consumables.

- And one small *Support Type 2 station*, measuring 3.05 by 2.44 meters, for special components for larger off-board systems, such as a dipping sonar.

In summary, then, the Flight 0 LCS will carry a minimum of 20 modular stations: three for *onboard* weapon systems; seven for manned or unmanned *off-board* systems or sensors; and ten for *off-board* system maintenance and support. Of course, the three remaining LCS design teams are free to incorporate additional mission module stations should their hulls be able to accommodate them. All stations must be designed to facilitate the rapid loading or unloading of single mission modules. All that will be required to prepare a LCS sea frame for an entirely new mission is to swap out different *mission modules* within the ship's *maximum payload allowance* to create an entirely new ship *mission package*, and then to conduct operational testing of the entire ship system.

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[460] "Netfires," at http://www.missilesandfirecontrol.com/our_products/firesupport/NETFIRES. See also Raytheon News Release, "Raytheon Precision Attack Missile Makes First Guided Flight," November 18, 2002, at http://www.raytheon.com/newsroom/briefs/111802.htm; and Lockheed Martin News Release, "Lockheed Martin Successfully Completes First Test Flight of Netfires LAM Prototype," at http://www.missilesandfirecontrol.com/our_news/pressreleases, November 11, 2002.

The definition of a maximum payload allowance for LCS mission packages is quite significant. In fleet service, small combatants have been notoriously prone to weight gain and performance loss as more and more equipment is jammed into their small hulls. For example, the World War I wooden-hulled subchasers had a design displacement of some 66 tons. During wartime service, as more capable and heavier ASW weapons were installed, their displacements rose to an average of 75 tons, resulting in significant degradation to the ships' speed and performance. The ships' loss of performance caught the attention of then-Assistant Secretary of the Navy Franklin D. Roosevelt who, 20 years later as President, required tight weight controls on new World War II subchasers.[461] By establishing a maximum weight range for the LCS's total mission package, the likelihood that the LCS will be able to retain all of most of its key performance specifications (e.g., speed, draft, and endurance) over its entire design life should be substantially increased.

One final, but critical, point. A ship's mission reconfiguration necessarily includes the amount of time necessary to prepare the crew for its new mission. In the StanFlex system, the RDN found that the required refresher training for a ship's crew after performing a particular mission for a lengthy period took much longer than the time necessary to reconfigure the ship itself.[462] By separating the LCS crew into a permanent ***core crew*** responsible only for operating the basic sea frame and its self-defense combat systems, and a specialized ***mission crew*** responsible for employing the ship's mission package and off-board systems, the Navy hopes that reconfiguration delays due to crew refresher training requirements will be dramatically reduced.

Altogether, the LCS represents a unique blending of MEKO® and World War I destroyer configuration modularity and StanFlex mission modularity concepts with onboard and off-board systems and a novel split crew concept to try and achieve an entirely new level of ship modularity.[463] This new level of modularity may allow future network battle commanders to both rapidly tailor their networks in response to existing access condition, and to continually adapt their networks over the course of a single joint campaign. In other words, the LCS aims to introduce an entirely new form of operational modularity referred to herein as ***battle modularity***.

THE LCS AS A TRANSFORMATIONAL SYSTEM

As way of a summary, if the Navy is asked to explain the potential transformational impact of the Littoral Combat Ship, it might answer along the following lines.

The LCS is being designed for sprint speeds in excess of 40 knots. While the ship's high top-speed has attracted much attention, its sustained battle speed that will cause the biggest change in fleet operations. Because the LCS will have the speed to keep pace with 20+ knot Expeditionary Strike Groups and enhanced network sea base and sealift ships as well as 30-knot Carrier Strike

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[461] Freidman, *US Small Combatants: An Illustrated Design History,* pp. 31-33.

[462] Scott, "Flexing a Snap-to-fit Fleet," pp. 22-27.

[463] The best description of the LCS's combined ship design attributes is found in Rear Admiral Don Loren, USN, "Littoral Combat Ships Will Help US Forces Gain Access," *National Defense,* December 2002, p. 20.

Groups, it will be the first small combatant (with a displacement less than 3,000 tons) capable of operating with high speed naval battle forces since the famous World War II ***Fletcher-***class destroyer. As such, it will be battle force capable or, more appropriately, ***battle network capable***.[464]

However, the LCS's real potential as a transformational battle network component lies in its modular design and its ability to be quickly reconfigured to perform different battle network roles.[465] Its payload volume will be divided among seven different types of mission module stations designed to accommodate either manned or unmanned off-board systems, onboard weapons and sensors, or mission pack-up kits (i.e., supply packages) in standard shipping containers. Moreover, the LCS crew will be separated into two parts: a permanent core crew that operates and maintains the basic sea frame; and a mission crew that comes aboard with a new mission package. By designing the ship around modular mission stations and by separating the ship's mission capability from its hull form, the Navy is aiming for a rapid, roll-on, roll-off mission reconfiguration process that will require minimal installation support. Indeed, such a design might even allow for the ***at-sea*** reconfiguration of LCS mission packages from enhanced network sea base ships.[466]

Said another way, the LCS is less of a ship, and more of a of battle network component system. This system consists of a sea frame, a core crew, assorted mission modules, assembled mission packages, mission package crews, and a reconfiguration support structure. The total system aims for a level of ***battle modularity*** that will allow for a LCS's complete mission reconfiguration—including operational testing of its combat systems ***and*** crew readiness for follow-on mission tasking—in less than four days. If successfully demonstrated, the LCS's high degree of modularity would be without precedent in naval history, and would afford the 21st century Total Force Battle Network a unique ability to adapt itself to confront any existing or evolving access challenge

Battle modularity will allow the LCS—and the similarly designed HSV—to accomplish key elements of ten of 11 traditional and emerging small combatant missions. The only mission that cannot be handled by these two different craft will be riverine warfare:

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[464] As discussed in Chapter IV, in the near term an Expeditionary Strike Group, or ESG, will include a three-ship Amphibious Ready Group carrying a Marine Expeditionary Unit (Special Operations Capable), two AEGIS combatants and a guided missile frigate, and an attack submarine. A Carrier Strike Group will include a carrier, three AEGIS combatants, an attack submarine, and a combat logistics force ship supported by land-based maritime patrol aircraft. It is at this unclear whether or not the ESGs will be accompanied by a combat logistics force ship, although the assignment of three surface combatants to the group would seem to argue for it.

[465] This point is perhaps best summarized by Vice Admirals Mustin and Katz, "All Ahead Flank for LCS," pp. 31-32.

[466] The potential of making mission package reconfigurations at sea from enhanced sea base ships was pointed out to the author by James. S. O'Brasky. Such a capability would likely require modifications to existing combat logistics force ships, or newly designed capabilities in future sea base ships.

- *Battle force (network) screening.* As has been stated, the LCS will have the sustained speed necessary to operate with both future Carrier Strike Groups and Expeditionary Strike Groups. The initial battle network screening roles now envisioned for the LCS are ASW against diesel submarines operating in shallow littoral waters and counter-boat operations close to shore.

  - Battle force ASW screening has been an important battle force mission ever since submersible torpedo boats (submarines) went to sea. In the future, with ever more capable air independent propulsion-equipped diesels available to potential adversaries, it will remain so.[467] In the battle force ASW role in defended access scenarios, the LCS will operate MH-60R ASW helicopters armed with dipping sonar, sonobuoys, and air-dropped torpedoes; USVs possibly armed with variable depth sonar and torpedoes; and sonar-equipped UUVs.[468] In the case of the latter, the Navy is giving thought to modifying the Remote Minehunting System to carry both active and passive ASW sonar systems. One concept calls for the cooperative employment of one RMS towing an active sonar with two RMSs towing passive arrays. Together, the three systems—which can motor at 14 knots for 39 hours at over-the-horizon ranges—could search a large underwater battlespace for both submerged and bottomed diesel submarines.[469] In fact, the operation of three cooperative search vessels would mimic the ASW tactics used by 110-foot wooden subchasers along the European littoral in World War I.[470] The only difference between them would be that no crewed vessels would be put at risk, and the kill mechanism would be provided by torpedoes dropped from helicopters rather than ship-dropped depth charges. Modifying UUVs and USVs for coordinated search operations may allow the LCS to make ASW mission contributions even in contested access environments. In the future, if provided more powerful towed active and passive acoustic arrays, the LCS might also be able to provide an open-ocean transit ASW capability for surging naval task groups.

  - Early torpedo boat destroyers screened the battle force from swarming torpedo boat attacks. And at the end of World War II, the Navy planned on using PT boats to

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[467] For a good description of littoral ASW, see Norman Polmar, "ASW Requires Practice," *Proceedings,* December 2003, pp. 86-87. For tactics to deal with diesel submarines, see Rear Admiral W.J. Holland, USN (Ret), "Battling Battery Boats," *Proceedings,* June 1997, pp. 30-33.

[468] "US Navy Works to Re-invigorate Anti-submarine Warfare in the Littorals," *Jane's International Defense Review,* October 2003, p. 3; Andrew Koch, "US Explores New Anti-submarine Warfare Concepts," *Jane's Defence Weekly,* July 2, 2003; Jason Sherman, "US ASW Study Proposes Extra Subs, Patrol Craft," *Defense News,* May 5, 2003, p. 13.

[469] For possible new ASW variations of the RMS, see "Sea TALON Overview/Update," a powerpoint presentation presented by Lockheed Martin's Naval Electronics and Surveillance Systems-Undersea Systems, dated 30 January 2003, and Richard Scott, "New Roles studied for unmanned vehicle," *Jane's Defence Weekly,* July 24, 2002, pp. 76-77.

[470] Friedman, *US Small Combatants: An Illustrated Design History,* p. 31 and 37*:*

screen amphibious ships from swarming suicide boat attacks should the invasion of mainland Japan be required.[471] Although the preferred means of engagement against attacking small boats will remain asymmetrical attack, the LCS promises to be a formidable boat killer in defended access scenarios, and in contested littorals once an enemy's A2/AD network has been degraded. When confronting swarming boats, the LCS will use its helicopters and VTUAVs for early warning and as airborne forward observers and fire support coordinators. Armed with air-to-surface missiles, both helicopters and VTUAVs will also augment the ship's concentrated, long-range defensive fires provided by the planned NetFires battery, and will pounce on any boats that break through the ship's outer defenses.[472] The LCS's mid-range weapon—a 57mm automatic cannon with a maximum effective range in the anti-surface mode of 5 miles—will also be used to destroy any "leakers."[473] Close-in terminal defensive fires will be provided by a Close-in Weapon System (CIWS) or other close-in gun system and the Rolling Airframe Missile (RAM) system firing in the anti-surface mode.[474] In the future, armed USVs may also lend support in the anti-boat mission.[475] Note also the LCS's anti-boat capabilities will provide the LCS with a high degree of self-defense against unexpected terrorist boat attacks when it is operating independently in unimpeded and guarded scenarios.

- *Littoral mine warfare.*
  - The threat of mines to future US battle networks is spurring a revival of US organic mine warfare capabilities. The LCS will be prominent among them.[476] As currently envisioned, both the high-speed Flight 0 LCS and HSV will revive the fast mine

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[471] This was referred to as the "flycatcher" mission. See Friedman, ***US Small Combatants: An Illustrated Design History,*** p. 191.

[472] US Navy helicopters can now be modified to carry machine guns and Hellfire laser guide missiles. The Navy is also pursuing other air-to-surface weapons for the anti-boat role, such as the Low-Cost Guided Imaging Rocket (LOGIR) that could be fired by both helicopters and UAVs. See Andrew Koch, "US Navy in Bid to Combat 'Swarming' Threat," ***Jane's Defence Weekly,*** October 22, 2003.

[473] The Bofors Mk3 57mm mount will also arm US Coast Guard cutters. It is a fully automatic and unmanned weapon mount that fires a pre-fragmented (2,400 tungsten fragments), programmable (6-modes), and proximity ("3P") round at rates of up to 220 rounds per minute. See section on 57mm cannon at http://www.uniteddefense.com/prod/ngun_mk3.htm. See also the section on Third-generation 57mm in Richard Scott and Ruggero Stanglini, "Multipurpose Naval Guns Set Their Sights High," ***Jane's Navy International,*** May 2001, pp. 21-25.

[474] For a discussion of close-in gun systems and their capabilities against boats see Mark Hewish, "Defeating the maritime mugger," ***Jane's International Defense Review,*** October 1999, pp. 40-46.

[475] Brown, "Not Just a Remote Possibility: USVs Enter the Fray," pp. 15-16.

[476] The Navy's concern about the future mine threat to battle networks operating in defended and contested access scenarios is quite high. It is spurring the development of organic capabilities on large combatants as well as the mine warfare focus of the LCS. See Admiral Natter, "Access Is Not Assured," pp. 39-41. See also Malina Brown, "Ryan: With or Without Littoral Ship, Organic MCM Will Be Fielded," ***Inside the Navy,*** May 26, 2003, p. 1.

countermeasure role once performed by destroyer mine sweepers. Both ships will be able to keep pace with CSGs, ESGs, and other fast sealift ships, and both will host new MH-60S helicopters employing an array of new airborne mine countermeasure systems, and numerous off-board UUVs, USVs and minesweeping drones.[477]

- The organic battle force mine countermeasures role focuses on reconnaissance, mine avoidance, and rapid minesweeping to allow "in-stride" battle force operations in mine-infested waters. In this regard, the Navy is now considering two types of LCS mine warfare mission packages: an "exploratory" package consisting of two MH-60S helicopters, the aforementioned Remote Minehunting System towing an AN/AQS-20 side scanning sonar, and two special-purpose UUVs; and a "punch-through" package consisting of helicopters, the Airborne Laser Mine Detection System, the Rapid Airborne Mine Clearance System, the Airborne Mine Neutralization System, and Explosive Ordnance Disposal Teams.[478] This mix of manned and unmanned off-board mine warfare systems may allow the LCS and HSV to perform mine countermeasure operations in all access scenarios. The key difference between them would be the stand-off range required for ship survivability and the level of the counter-air threat, which would dictate helicopter employment. Obviously, having to operate over the horizon or with limited helicopter support would dramatically increase the time to create mine-swept routes.

- There appears to be no reason why future flights of LCSs and HSVs could not perform the deliberate minesweeping mission now performed by slower purpose-built mine countermeasure ships. UUVs towing new and improved side-scanning and new synthetic aperture sonar should be able to cut down the high false alarm rate associated with deliberate minehunting, perhaps greatly accelerating the pace of mine field clearing.[479] However, to be fully capable of meeting existing mine warfare threats, future flight LCSs and HSVs will need an ability to sweep broad areas for influence mines, a capability not now included in Flight 0 packages. Perhaps a newly

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[477] For a concise description of the entire array of new mine warfare systems being developed, see Admiral Natter, "Access Is Not Assured," pp. 39-41; and "Mine Warfare Revisited," in *Sea Technology,* November 2002, pp. 51-52. For an example of how USVs might augment future mine warfare efforts, see "Northrop Grumman and NUWC Successfully Complete Unmanned Surface Vehicle Mine Demonstration," Northrop Grumman Public Information News Release 1003-354.

[478] A thorough description of the mine warfare modules now being considered for the Flight 0 LCS can be found in Glenn W. Goodman, Jr., "Turning Stop Signs into Speed Bumps: Organic Mine Countermeasures To Clear Path for Navy," *Armed Forces Journal,* January 2004, p. 36. See also "US Navy Pursues Aggressive Schedule for Littoral Combat Ship," *Jane's International Defense Review,* March 2003, p. 4.

[479] For examples of new, improved minehunting systems, see Norman Friedman, "Mine Clearance Progresses," in World Naval Developments, *Proceedings,* March 2003, p. 6; "The Commanders Respond," *Proceedings,* March 2003. p. 38.; Norman Friedman, "Mine Warfare Sensors Get Smarter," in World Naval Developments, *Proceedings,* January 2004, p. 4; and "Operational SeaKeeper Test Yields High-accuracy Minehunting results," *Jane's International Defense Review,* November 2003, p. 24.

developed drone will be able to perform this role.[480] Future LCSs might also need new capabilities to counter mobile mines or slow-moving autonomous underwater vehicles should they be fielded by potential adversaries. In any event, replacing the slow legacy mine countermeasures force with a force equipped with LCSs and HSVs would obviate any future requirement to routinely forward base mine countermeasure ships in forward theaters, although the practice might still be attractive for operational or tactical reasons.

  - Since World War II, the Navy has laid mines primarily with aircraft.[481] There are no current plans for either the LCS or HSV to duplicate the *offensive* mine warfare role once performed by the fast light minelayer (DM). However, given their high speed and payload, both would appear capable of performing this mission in defended access scenarios while operating under the protection of a local area battle network. By carrying long-range mobile mines, the ships might also perform this role in contested and denied access scenarios.[482]

- *Protection of shipping.*

  - LCSs will be able to screen fast strategic sealift ships, maritime prepositioning ships, and combat logistics force ships that transit or enter littoral waters from both littoral submarine and swarming boat threats. They will also perform an important protection of sea base role whenever an enhanced networked sea base is assembled.

  - The current lack of any credible open-ocean air or submarine threat has allowed the Navy to reduce both the number and capability of its protection of shipping assets. Less than 30 active FFGs remain in the fleet, and their AAW systems are being removed.[483] Consistent with the diminishing requirement for open ocean escorts, the Flight 0 LCS will lack a local air defense and open-ocean ASW capability. However, if an open-ocean threat reappears, the addition of a small active electronically scanned array radar, vertically-launched Evolved Sea Sparrow Missiles, and new

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[480] For example, the Royal Danish Navy StanFlex 300 combatant can control two smaller SF100 vessels rigged for influence sweeping. These vessels can either be employed as unmanned drones, or manned with a crew as small as three sailors. See the Standard Flex 100 section at the Naval Team Denmark website at http://www.navalteam.dk/300.htm. See also Richard Scott, "ADI Influence Sweep Gear SWIMS ahead," *Jane's International Defense Review,* June 2003, p. 16.

[481] For a discussion about US Navy mines, see Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, pp. 489-93.

[482] While the Navy does not currently have surface laid mobile mines they could be easily made, perhaps as derivations of the submarine-launched mobile mines long employed by US naval force. See Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, pp. 491-92.

[483] James W. Crawley, "Frigates to Forgo Missiles," *San Diego union-Tribune,* January 2, 2004.

long-range active and passive towed arrays might allow later flights to perform as austere, but still capable, ocean escorts.[484]

- *Battle force scouting.* Small, fast LCSs, employing a variety of off-board systems capable of over-the-horizon operation will be able to augment battle network "tactical" scouting efforts in unimpeded, guarded, defended, and contested access scenarios. The LCS's shallow draft will make it especially useful in leading battle network transits through narrow straits and passages, and will enable the ship to scout the shallow operational sanctuaries often used by small craft and vessels close to coastlines. "Strategic" scouting will continue to be performed by aircraft, submarines, and stealthy craft. In the future, a stealthy variant of the LCS might be suitable for this role. However, none are contemplated in the navy's current program.

- *ASuW/offensive maritime interdiction.* The same attributes that will make the LCS an effective battle force screening unit against swarming boats will make it especially useful in the offensive maritime interdiction role. A single LCS will be able to patrol large segments of coastline and to pursue and, if necessary, destroy enemy coastal supply traffic. Its MH-60 helicopter and VTUAVs will provide all-around, long-range situational awareness of coastal surface traffic. Its two, armed 11-meter RHIBs/LRIs/USVs will be able to operate at over-the-horizon ranges while its two, armed 7-meter RHIBs/SRPs/USVs operate at closer ranges. The LCS itself will have the high sustained speed necessary for long-range pursuits, and its 57mm cannon, NetFire missiles, and armed helicopter will overmatch small coastal craft and vessels. Consistent with US naval emphasis on asymmetrical anti-surface engagements against major surface vessels, the LCS will not carry long-range anti-ship cruise missiles, although there is no reason why it could not be modified to do so.

- *Amphibious/sea base support.*

  - The HSV, which will have the sustained speed necessary to keep up with 20-knot (+) ESGs and sea base and sealift ships, will re-introduce the ocean-going sea base augmentation mission to the 21st century TFBN. These ships will work in tandem with the smaller special purpose MSVs carried by the large amphibious ships that specialize in the ship-to-shore movement of goods, like the LCU, LCAC, and LCM.

  - The HSV will also be capable of high-speed *independent* transport of small units in unimpeded and guarded scenarios. In defended access scenarios, the HSV's speed will afford it a high degree of self-protection against enemy diesel submarine threats. In cases where the opponent has a long-range maritime strike capability, it would

[484] The Navy is already experimenting with small, lightweight ESSM launchers. See "USN to Fit Vertical-Launch ESSM on Large-Deck Ships," *Jane's International Defense Review*, March 2003, p. 20; and Richard R. Burgess, "Lockheed Martin, United Defense Developing Single-Cell Launcher," *Sea Power*, May 2002, p. 19. By equipping the ship with ESSM and a small electronically scanned array with modest range, the LCS may be able to carry a useful local air defense capability.

require an accompanying escort with a capable local air defense system (e.g., an escort equipped with at least the Enhanced Sea Sparrow Missile).

- *Close-in fire support*. The LCS will re-introduce this mission to fleet operations in support of Marine and joint operational maneuver from the sea. Although the LCS will not be able to accompany landing craft all the way into the beach like the powerful, specially modified World War II fire support landing ships and craft, the precision fire provided by the ship's future missile battery, directed by the ship's armed helicopter, should help to compensate for its inability to land directly on a littoral penetration point. Moreover, the ship's 57mm automatic cannon has a maximum range of 17 kilometers in the fire support mode, and the high rate of fire CIWS can provide high-volume suppressive fires on the beach, if needed.[485]

- *Support of naval special operations.* The LCS will re-introduce fleet capabilities lost with the disappearance of the fast destroyer transport (APD). SEALs and joint special operators will find the LCS to be larger, more roomy, more heavily armed, and carry more small boats (two 11-meter RHIBs and two 7-meter RHIBs) than the 350-ton *Cyclone*-class PCs most recently used for naval special operations support.[486] The LCS's ability to carry two MH-60 class helicopters will provide great flexibility in planning SEAL platoon raids and direct action missions, and the precision fires of the ship's planned NetFires battery will provide persistent fire support for coastal raids. In contested access scenarios, however, SEALs will most likely deploy from SSGNs, SSNs, or in stealthy, over-the-horizon range, covert littoral penetrators.[487] The HSV, if properly configured, could also support larger Marine Corps reconnaissance units configured for clandestine advance force operations.

- *Maritime domain awareness and maritime patrol*. The same capabilities that make the LCS effective as a littoral maritime interdiction platform are also relevant the maritime domain awareness and maritime patrol role during peacetime or in crises short of war. The small, handy, shallow-draft LCS will be suited for sanctions enforcement; counter-drug, counter-piracy, and counter-terrorist patrols; patrols of high traffic straights; and countering the at-sea trafficking of weapons of mass destruction, conventional arms, illegal immigrants, or contraband. The HSV, if properly equipped, will also be capable of performing these roles. Note also that the LCS and HSV would also be able to augment the US Coast Guard for US maritime domain awareness and defensive maritime interdiction in the US exclusive economic zone, if required.

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[485]See the section on the 57mm cannon at http://www.uniteddefense.com/prod/ngun_mk3.htm.

[486] Polmar, *Ships and Aircraft of the US Fleet,* 17th edition, pp. 208-10. The small PCs have been being transferred to, or are under the operational control of, the Coast Guard for homeland security duties. See "Navy Ships," in the *Almanac of Sea Power 2004,* p. 31.

[487] See "US Navy SEALs Receive Stealthy New Platforms," *Jane's Defence Weekly*, September 2003, p. 26. See also Michael Sirak, "Lockheed Unveils Small, Stealthy Attack Vessel," *Jane's Defence Weekly*, June 25, 2003.

- *Battle network sensor emplacement*. The LCS and HSV will both be capable of performing sensor and sensor grid emplacements in unimpeded and guarded access scenarios, and in defended access scenarios if properly covered by long-range battle network defenses. Neither ship appears to have the stealth or staying power required to perform as a Contested Littoral Delivery System for fixed sensors. Perhaps a small class of specially configured LCSs with an extremely high degree of stealth could perform this difficult and dangerous mission. However, ships of this type are not currently envisioned by the Navy as part of the LCS program.

If the LCS and HSV successfully demonstrate the degree of battle modularity and mission adaptability just outlined, the 21st century Assured Access Navy will accrue several additional and powerful additional benefits:

- First, when designing a combatant with a displacement less than 3,000 tons, past naval architects have routinely been forced to focus the ship's role and combat systems on a single mission such as anti-submarine warfare, mine warfare, or torpedo attack. Because each of these different missions demanded different design attributes and characteristics, past small combatants have been typified by a very large number of different ship types, classes, hull forms, and combat systems. In sharp contrast, the Navy's planned family of 21st century small network combatants should be able to effectively accomplish the key elements of all but one of the eleven traditional or emerging small combatant missions (riverine warfare being the exception) *with only two different basic hull forms,* augmented by existing special purpose ship-to-shore landing craft (and perhaps, over time, with stealthy variants).

- Second, based on empirical evidence developed by the Royal Danish Navy, the Navy's planned force of 56 multi-role LCSs with 112 to 134 mission packages (reflecting a 2.0-2.4:1 mission package to hull ratio) would be equivalent to a mixed force of 77 to 88 small single-mission ships that cannot be reconfigured. However, by improving on the Dutch model, the Navy should expect a higher "battle modularity factor." As a result, 56 US LCSs may prove to be functionally equivalent to a mixed force of single-mission ships that is substantially higher than the gains suggested by the Dutch experience.

- Third, weight gain in small combatants has been a consistent problem since 1889, leading to the continual degradation of their designed performance in operational service. By having an aggregate payload weight limitation for its modular mission stations, the LCS should be able to maintain its key design performance characteristics—speed, draft, endurance—throughout its operational life. This seems especially probable given the likely advances in miniaturization expected over the life of the ship, which should help to limit weight gains in future mission packages.

- And fourth, since World War II, small combatants have generally not lasted more than 15 years service because their designed systems were too limited in capability and their small hulls were generally unsuitable for modernization. Because the LCS is designed to easily accommodate new manned and unmanned *off-board* systems, the LCS should be

> able to continually expand its mission set and make important battle network contributions for the duration of its expected 20-30 year service life.

In other words, by designing the ship around mission module stations designed primarily for manned and unmanned off-board systems, the LCS is designed to be "invulnerable to operational obsolescence."[488] To paraphrase Dr. Norman Friedman, the Littoral Combat Ship will:

> Have a design that is sufficiently flexible, with the weight and volume margins necessary to respond to needs that cannot be defined when the ship is being designed. In short, to compensate for future surprise and changed access situations.[489]

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[488] Truver, "The BIG Question," p. 24.

[489] Truver, "The BIG Question," p. 24.

VII. OUTSTANDING ISSUES

Despite the arguments for the Littoral Combat Ship derived from a review of the historical record and from the results of previous Navy analysis and war gaming, there remain a number of unresolved issues about this ship and its associated organizational and support structure. The purpose of this chapter is to highlight some of the more important ones.

WHAT ARE THE TRUE OPERATIONAL AND TACTICAL BENEFITS OF BATTLE MODULARITY, AND ARE THEY WORTH IT?

Battle modularity is the most important aspect of the LCS design concept. However, while a recent study by the Institute of Defense Analysis (IDA) concluded that multi-role single mission ships were likely to perform any particular mission more effectively than a multi-mission combatant, it was uncertain whether or not fleet commanders could successfully predict which mission packages would be needed prior to the start of a campaign, and it did not comment on the fleet's ability to reconfigure mission packages during the course of ongoing operations.[490]

Many questions remain over the true operational and tactical benefits of battle modularity and whether or not they will be achievable in fleet operations. For example:[491]

- Will the LCS be able to effectively operate and integrate its various off-board systems in both independent and squadron operations? This may prove especially challenging for the Flight 0 LCSs, since they will operate off-board systems now in various stages of development that were not designed to be part of a single ship "system of off-board systems."[492] This tactical challenge aside, the broader operational and technical challenges associated with connecting all of the disparate off-board systems operated by a large fleet of LCSs within naval, joint, and allied battle networks represent a ship and battle network integration challenge that is by no means solved.[493]

- Can current and future combat logistics force ships be modified to carry, service, replace and deliver LCS mission packages while on deployment? Will a new mobile LCS support

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[490] "Small Combatants: Implications for the Effectiveness and Cost of Navy Surface Forces," p. 3.

[491] The following questions were developed from an email from Jim O'Brasky to the author dated January 7, 2004.

[492] One problem the Navy faces is that the development of mission packages is the responsibility of different Program Executive Officers (PEOs). For example, the PEOs for the Littoral Combat Ship, Integrated Mine Warfare Systems, and Integrated Warfare Systems all have responsibilities in this area. A Memorandum of Understanding and Agreement was signed among them in early 2003 to coordinate their efforts. See B.C. Kessner, "Program Executive Office Directive to Impact LCS Mission Module Development," *Defense Daily,* February 13, 2003.

[493] Sandra I. Erwin, "Littoral Combat Ship Sensors Pose Integration 'Challenges'," *National Defense,* December 2003. The article can be found at http://www.nationaldefensemagazine.org/article.cfm?Id=1295.

ship be necessary for future CSGs and ESGs to allow these groups to take operational or tactical advantage of the ship's high degree of modularity?

- Can the LCS mission reconfiguration process occur at sea, either alongside ships operating as part of an enhanced network sea base, or using helicopters, or both? How will containerized LCS mission pack-up kits be handled at sea?

- Will expeditionary mission changes in support of battle network operations in defended or contested littorals require protected in-theater anchorages or shored-based facilities? Will the development of purpose-built LCS mission package support tenders be required? If so, what additional battle network defensive requirements for the protection of forward logistics sites or tenders will accrue?[494]

Answers to the foregoing questions will help to illuminate the overhead costs associated with battle modularity, and help determine whether or not they are worth it. For example:

- How much will the modules themselves cost? One consequence of separating capability from hull form in the LCS battle network component system has been that the costs of the LCS sea frame have been separated from those of the mission modules.[495] This has helped to hide overall program costs, and has been a source of concern in the Congress. Indeed, the Congress recently expressed worry over the lack of Navy mission module integration or risk reduction plans, and increased the Navy's budget by $35 million to help further develop them.[496] Until mission module costs are conclusively known, the overall cost of a mission capable LCS will remain a question, as will the program's overall cost.[497]

- Assuming the LCS's rapid mission reconfiguration process proves to be achievable, what is the correct ratio of mission packages to hull forms? Operational testing should be able to identify the tradeoffs of pursuing a 3:1 ratio, which would allow maximum fleet

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[494] The question whether or not the LCS requires tenders is still a big one within Navy circles. Admiral Donald Pilling, Vice Chief of Naval Operations during the 2001 QDR, still asserts the LCS will be too small to be able to deploy and operate autonomously without an accompanying tender. See Sandra I. Erwin, "Novel Ship Hull Forms Still a 'Tough Sell'," p. 4.

[495] Truver, "USN LCS Program Moves Out." At least one shipbuilding expert believes the Navy's decision to segregate the mission modules from the hull is risky. See comments by Guy Ames Stitt in Sandra I. Irwin, "Navy's Littoral Combat Ship Tests Contractor's Creativity," *National Journal*, June 2003.

[496] "Littoral Combat Ship," Title II (RDT&E), Other Matters of Interest, Navy, in the House Armed Services Committee Report , 108-106, for the Fiscal Year 2004 Defense Authorization, HR1588, pp. 181-182.

[497] The price quoted for a complete mission package ranges up to $180 million, making the maximum cost of a complete mission-ready LCS approximately $400 million. See Michael Fabey, "Ships Will Allow Navy to Fight Littorally, In Shallows," *Newport News Daily Press*, January 5, 2004. However, these prices are by no means certain, causing some analysts to question the program's overall costs. See for example Ron O'Rourke, *Navy Surface Combatant Acquisition Programs: Oversight Issues and Options for Congress* (Washington, DC: Congressional Research Service (CRS) Report RL32109, dated October 14, 2003), p. CRS-41.

flexibility in reconfiguring single ships for either littoral ASW, mine countermeasures, or counter-boat missions; the 2.0-2.4:1 ratio suggested by Royal Danish Navy experience; or even a smaller ratio. What will be the impact of the suggested ratio on the LCS's total life cycle costs?

- Should the modifications to the combat logistics force or the special LCS tender previously discussed be required, what will be their impact on the LCS's total life cycle costs?

- What new skill sets will be required of LCS core and mission crews?[498] Will they require a higher percentage of senior ratings for LCS crews? What will be the overhead training and personnel cost associated with maintaining idle or unassigned mission package crews? Will the combined personnel and training costs for the LCS be higher or lower than legacy combatants?

Once the overhead costs for the LCS program are determined, the Navy will be able to make a better determination as to whether the added battle network flexibility afforded by the ship's high degree of battle modularity is worth the combined costs of the LCS program. In this regard, even if the overhead costs for battle modularity (i.e., changing out mission modules during an ongoing campaign) may prove to be prohibitive, the overhead costs associated with exploiting the ship's configuration and mission modularity (i.e., changing out mission modules for planned deployments or before a battle network surge operations) may prove to be a tremendous bargain.

HOW SHOULD THE LCS FORCE BE BEST ORGANIZED?

The LCS Concept of Operations explains that the LCS can *be employed* as part of Carrier Strike Groups and Expeditionary Strike Groups; in separate LCS Squadrons or Divisions; or independently for limited operations.[499] However, it is silent about how fleet LCSs should be *best organized* within the 21st century Total Force Battle Network to support these different employment options.

At this point, there appear to be three broad choices. The first would be to organize LCSs into a ship type pool consisting of large administrative squadrons or divisions assigned to both the Atlantic and Pacific Fleets or to each numbered Fleet. Fleet operations officers would assign individual ship missions depending on emerging requirements. An LCS Theater Support Command might provide worldwide mission reconfiguration support.[500]

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[498] Lorenzo Cortes, "Navy Official: LCS Training Could Create Unique Skill Sets in Navy," *Defense Daily*, September 11, 2003, p. 8.

[499] "Littoral Combat Ship Concept of Operations (CONOPS)," a PowerPoint briefing provided to the author by Commander Al Elkins, USN, Navy Warfare Development Command.

[500] The idea of a LCS Theater Support Command came from James S. O'Braskey in conversations with the author in January 2004.

A second approach would be to organize operational squadrons that train to operate with *mixed* mission systems. The squadron commander would work with supported strike group or battle network commanders to provide them with the mix of capabilities required. Mission changes during the course of an operation might be supported and directed by a Squadron Support Unit.

The third approach would be to employ LCSs in operational squadrons composed of ships with *common* mission configurations and focused on the same mission. This was the preferred organizational approach in several of the Global War Games, during which squadrons of eight commonly configured ships were employed by game players. In this case, if required, the entire squadron would likely conduct a mission change at the same time, probably with the support of a large LCS Theater Support Command.

The Navy must determine which of these or other options provide the optimum organizational and support structures necessary to properly exploit the LCS's high degree of battle, mission, and configuration modularity. For example, if commonly configured squadrons proved to be the most effective approach, would not the preferred employment option then be to just swap out different squadrons rather than individual LCSs mission packages during the course of a campaign? If so, the important question would not be the correct ratio of mission packages per hull, but the correct ratio of ASW squadrons, mine warfare squadrons, and counter-boat squadrons in the TFBN. The Navy might then, in turn, discover that the big payoff of LCS modularity is that it allows the Navy to quickly change the TFBN mission squadron ratio in response to evolving access threats rather than allowing it to change mission packages during the course of a single campaign.

SHOULD FUTURE FLIGHTS OF LCSS BE MULTI-ROLE, SINGLE-MISSION COMBATANTS, OR MULTI-MISSION MODULAR WARSHIPS?

A fourth organizing option might be to group LCSs into squadrons of three ships—each configured with a different mission package—and to employ them as a single "distributed multi-mission ship." This option helps to highlight the two broad potential evolutionary pathways for future LCS flights.

The Navy has explored the idea of distributing multi-mission capabilities among small ships of the same class at least twice before. The original idea for the ship that became the *Oliver Hazard Perry* FFG was to build three smaller, austere single-mission frigates, including an ASW version, an AAW version, and an ASuW version. The thinking was that since each of the versions would focus on only a single mission, they could be smaller (on the order of 3,000-3,500 tons) and cheaper. However, a cost analysis showed that the additional support costs (additional crews, etc) associated with the single-mission approach were higher than building a slightly larger and more expensive multi-mission ship with a capable ASW system and the Mk-13 missile system (that could fire both Harpoon anti-ship missiles and Standard SAMs).[501]

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[501] Friedman, *US Destroyers: An Illustrated Design History*, pp. 381-85.

Similarly, the original PHM concept called for five different ship mission configurations, including a coastal ASW configuration; a gunboat configuration; a FAC configuration (with anti-ship cruise missiles); a special operations configuration; and an electronic warfare version. These were to be used in different combinations to create a "multi-hull equivalent of a conventional [multi-mission] warship."[502] In the end, however, it proved cheaper to combine the gunboat and FAC missions into a single hull and to forego the goal of a distributed warship.[503]

If the Navy once again concludes that the flexibility of a distributed multi-mission ship option is tactically attractive but not cost effective, then it might decide that a slightly larger ship capable of simultaneously carrying several different off-board mission packages—in essence, a tactically modular, ***multi-mission*** ship—may be the preferred evolutionary pathway for the Littoral Combat Ship. This design approach would allow the ship to conduct (control) several off-board missions simultaneously, or to immediately concentrate on an emerging new mission without having to withdraw to a forward operating base for reconfiguration.

There is already a precedent for an evolutionary branch toward somewhat larger, modular ships. Recall that after considering the lessons learned from their own out-of-area deployments and the success of their StanFlex modular design approach, the Royal Danish Navy decided that their new Flexible Support Ships and Patrol Ships should both be ***intermediate***-size ships. As originally planned, the FS would have a basic hull of some 4,600 tons, capable of carrying payloads up to 1,800 tons, while the PS will have a basic hull of some 3,500 tons capable of carrying over 1,000 tons. Both ships would carry six StanFlex container positions and operate two large helicopters, the difference in their size being the removal of one full deck in the smaller PS, and the size of their large open "flex-decks." However, the RDN now plans only for the ships to share a common hull based on the ***larger*** FS design, and modifying the internal arrangement of the two ships for different missions. For example, the PS is now expected to carry three 8-cell "strike configured" (i.e., Tomahawk-capable) VLS modules, and only one large helicopter.[504] The British Royal Navy is also pursuing intermediate size, modular, multi-mission ships.[505]

If the LCS's battle modularity proves to be operationally attractive and its associated overhead costs reasonable, continuing the development of cheaper and more numerous multi-role, single-mission ships will likely remain the best evolutionary pathway for the ship. This would especially be true if shipbuilding budgets remain constrained and the need for global naval battle network coverage increases. If not, the best evolutionary pathway for future LCSs might instead be intermediate size, multi-mission modular warships. Of course, these larger multi-mission

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[502] Friedman, *US Small Combatants: An Illustrated Design History,* pp. 379-83.

[503] For a thorough discussion about the PHM's history, see Freidman, *US Small Combatants: An Illustrated Design History,* Chapter 15.

[504] Richard Scott, "Denmark Works to Define Future Patrol Ship," *Jane's Defence Weekly,* 4 June 2003, pp. 29-30.

[505] Richard Scott, "Sea Change on the Horizon: RN's Future Surface Combatant," *Jane's Defence Weekly,* December 24, 2004, pp. 26-29.

ships would be more costly to build than smaller, multi-purpose, single mission ships, and the Navy would be able to buy fewer of them. However, their overhead costs would likely be substantially lower. In any event, however, the Navy must consider the best evolutionary path for future LCS flights within the context of its emerging Total Force Battle Network. Indeed, it may be that the TFBN will be best served if the LCS evolves into a family of modular ships including both small *and* intermediate network combatants.

WHAT IS THE PROPER ROLE FOR THE LCS IN CONTESTED ACCESS SCENARIOS?

Given the heavy emphasis placed on sensor-based operations by US joint and naval forces, any future enemy capable of erecting a formidable A2/AD network will likely emphasize counter-information operations. Indeed, these adversaries could easily take the emplacement of US battle network sensors in its littoral waters as a prelude to war, especially if pre-hostility tensions are already escalating. It goes without saying that once hostilities begin, future high-end littoral adversaries will place high targeting and destruction priority on US sensor platforms. It thus seems likely that any capable enemy might try to preempt or disrupt early US sensor emplacement operations; especially those involving long-dwell fixed sensors that would give an approaching US naval battle network a significant early information advantage.

The current LCS therefore appears to be ill-suited as a contested littoral delivery system for *fixed* sensors, especially before the adversary's A2/AD network has been taken down. It will be a relatively inexpensive ship, with neither a high degree of stealth nor staying power. In these scenarios, the risks associated to the LCS and its crew likely would be too high to warrant their employment. The LCS will be suitable for fixed battle network sensor emplacement in unimpeded and guarded access scenarios.[506] It could also emplace fixed sensors and arrays in defended access scenarios, provided it was operating under the protective umbrella of a larger fleet battle network and while enemy shore-based defenses were being heavily suppressed.

If future fixed battle network sensors are too heavy to be emplaced by stealthy aircraft or unmanned sensor dispensers, and should the Navy elect not to emplace them with submarines, one possible solution would seem to be a small number of LCS variants specifically designed for the covert littoral delivery of fixed sensors. This might entail building an LCS variant with a much higher degree of stealth shaping and signature management, or even a new semi-submersible design. Given that true contested littoral scenarios likely will be rare over the near- to mid-term, only a small number of these special purpose vessels would likely be needed to meet the needs of the 21st century Assured Access Navy.[507]

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[506] Of course, there being no naval threat in these scenarios, the sensors would have to contribute in some way to operations ashore.

[507] Stealth, or, more broadly, all-aspect signature management coupled with passive and active electronic warfare systems could potentially allow a combatant greater freedom of action in a contested access scenarios. Given their small size, this is especially true for small combatants. See James H. King, Office of Naval Research, "Technology Challenges for Small Ships," a presentation to the 71st Military Operational Research Society Symposium, June 10, 2003.

As has been discussed, however, the basic LCS's heavy emphasis on off-board sensors may allow it to contribute in contested access scenarios. Until an enemy's A2/AD network is sufficiently degraded and disrupted by joint and TFBN and counter-A2/AD forces, the LCS would operate far over the horizon, under the protection of fleet battle network defenses. From there, it might be to employ long-range, unmanned littoral penetration systems. Operational testing would help to identify the long-range, off-board sensors and systems that would allow the LCS to make the best contribution in contested/denied access scenarios. Indeed, one would expect such testing to spur new long-range unmanned systems designed to better complement evolving battle network capabilities, and to respond to emerging access threats. For example, one off-board concept now being discussed is a cooperative, swarming pack of USVs that can operate with a high degree of autonomy.[508] Perhaps future LCSs would carry and launch several of these cooperative packs, which would provide sensor coverage in denied areas or attack highly defended offshore components of the enemy's A2/AD network.

Given its relatively small payload, when operating at long-ranges, the LCS would not be the optimum long-range systems tender in *contested* access scenarios.[509] In these high-threat circumstances, most ships in the TFBN will be compelled to operate from stand-off ranges until the enemy's A2/AD network has been suppressed. Operating at long ranges in contested littorals will necessarily require larger and heavier unmanned systems, and more of them to make an effect on the enemy's network. Commercial and military satellite communications will allow future battle network commanders to control unmanned vehicles of all types from extremely long-ranges. Large ships designed to commercial standards with large carrying capacities would be more effective unmanned system tenders than the LCS in these scenarios. This paper takes the position that the LCS should only be pursued if it can effectively conduct the broad range of small combatant missions in *defended* littorals, as well as cost-effectively perform the numerous small combatant roles in unimpeded and guarded access scenarios. These capabilities will make the most important small combatant contributions in the 21st century TFBN. If unmanned systems allow the LCS to contribute in some way in contested scenarios, so much the better.

The Navy must decide the primary access conditions for which the LCS will be expected to operate. Under any circumstances, the notion that the basic 2,000-2,800-ton LCS with a crew of up to 75 Sailors is expendable, should be designed to lose, or allows risk tolerant employment of fixed sensors in contested access scenarios should be rejected.

WHAT IS THE SEPARATION OF RESPONSIBILITY BETWEEN MISSION AND CORE CREWS IN TACTICAL ENVIRONMENTS?

For example, who is responsible for the ship's safety in combat? Traditionally, a ship's captain both fights the ship and is responsible for the ship's safety. The separation of the LCS crew into core and mission segments appears to break this long tradition, and current similar situations do

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508 Brown, "Not Just a Remote Possibility: USVs Enter the Fray," p. 15.

509 Krepinevich, Watts, and Work, *Meeting the Anti-Access and Area-Denial Challenge,* p. 61.

not appear to fully resolve the uncertainties that will undoubtedly arise.[510] Any tension between a carrier's captain and the air group commander over ship safety and mission requirements can be resolved by the on-board battle group commander. And when a LAMPS helicopter detachment is assigned to an intermediate or large surface combatant, the LAMPS is merely an airborne extension of the ship's combat system, and its employment is directed by the ship's captain and crew. On the LCS, the helicopter detachment will presumably be assigned to the mission package commander, who will have the best sense on how to tactically employ the entire mission package. One might also presume that the mission package commander will direct the maneuver of the ship to attain positional or tactical advantage for other mission package systems. If true, who would be relieved if the ship runs aground when performing its mission? The mission package commander, the core commander, or both?

Similarly, what are the mission crew's responsibilities for basic ship operations? For example, because of the small core crew size now envisioned, mission crews would presumably be expected to assist in damage control efforts if an LCS were hit or damaged during operations. In this role, they would presumably be directed by the core crew. Should the familiarization drills necessary to forge capable ship damage control teams be included in the mission reconfiguration time? Will these drill dramatically increase the time require to prepare a ship for a new missions?[511]

The separation of such a small crew into core and mission components will likely cause ship operation problems not entirely foreseen by fleet planners.

ARE THE REQUIRED SHIP TRADEOFFS TO ACHIEVE HIGH SPRINT SPEED WORTH IT?

Another key operational question that merits more detailed operational review is the requirement for the LCS to have a sprint speed of 40-50 knots. The quest for high surface combatant speed has been a long one for Navy surface warriors, and high platform speed and "speed of effect" is a central tenant of network centric warfare. However, it is not altogether clear why the LCS must be able to achieve tops speeds in excess of 40 knots.[512]

The thinking goes that all things being equal, the greater a ship's top end speed the better—and few would argue with this logic. However, in ship design, things are seldom equal, and designers are constantly faced with making tradeoffs within the "iron triangle" of speed, endurance, and payload. Conventional wisdom is that two of the three can be maximized for relatively low cost, while maximizing all three is both difficult and expensive.[513] Thus, until marine technologies

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[510] "Admiral Says Navy Needs 45 to 60 Littoral Combat Ships," *Sea Power,* September 2003, p. 36.

[511] For some of the challenges associated with the lean manning of small combatants, see Doron, "The Israelis Know Littoral Warfare," pp. 68-69.

[512] Polmar, "Getting the LCS to Sea, Quickly," p. 106.

[513] Irwin, "Navy's Littoral Combat Ship Tests Contractor's Creativity."

improve and conventional wisdom is proven wrong, the early flights of the LCS will require the Navy to make important tradeoffs between the ship's speed, endurance, and payload, and to make compromises to achieve the most attractive overall balance.[514]

From a historical perspective, of the three characteristics in the iron triangle, the requirement for high sprint speed, defined here as 40 knots or greater, should ***not*** be the driving factor for LCS design. Fleet experience has proven time and again that it is simply not worth the cost or the tradeoffs in either payload or endurance.[515]

Four historical examples are instructive. When designing early destroyers, the Navy staff decreed that the ships must have a 70 percent speed margin over the battle line so that they could maneuver freely around it. This figure, undoubtedly the result of measured analysis, made perfect sense as long as the battle line advanced at a speed of only 21 knots. However, upon transitioning to the carrier era, if the fleet used the same logic, the 33-knot fast fleet carriers would require a destroyer with a top speed of over 50 knots! As a result, desired destroyer top speed was reduced to 38 knots, and even this figure proved difficult to achieve. Fleet planners ultimately were willing to accept lower speeds as long as the destroyer was "capable of accompanying the (carrier) fleet without detracting from its mobility in any except the worst weather…" As a result, while battle force capable ships in the carrier era had to be able to ***sustain*** 30 knots in any weather, top speeds of 32-35 knots proved more than adequate in fleet operations.[516]

In World War II, the Navy staff consistently demanded that PT boats be able to achieve 40 knots during tactical operations, which meant that their trial speeds had to be well above 40 knots. It is not clear where this requirement came from, but it was likely once again the result of detailed staff analysis.[517] However, the wartime PT boat commanders rarely, if ever, found a speed of 40 knots to be tactically useful. Because of their vulnerability to air attack, wartime PTs would operate almost exclusively under the cover of darkness. They would conduct a high-speed ingress to their patrol areas, conduct their patrols at low speed, and then conduct a high-speed egress to return to their bases before first light. In these instances, the ability of the PT boats to sustain a somewhat lower speed over a long patrol was more important to commanders than high top-end speed. Moreover, the commanders valued acceleration and maneuverability above high speed for evasive tactics. Wartime PT commanders therefore concluded that a sustained speed of 30 knots and a high top-end speed of 30-35 was more than adequate for their needs.[518]

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[514] King, "Technology Challenges for Small Ships."

[515] Hughes, *Fleet Tactics and Coastal Combat,* p. 204.

[516] Friedman, *US Destroyers: An Illustrated Design History,* p. 23, 113.

[517] Friedman, *US Small Combatants: An Illustrated Design History,* p. 149.

[518] Freidman, *US Small Combatants: An Illustrated Design History,* Chapters 6, 7, and 10. See especially the remarks attributed to a Captain Barnes on p. 250.

Throughout the 1950s, OPNAV and the Office of Naval Research considered the emerging tactical problem of combating fast Soviet attack submarines. After measured review, they concluded that the speed of surface combatants had to be raised substantially and they began to pursue hydrofoil technology to achieve that goal. In 1960, the ASW panel of the President's Science Advisory Committee agreed with the Navy, and recommended a massive investment in fast, open-ocean hydrofoils. After all, their analysis suggested that the hydrofoil had all of the advantages of helicopters without their disadvantages of low endurance, and weather and weight restrictions. However, this analysis led to a dead end. After much expenditure in time and money, and the development of two hydrofoil prototypes, it turned out that the best and most cost-effective solution for the Soviet fast submarine threat was cheaper, more traditional combatants with top ship speeds of 30 knots that were armed with an ASW helicopter.[519] A modern, capably armed ASW helicopter gave any ship to which it was attached a high "virtual speed"—and one much higher than any hydrofoil was capable of matching.

Finally, when analyzing requirements for the counter-Fast Attack Craft mission, fleet planners demanded that the ***Asheville*** PGs achieve a top speed of 40 knots. In the event, the ships seldom achieved more than 37-38 knots in fleet service, and even this speed proved unnecessary for the maritime interdiction role they played along the coasts of Vietnam. The answer to the FACs proved to be fast missiles launched from slower surface combatants; missile armed aircraft; or armed helicopters. The anti-ship missile gave any ship or aircraft so armed with a higher virtual speed than any FAC could hope to achieve. As a result of this simple truth, the high speed of Admiral Zumwalt's 45+ knot-Patrol Hydrofoils Missile (PHMs) did not prove to be worth their high relative costs, low endurance, and small payloads.[520]

Based on the historical record, and especially that since the introduction of helicopters and missiles, it seems safe to assume that any current analysis that indicates a compelling LCS requirement for a top speed in the vicinity of 40-50 knots is well-reasoned, perfectly logical—and likely flawed. Peacetime analyses are often based on absolute worst-case scenarios involving circumstances that most prudent commanders would seek to avoid, in which other battle fleet advantages are eliminated from consideration, and in which reasonable tactical alternatives are not modeled. As the aforementioned examples illustrate, the result has been a continual over-valuation of high combatant speed.

The current scenario demanding a high top-end speed for the LCS is the swarming boat threat.[521] Unfortunately, since the analysis of this scenario is classified, no detailed comment on it can be

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[519] The referred to hydrofoils were the smaller ***High Point*** Patrol Combatant Hydrofoil (PC(H)), and the much larger ***Plainview*** Hydrofoil Destroyer (DD(H)). Freidman, *US Small Combatants: An Illustrated Design History,* pp. 212-213.

[520] Friedman, "New Roles for Littoral Combat Ships," p. 4; see also Kelley, "Small Ships and Future Missions." For a more sympathetic view of the PHM's costs, see Jenkins, "Patrol Combatant Missile (Hydrofoil): PHM History 1973-1993."

[521] See for example Lieutenant Michael Farmer, USN, "We Must Defeat the Small-Boat Threat," ***Proceedings,*** January 2004, p. 81.

made here. However, in general terms, the threat appears to focused on 12- to 26-meter (or even smaller) boats with extremely high speeds (up to 60+ knots) and equipped with short-range missiles, rockets, rocket propelled grenades, heavy machine guns or—in the suicide role—shaped or high explosive charges.[522] When protecting ships at anchor or when protecting one's own coast from attacks from these types of boats, a case can be made for relatively small, short-range, high speed boats in the defensive interceptor role.[523] However, the LCS is designed to cross the Atlantic and Pacific Oceans before confronting these threats, and the case for high speed in the counter-boat screening role during distant power projection operations appears to be far less compelling.

The worst swarming boat scenario for an LCS would be if it were attacked while operating independently or while operating as part of a fleet battle network with no friendly air cover, or if it was screening a high value ship in restricted waters with little maneuver room, such as in the Persian Gulf. In the case of the former, a high top-end speed of 38-40 knots would allow an LCS to complicate an enemy's attack geometry, since a speed advantage of at least 50 percent would be necessary for an attacking boat to ensure a successful intercept.[524] With a combat system with good range or with its helicopter and VTUAVs providing early warning of a potential attack, a high speed of 38-40 knots coupled with good maneuverability would likely allow an LCS to keep the range open between itself and the threat, and for it to attack or withdraw under the cover of its own armed helicopter, VTUAVs, and USVs, and the heavy precision fire from its planned NetFire missile battery.

Similarly, a ready battle network with sensors on and air cover and defenses up would likely be more than a match for any attack against a high value target. In any event, combatant speeds greater than 40 knots would likely prove to be tactically insignificant in an at-sea "dog-fight." As the PT boat commanders found, ship acceleration, maneuverability, weapons platform stability, and an advantage in effective weapons range will likely be the deciding tactical factors.[525] Even if higher speed proved necessary to counter attacking boats, it would seem more prudent to build small high-speed boats that could be carried by the LCS, perhaps along the lines of the manned Covert High-speed Attack and Reconnaissance Craft (CHARC) concept developed by Lockheed

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[522] See Joris Janssen Lok, "Countering Asymmetrical Threats," ***Jane's International Defense Review,*** November 2003, pp. 51-55. For increasing naval fears about suicide boat attacks, see "Force Fears Suicide Boats," from "This is London," found at http://www.thisis London.com/news/articles/3749918?source=Reuters, and "Navy Alert to Suicide Attacks After Speedboat Bomb Intercepted," at http:www.smh.com.au/articles/2003/03/26/1048354634465.html.

[523] As was previously mentioned, during planning for the possible invasion of Japan, PT boats were to be assigned the "flycatcher" role against Japanese suicide boats. Friedman, ***US Small Combatants: An Illustrated Design History,*** p. 174, 191.

[524] From conversations and emails with James S. O'Brasky.

[525] In addition to Friedman, see King, "Technology Challenges for Small Ships."

Martin or the Protector USV developed by Israel, rather than paying the penalties inherent in designing a 2,000+ ton vessel to conduct a high-speed counter-boat dog-fight.[526]

Some might argue that a higher 45-50 knot dash speed would allow the LCS to "sprint ahead" of an advancing battle network to conduct its screening missions prior to the network's complete arrival. However, as has been discussed, operating an LCS forward of battle network air cover and missile defenses in a defended access scenario with any type of serious littoral naval threat appears both rash and foolhardy. In a contested access scenario, it would be suicidal.

Remember the "iron triangle." The problem with pursuing speeds in excess of 40 knots is that whether or not it is ever used tactically, the power densities and design requirements needed to achieve it require ship design approaches that normally have adverse impacts on a ship's endurance and payload.[527] If it is still true that a ship design can only maximize two of these three key characteristics for a reasonable cost, the foregoing discussion suggests that the LCS should sacrifice high top-end speed to maximize its payload and endurance. Indeed, since the LCS is an off-board sensor "truck," it would seem more prudent to maximize its payload to enable it to carry the maximum possible off-board system/sensor load. Similarly, since the ship will most often operate independently during peacetime or with larger battle networks during wartime, its endurance should be maximized to give the ship a long station patrol time or to extend the periods between required at-sea refuelings. As one naval officer has written, "increased speed rarely compensates operationally for constrained range and the need for frequent refueling.[528]

So, how fast should an LCS be able to go? As in the past, the key speed requirement for the LCS is the ability to sustain 30 knots in almost any weather, which would allow it to accompany both fast CSGs and SAGs, and slower 20+ knot ESGs and sea base and sealift ships. The LCS's "economical cruising speed" should be close to the average speed of advance of battle network ships conducting a "fleet surge operation," whatever this speed turns out to be.[529] A top ship speed of 38-40 knots would appear to be more than adequate; the ship's VTUAVs, helicopter(s),

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[526] Sirak, "Lockheed Unveils Small, Stealthy Attack Craft;" and "Israeli Navy to Evaluate Protector USV," *Jane's International Defense Review,* September 2003, p. 31.

[527] A concise and cogent explanation of the impact of designing high speed vessels on payload and endurance can be found in David Rudko and David Schrady, "Logistics Analysis of the Littoral Combat Ship," a paper delivered at the 20th ISMOR held at the US Naval Postgraduate School in August 2003.

[528] Kelley, "Small Ships and Future Missions."

[529] In the carrier era, carrier groups on routine deployment often steamed at 15 knots. In the battle network era during which the fleet emphasizes surge operations, one would expect the battle network speed of advance to be higher. From conversations with James S. O'Brasky.

and 40 kilometer NetFire missiles will give the LCS a much higher virtual speed or "speed of effect" than any surface ship it is designed to confront head-on.[530]

In summary, it would appear that any top speed over 38-40 knots should be pursued *only if it does not appreciably reduce the LCS's payload and endurance*. Operational testing in realistic fleet operational settings should be able to help better resolve the tradeoffs among LCS speed, payload, and endurance.

IF SPEED PROVES NOT TO BE A CRITICAL DISCRIMINATOR AMONG LCS DESIGNS, WHAT SHOULD BE?

When down-selecting to the final LCS design or designs, the Navy will aim to select those ships that best blend the ship's operational requirements for a not-to-exceed basic ship cost of $220 million (not counting mission packages).[531] Some candidate discriminators for the final fleet choice will be:

- *An ability to launch, operate, and recover off-board systems and sensors*. As a mother ship for a variety of off-board systems, any LCS design must allow the ship to be able to efficiently and effectively ***deploy, maintain, exploit, refuel, reposition, recover, replace, and redeploy*** both manned and unmanned off-board systems, even in rough weather. A ship's ability to easily conduct so-called "DMER5" for off-board systems in even heavy seas will obviously be among the top discriminators for competing LCS designs.[532] This suggests that superior seakeeping as well as easy-to-operate and easy-to-maintain launch and recovery systems will help to narrow competing LCS designs. Indeed, launch and recovery of off-board systems is so critical for the LCS concept of operations that the Naval Warfare Development Command is sponsoring research and experimentation for "Surface Common Off-board Systems Rapid Launch and Recovery Equipment."[533]

- *An ability to survive in defended access scenarios.* As has been discussed, it seems highly unlikely that the Navy will be able to design a $220 million ship that can survive in hotly contested littorals. In this case, only off-board systems will allow the ship to make any substantial contribution. However, the LCS should be capable of operating with an acceptable degree of risk in defended access scenarios. Because of its relatively small

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[530] The young fleet operators who created the operational requirements document for the SEA LANCE concluded that a top speed of 38 knots was sufficient for all contested littoral mission tasks. Fleet experience supports their judgment.

[531] A useful overall description of the long list of LCS design requirements can be found in Admirals Giffin and Tozzi, "'C' in LCS Stands for Combat," pp. 88-89.

[532] NWDC, *Littoral Combat Ship Concept of Operations,* p. 13.

[533] Navy Warfare Development Command, "Surface Common Off-board Systems Rapid Launch and Recovery Equipment: Initiative for Research and Experimentation," undated. Provided to the author by Commander Al Elkins, USN, Navy Warfare Development Command.

size, the LCS will have little staying power.[534] Its survivability will therefore rely on its prudent use in light of prevailing threats, the over-arching defensive firepower of associated fleet battle networks, and *the ship's ability to avoid being hit*. Recall that hit avoidance depends on the ship's own low signature, on-board and off-board passive and active electronic countermeasures, and its acceleration and maneuverability. The Navy has chosen in its Flight 0 LCS design to value speed above signature management. Given the ship's potential operational and tactical requirements in defended access scenarios, is that the prudent prioritization? Operational testing should help answer this question. Should high speed continue to be emphasized over signatures management, future LCSs will have to be constantly on alert for any over-matching threat so that they can quickly withdraw from the area or sprint under the protective defensive envelope of nearby fleet battle networks. Since weather or other circumstances may prevent the launching of manned or unmanned aerial vehicles that will provide the ship with its best situational awareness, the range of the basic LCS surveillance system may become a key discriminator among Flight 0 designs. Obviously, the longer the range, the earlier the warning of potential over-matching threats, and the better the chance of LCS survival.[535]

- *An ability to operate in close-in littoral waters.* World War II PT boat experience helps to highlight the most desirable features for a ship designed to fight close to shore: shallow draft; low radar cross-section; ability to suppress wakes and to muffle engines; weapons platform stability; rapid acceleration; and maneuverability. The LCS that best blends these characteristics will have a leg up on the competition. This list of features is straight forward and requires little comment here, except for three quick points. First, the ability of a small combatant to bring its weapons to bear when maneuvering at tactical speeds is critical in close-in fights against surface and land targets. The PHM was valued as much for its weapons platform stability at speed as its high top-end speed. The ship design that provides the most stable weapons platform under all maneuvering conditions will also have an advantage. Second, in close-in waters, the LCS's "tactical diameter"—the number of ship lengths required for the ship to reverse its course—is the key measure of maneuverability. The smaller the tactical diameter, the better the chance of a ship avoiding collision with underwater obstacles or weapons (i.e., mines), and in complicating enemy targeting solutions when under attack. Finally, high speed operations in shallow waters imply some means of precision underwater sensing or navigation to prevent accidental grounding. Any LCS will have to have such a system if it is to fully exploit its speed close to the shore.

- *Crew habitability and endurance.* Smaller ships are normally much livelier in a seaway than larger ships. This can take a heavy toll on the crew. For example, the *Asheville* PGs rolled and pitched heavily in 10 foot seas, and their crews became badly fatigued after

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[534] Hansen, "They Must Be Sturdy." See also the comments in Doron, "The Israelis Know Littoral Warfare," pp. 67-68.

[535] For a concise discussion on contemporary tracking and fire-control systems, see Richard Scott, "Putting Eyes of the Target," *Jane's Navy International*, January/February 2004, pp. 22-25.

little more than 72 hours.[536] LCS designs that are good sea-keepers and that have high degrees of crew habitability and comfort will be highly advantaged, especially since these ships will often conduct long independent missions when conducting maritime domain awareness and maritime patrols. Crew habitability and endurance will be especially important for these missions, since the LCS will have a very lean, "optimally manned crews."

These discriminators are just four among the many possible. Operational testing will allow fleet operators to weigh in on the most important design and operational characteristics for the new ship.

THE LCS: NAVAL EQUIVALENT OF THE JSF?

One argument sometimes used by naval leaders to justify the LCS is that it will help to "transform" the US shipbuilding industry.[537] This argument appears to be slightly miscast. The US shipbuilding industry has long built the very ships the Navy has asked it to build.[538] It is thus perhaps more accurate to say that the LCS has helped to finally change the ***types of ships*** that Navy leadership has sought for fleet service. Regardless, however, the LCS may prove to be a boon for the American shipbuilding industry.

As has been discussed, during the early stages of the Cold War, as the US began to concentrate its design and building programs on intermediate size multi-mission carrier era combatants, it transferred many of its wartime small combatants to the nascent NATO navies. Indeed, up through the 1960s and 1970s, the Navy continued to design and built small combatants for allied navies until their own shipbuilding capabilities emerged. This contributed, in no small way, to a NATO TSBF that relied on the US for larger multi-mission warships and on its allies for smaller single-mission combatants.

However, this prudent division of labor among the NATO navies gradually eliminated the US from the small combatant business, and helped to limit the penetration of the US shipbuilding industry in the international naval market. Foreign navies generally neither require nor desire the larger more sophisticated combatants preferred by the US Navy.[539] The US participation in overseas naval sales thus gradually focused on the transfer, lease, or sale of its used frigates—which at up to 4,000 tons represented the "capital ship" for many small navies. Beyond a few

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[536] Friedman, *US Small Combatants: An Illustrated Design History*, pp. 269-71.

[537] Admirals Mustin and Katz, "All Ahead Flank for the LCS."

[538] This point is cogently made by Captain David H. Lewis, USN, in a response to Admirals Mustin and Katz, "All Ahead Flank for the LCS," published in Comment and Discussion section, ***Proceedings***, March 2003, pp. 10-14.

[539] As AMI's president, Guy Ames Stitt said, "Our builders don't have designs that are exportable. No one is buying DDG-51s. More buyers are interested in light frigates and corvettes." Quoted in Irwin, "Novel Ship Hulls Still a 'Tough Sell'," p. 5.

rare successes, US shipbuilders could not build small combatants that competed with foreign designs.[540]

The LCS promises to reverse this unfortunate trend. Its size is more in line with the requirements for small navies; its modularity will allow potential customers to customize their ships for their own particular requirements; and its emphasis on mission modules will be attractive to many foreign navies that are also adopting this design approach.[541] A recent NATO agreement on cooperative development of mission modules highlights the strong interest in developing new mission modules.[542] The keen interest on the ship's mission module development suggests that even nations without a capability to build ships might profitably build ship modules or mission packages, thereby greatly expanding the ship system vendor base. The interest also provides strong hints about the likely spirited development of potential new mission modules which will help to continually expand the LCS's mission menu.[543]

A willingness to make modest LCS design tradeoffs to accommodate the needs of allied small combatant navies and overseas module builders would thus likely broaden both the ship's domestic and international appeal.[544] With regard to the former, the displacement of the Coast Guard's new Offshore Patrol Cutter and the LCS appear to be about the same, although the potential $400 million total ship cost of the LCS (the $220 million LCS plus its $100-180 million government furnished mission package) is likely to be too high for the limited Coast Guard budget. By designing future LCSs with modular engine spaces like the World War I flush deck destroyer, the Coast Guard might be able to get a lower-speed LCS "truck" for much cheaper than the $220 million Navy variant. And by developing a set of less capable but lower cost off-board systems, the Coast Guard may be able to affordably outfit the hull with compatible, if somewhat less capable, systems.[545]

The same logic holds true for foreign navies, if not more so. One of the reasons why the Navy gradually was pushed out of the small combatant market was that foreign navies did not want to

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540 US Department of Commerce, *National Security Assessment of the US Shipbuilding and Repair Industry* (Washington, DC: US Department of Commerce, May 2001), p. 27.

541 Jason Sherman, US, "Europe May Join to Build Littoral Ship Arms," *Defense News.*

542 Jason Sherman, "US-Euro Teaming Likely on Littoral Combat Ship Program," *Defense News.*

543 Kathryn Shaw, "Co-Operation Amid Transformation for USN," *Jane's Navy International,* July/August 2003, pp. 32-35. See also Hunter Keeter, "Navy Set LCS Unit Cost Objective: $160 Million," *Defense Daily,* February 21, 2003, p. 1.

544 Guy Ames Stitt, as reported in Irwin, "Novel Ship Hulls Still a 'Tough Sell'," p. 5; and Sherman, "US-Euro Teaming Likely on Littoral Combat Ship Program."

545 The LCS provides a golden opportunity for the Navy and USCG to collaborate on a ship program, and to help bring down total system costs by increasing the buy of the ship. Although many officers recognize this opportunity in print (see for example Admirals Giffin and Tozzi in "'C' in LCS Stands for Combat," p. 88, and Admiral Loren and Captain Kelly in "Old Shipmates, New Goals,"), it is not at all clear that the collaboration between the Navy and the Coast Guard staffs is anything more than public relations.

buy US ships that the US Navy itself did not operate.[546] Purchasing an LCS would give these navies a combatant similar to—if not identical to—ships operated by US Navy crews, ***and one designed from the keel up to "slot into" a US naval battle network***. This is an extremely attractive selling point, as the success with the US Joint Strike Fighter—an airplane designed to let its foreign operators to take part in and make vital contributions to a US-led precision air campaign—attests to.[547] Moreover, pursuing the LCS as an international program might also help the Navy to better implement its emerging vision for the establishment of a global maritime coalition to battle worldwide terrorism.[548]

Pursuing the LCS as an international program would also help exploit the experience of navies that have specialized in small littoral combatants, such as the Norwegian and Swedish Navies. For example, the Royal Norwegian Navy (RNoN) is converting its Coastal Flotilla, long focused on defending the 2,200 kilometer-long Norwegian coastline, into a Norwegian Task Group focused on early access operations during NATO power projection operations. This Task Group will have small surface effects ships, a covert mine reconnaissance and clearance force that relies on UUVs and drones, and a Coastal Ranger Commando capable of deploying up to 30 "ISTAR" (for intelligence, surveillance, target acquisition and reconnaissance) patrols. Since Task Force officers know well how to deploy forces in defense of a coastline, they should be able to develop very effective counter-tactics.[549] In a similar way, the Swedish Navy worked hard over the past several decades to operate very close to the coastline, and in shallow waters, to threaten any invading nation. In the process, they came to value naval stealth in the "extreme littoral," and likened their operations to naval guerilla warfare. One result is the highly regarded *Visby*-class stealth corvette, one of the most innovative ships in the world.[550] Incorporating these navies' experiences in LCS operational testing would seem to be highly desirable.

In this regard, and taking a page from the JSF playbook, the US might consider structuring the LCS program so that foreign LCS partners could opt for different levels of US battle network interoperability. "Type I partners" might have full interoperability; "Type II partners" might have a multi-level security system allowing partial interoperability; and "Type III partners" might have only a receive-only capability. The possibilities appear endless. In fact, one could even foresee *foreign* mission packages and crews operating onboard a US LCS in an allied naval coalition. The point here is that by considering the LCS an international program, marketing it as the JSF-equivalent of 21st century naval combatants, and allowing foreign navies to participate in

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[546] Freidman, *US Small Combatants: An Illustrated Design History,* p. 264.

[547] Freidman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," pp. 380-81.

[548] Robert A, Hamilton, "Navy's Top Officer Calls for a Global Naval Force," *New London (CT) Day*, October 28, 2003.

[549] "Norwegian Navy to Build Specialized Expeditionary Coastal Force," *Jane's International Defense Review;* June 2003, p. 6; Richard Scott, "Norway's New-Model Navy Looks Beyond its Borders," *Jane's Navy International*, February 2004, pp. 11-13.

[550] "Controlling the Extreme Littorals," *Jane's International Defense Review,* August 2003, pp. 48-49.

the ship's operational testing, the US may be able to stimulate long-term allied naval industrial ties and corner a share of the foreign combatant market in ways not seen since the end of World War II.[551]

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[551] See comments made by Guy Ames Stitt in Erwin, "Novel Hull Forms Still a 'Tough Sell'," and by Rear Admiral Hamilton in Keeter, "Navy Sets LCS Unit Cost Objective: $160 Million." The comments made by Vice Admiral Phillip Balisle, Commander Naval Sea Systems Command, in Kathryn Shaw, "Co-Operation Amid Transformation for USN," in ***Jane's Navy International***, July/August 2003, p. 32, also indicate a determination on the part of the Navy to consider increased consideration of allied naval needs. The positive JSF experience is instructive in this regard. See Douglas Barrie and Robert Wall, "Group Therapy," ***Aviation Week and Space Technology,*** November 24, 2003, pp. 20-21.

VIII. SQUADRON OPERATIONAL TESTING: THE WAY AHEAD?

A thorough review of the forces impelling current naval transformation efforts, the arguments for and against small combatants made during the *Streetfighter* debates, the Navy's broader transformation plans, the potential role of small combatants in the 21st century "Assured Access Navy," as well as the design goals for the LCS itself leads to the following proposition: *small network combatants have an important role to play in 21st century naval warfare, and the reconfigurable Littoral Combat Ship may make important warfighting contributions as part of the Navy's 21st century Total Force Battle Network.*

Despite its undeniable promise, however, the LCS represents the first small US battle force capable combatant to be designed and built by the Navy and the US shipbuilding industry in over 60 years. Moreover, the ship itself is only one part of a battle network component system that will introduce an entirely new concept of modularity with no US or foreign naval precedent. Therefore, a second proposition is that *the LCS program must undergo thorough operational experimentation in addition to any continued analytical study before the Navy commits itself to a general class production run.*

THE HISTORICAL PRECEDENT FOR OPERATIONAL TESTING

Operational testing will help to diminish the probability that the selected LCS design will prove to be a dead-end or ill-suited for future TFBN operational needs. The experience of the British Admiralty before the turn of the 20th century is instructive in this regard. Between 1880 and 1900, while wrestling with the operational challenge of mounting a close blockade against a French Navy equipped with new torpedo boats, the Admiralty concluded that the battle line required a screen of small combatants. It therefore committed itself to several classes of "torpedo gunboats" or "torpedo boat catchers" before the operational problem was fully understood or the appropriate tactical response was fully resolved. When fleet operational testing later proved that distant blockade was a better operational approach, the initial 50+ small torpedo boat gunboats designed for operations in calmer in-shore waters proved unsuitable for open-ocean fleet operations, and they rapidly passed from fleet service.[552]

The Admiralty's unhappy experience is not unusual. Wayne Hughes has argued that history has proven that during times of high technical or strategic uncertainty, "paper ship designs" are seldom enough and that staff mission analyses will often fail. His evidence appears to be compelling. He points out that between 1890 and 1910, a period of rapid technological change, no less than 74 different pre-*Dreadnought* and six *Dreadnought classes* of ships were built as

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[552] Robert Gardiner, editor, *Steam, Shell, and Gunfire: The Steam Warship 1815-1905* (Edison, NJ: Chartwell Books, 1992), pp. 142-45. Also Andrew Krepinevich, *From Battleships to Battlecruisers and Flotillas: Transforming the Royal Navy*, draft report (Washington, DC: Center for Strategic and Budgetary Assessments, January 2004).

navies struggled to determine the best design attributes for warships. He also points out that although potential enemies were relatively clear to Navy planners throughout the interwar period, the abrupt shift between the battleship and carrier eras caused every ship in the fleet to be used for a different purpose than originally conceived.[553] Hughes' judgment is also supported by historian Geoffrey Till, who concluded that between the world wars the British, American, and Japanese navies all failed to realize fully the transformation that airpower would cause in naval warfare, and thus were unprepared in various degrees for the abrupt transition from the battleship to carrier eras.[554]

Technological change at the turn of this century appears to be every bit as rapid as that of the last, and the ongoing shift from the carrier to distributed battle fleet eras promises to reveal aspects of fleet operations, tactics and ship design that have no analytical precedent and that take the Navy by surprise. For example, it seems highly unlikely that further staff analyses will completely answer one basic question concerning the Navy's current transformation path: What combination of large, intermediate, and small combatants and unmanned systems will lead to the most effective and powerful distributed fleet battle network? Nor will further staff analyses likely fully reveal whether or not the LCS's high design level of battle modularity can be exploited by fleet battle networks during the course of a single joint campaign. Both of these questions, and others like them, would appear to require fleet experimentation before any valid interim conclusions can be made.[555]

The Navy, responding to Ronald O'Rourke's observation that the LCS was the result of an "analytical virgin birth," noted that the 1919 service-authorized conversion of the 11,500-ton collier USS ***Jupiter*** was another such "virgin birth," which resulted in the 1922 commissioning of the new aircraft carrier USS ***Langley,*** CV-1. In January 2003, Rear Admiral Harry Ulrich, then-Director of the Surface Warfare Division, argued that the ***Langley*** had no US naval antecedent and was not the product of extensive review. However, this did not stop the Navy from pursuing the ship, which later helped to integrate aircraft into surface fleet tactics and to inspire an entirely new era in battle fleet operations. Admiral Ulrich believed the LCS would result in a "similar paradigm shift," and that further analytical study or testing should not delay its introduction.[556]

The admiral's analogy is strained. The Royal Navy developed 12 different aircraft carriers during the First World War, culminating with the 1918 launching of HMS ***Argus,*** the world's first

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[553] Hughes, "LCS Isn't Right Yet. That's a Good Reason to Build It."

[554] Geoffrey Till, "Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies," in Williamson Murray and Allan R. Millet, editors, *Military Innovation in the Interwar Period* (New York, NY: Cambridge University Press, 1996), pp. 191-226.

[555] Even fleet experimentation will be insufficient to reveal all aspects of fighting in a contested littoral. The Navy conducted extensive war games and fleet experiments during the inter-war years. However, as has been discussed , it was still surprised in many tactical respects when war actually broke out.

[556] Keeter, "Balisle: LCS Concept Based on Sound Reasoning," p. 2.

aircraft carrier capable of launching and landing aircraft at sea. Moreover, by 1918 the Royal Naval Air Service was operating aircraft from carriers that could shoot down enemy fighter planes, conduct reconnaissance, and drop bombs and torpedoes. Due to its close ties with the Royal Navy, the US Navy benefited greatly from British developmental and operational testing conducting during the war. As a result, the *Langley* was, in essence, a technical and operational development platform built in preparation for the commissioning of the *Saratoga* and *Lexington*—battlecruisers the Navy had decided to convert into aircraft carriers as a result of Britain's World War I experience and in anticipation of the Washington Naval Treaty.[557]

Based on this paper's foregoing analysis, it would seem more appropriate to compare the *DD(X) family of ships* to the inter-war *family of carrier prototypes.* Between the commissioning of the *Langley* and World War II, the Navy continuously explored the appropriate military functions for naval aviation. For nearly 20 years, naval officers experimented with the proper types of aircraft and tactics needed to perform reconnaissance, spotting, fleet air defense, anti-surface warfare, strike, and anti-submarine warfare. Tactical war games and simulations held at the Naval War College were tested in annual "fleet problems." These simulations and fleet problems helped to Navy to forge a fleet aviation capability that ultimately led to the transition to an entirely new battle fleet era.[558]

As part of this process, the Navy built a family of carrier prototypes that included small carriers like the *Ranger* and *Wasp* (approximately 14,500 tons each), intermediate carriers like the *Enterprise*, *Hornet,* and *Yorktown* (approximately 20,000 tons each), and large carriers like the aforementioned *Lexington* and *Saratoga* (converted battlecruisers at 33,000-tons). These prototypes convinced Navy planners that the best fleet carrier should be approximately 27,000 tons, which gave the carrier great staying power and enabled it to carry a large air wing. However, they also proved that smaller carriers provided important capabilities, especially since their smaller air wing could be launched extremely quickly. As a result, during the War the Navy built twenty-three 27,000-ton *Essex*-class fleet carriers, nine 11,000-ton *Independence*-class light carriers, and 124 assorted escort carriers.[559]

In a similar way, as the Navy shifts to the new distributed battle fleet era, fleet operators and planners will need to determine the appropriate mix of large, intermediate, and small combatants and unmanned systems for the 21st century TFBN. Analytical studies have already indicated that the most effective overall battle network should include *both* large DD(X) combatants as well as small LCSs.[560] However, just like during the interwar period, fleet operational testing and

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[557] Till, "Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies," pp. 194-198. The author is indebted to Jim O'Brasky for pointing out the Navy's knowledge of aircraft carriers before converting the *Jupiter* to an operational test bed.

[558] Dr. Thomas C. Hone, "We Have a Process for Transformation," *Proceedings,* January 2004, pp. 24-25.

[559] The displacements given here are standard displacements, not full load. Hughes, "LCS Isn't Right Yet. That's a Good Reason to Build It."

[560] "Small Combatants: Implications for the Effectiveness and Cost of Navy Surface Forces," *Institute for Defense Analysis Research Summaries,* Volume 10, Number 1, Winter 2003, pp. 1-4.

experiments will be needed to better refine distributed fleet battle network operations in varying access scenarios, and to determine the most effective battle network architectures.[561]

Indeed, the Navy's recently announced shift to a new battle network surge deployment pattern will duplicate, to some degree, the conditions of the interwar battleship era when the fleet was concentrated in US home waters. This concentration should allow the fleet more opportunities to conduct regular large distributed battle network experiments, just as the interwar fleet experimented with carrier operations in its yearly fleet problems.

Perhaps a more appropriate direct analogy to the lack of specific analysis on the LCS is the decision to convert four *Ohio*-class strategic ballistic missile submarines into conventionally armed SSGNs—in essence, covert VLS batteries and special operations support bases. No cost-benefit analysis or a formal analysis of alternatives was conducted prior to the decision. Indeed, no analysis suggested that the fleet battle network required more VLS tubes, or that a requirement existed to transport 102 special operators underwater. Instead, this conversion was pushed through by the Office of the Secretary of Defense and Congress—and over the Navy's initial objections—because of a simple, logical argument: that a modern nuclear-powered submarine with a huge amount of internal space and volume and with a 22-year residual service life would likely be a smart investment in an age of rapid weapon and unmanned system development.

After initially fighting the conversion, the Navy is finding through experimentation that this simple logic is true.[562] Early experimentation with the SSGN's large internal volume is already suggesting new roles for the converted submarine, such as a covert, large-capacity UUV tender, capable of carrying 154, 21-inch diameter UUVs, or a covert large capacity sensor dispenser. Further tests and experiments will likely reveal additional roles.[563]

In a similar way, it seems likely that the LCS's relatively large amount of usable internal volume and payload and similar service life (20 to 30 years) will also prompt new ideas about the ship's most appropriate use in future littoral combat, as well as the new systems, weapons, sensors, and systems that will help it make more valuable battle network contributions—especially once it becomes available for fleet operational testing and experimentation. It therefore seems appropriate that Congress support the Navy's budding LCS program without demanding much

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[561] Freidman, O'Brasky, and Tangredi, "Globalization and Surface Warfare," p. 374 and 375. For possible examples of fleet tactical groupings, see J. Noel Williams and James S. O'Brasky, Chapter 28, "A Naval Operational Architecture for Global Tactical Operations," in ***Globalization and Maritime Power,*** edited by Sam J Tangredi (Washington, DC: National Defense University Press, 2002), pp. 517-534. See also James S. O'Brasky and Steven E. Anderson, "Tsunami-2050: A Naval Operational Concept and Force Design for the 21st Century," *Naval Surface Warfare Center, Dahlgren Division Technical Digest,* 1999 Issue, pp. 12-51.

[562] See Nick Jonson, "SSGN Conversion Is Changing Navy Undersea Warfare Operations," *Aerospace Daily,* November 20, 2002; and "Sub Director Foresees 'Revolutionary' Power of SSGNs," *Sea Power,* July 203, pp. 21-23.

[563] Hunter Keeter, "Huge Undersea Test in Pacific May Follow Giant Shadow," *Sea Power,* December 2003, p. 30.

further analytical justification—with the caveat that it expects the Navy to conduct thorough operational testing before committing itself to a large class production run.[564]

ALL AHEAD, SLOW

The recently approved LCS building profile is for one LCS in Fiscal Year 2005 (FY05), two in FY06, and one in FY07, followed by a sharp increase in class production. At this point, three additional ships are programmed for FY08, followed by six more in FY09.[565] This profile is in keeping with the current, "significantly compressed," LCS program, in which the Navy expects to rapidly commit to a single ship design and pursue a class production run characterized by different flights.[566] As suggested by the foregoing discussion, however, it is hard to see how the Navy will be able to resolve all of the outstanding design and operational issues surrounding this new battle network component system in the midst of such a compressed schedule.

A period of operational testing, even a short one, would help to better resolve some of the many issues surrounding the ship, and lower the likelihood that the Navy repeats the Admiralty's unhappy experience with torpedo gunboats. Therefore, before committing itself to a general class production run, the Navy should consider building several operational prototypes, and then plan for a production pause to allow a period of operational testing.[567]

Given the many degrees of design freedom in meeting the Flight 0 LCS requirements (six initial designs and three remaining designs, including a steel semi-planing monohull, a trimaran, and a surface effects ship), the Navy should profit from building at least two different operational prototypes. Recall that the *Langley* was simply the first in a series of ***eight*** different prototypes built to ***five*** different designs. It took nearly 20 years of experimentation before the Navy settled on the famous *Essex*-class fast fleet carriers that spearheaded the World War II drive to the far reaches of the Western Pacific. Given the still unresolved issues surrounding the LCS, it might be prudent to adopt a similar multi-prototype approach, albeit with a much shorter experimental time horizon. Indeed, this appears to be the strong preference of the Office of the Secretary of Defense and the Office of Management and Budget, which have approved using research and development money to build the first two LCSs *provided they are of different designs.* Otherwise, they will approve the use of R&D money for only one ship. It would seem prudent

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[564] This appears to be the clear intent of the Congress. See "Littoral Combat Ship," Senate Armed Services Committee Report 108-046 for the Fiscal Year 2004 Defense Authorization, S 1050, pp. 179-80.

[565] Castelli, "Wolfowitz Approves Navy Shipbuilding Changes for FY-05 Budget," p. 1.

[566] Erwin, "Littoral Combat Ship Sensors Pose Integration 'Challenges'," p. 3.

[567] This argument was well made by Ron O'Rourke when he wrote, "…while it may be acceptable to convert a single ship like the *Jupiter* into an operational prototype like the *Langley* without first having analytically validated the cost-effectiveness of the effort, it is quite another thing to propose a 30- to 60-ship procurement program with a potential total acquisition cost of $7 billion to more than $15 billion without first examining through rigorous analysis whether this would represent to most cost effective way to spend such a sum." See O'Rourke, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress*, p. CRS-5.

for the Navy to take advantage of this proviso and to pursue two different classes of Flight 0 LCSs from the three remaining LCS designs.

Building two different ship prototypes would give fleet operators a chance to determine if they found any particular design approach to be superior during actual fleet operations. Indeed, at the end of operational testing the Navy might conclude that having two different classes of LCS is desirable—much like it did during World War II when it ordered both a 78-foot PT boat from Higgins and an 80-foot PT boat from Elco. The Elco was faster, had a greater range, and rode better than the Higgins; the Higgins proved to have a tighter turning radius and be more maneuverable. Although subsequent wartime experience favored the Elco, both ships proved to be effective.[568] A thorough and measured testing program might illuminate similar complementary advantages in competing LCS designs. Having two different designs might also increase the international appeal of the program.

However, choosing two different prototypes will not completely resolve many of the operational issues previously highlighted. It seems clear that only by testing ***squadron*** prototypes will the Navy be able to fully resolve issues such as the best squadron organization; the best way to employ the ship in Divisions or Squadrons; whether or not individual or squadron ship mission reconfigurations are worth pursuing, and whether the overhead costs associated with battle modularity are worth it. Among other things, squadron operational testing would allow the Navy to examine different ways of conducting forward theater ship mission reconfigurations (e.g., from tenders, at forward staging bases, or at sea), to determine which method was the cheapest and most effective. Accordingly, the Navy should consider building two operational squadrons, composed of a common number of Flight 0 LCSs, and a number of supporting mission modules (perhaps 2 mission packages per hull).

It appears as though the current shipbuilding profile for the LCS could be easily modified to pursue two operational prototype squadrons. Assuming the Navy down-selects to two different designs, it should award one competitor a R&D contract for a ship in FY05 and a follow-on version in FY06 paid for by ship construction money. Similarly, it should then award a second competitor a R&D ship contract in FY06 and a follow-on version in FY07. In this way, the Navy could have two different 2-ship squadrons by FY08, which would seem to be the minimum size needed to conduct comparative squadron operational tests. If the Navy felt that a larger squadron was necessary, it could award each competitor with a further two to four ships over FY08 and FY09, allowing the formation of two, 4-, 5-, or 6-ship operational squadrons. Regardless of the final size of the squadron, however, once the Navy determined the minimum appropriate size it would then delay the final production decision for a year to conduct meaningful operational testing. While this notional approach would result in a one year delay in current LCS production plans, it would give the Navy and both competitors ample time to refine their LCS concepts and operations, and for the results of squadron operational tests to be made clear.

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[568] Freidman, *US Small Combatants: An Illustrated Design History*, pp. 140-51.

A less costly alternative approach would be to buy or lease ships and assemble one or two surrogate LCS squadrons. This would allow the Navy to both test key LCS components and to iron out tactical issues. Indeed, the Navy has already used surrogates to test certain aspects of the LCS. For example, the Navy used Lockheed Martin's *Sea SLICE* as an LCS surrogate in its Fleet Battle Experiment-Juliet, demonstrating rapid ship mission reconfigurations.[569] The Navy is using the aforementioned catamaran ***Swift***, HSV-2, as an LCS surrogate to test off-board command and control systems.[570] The Navy experimented extensively with the Royal Norwegian Navy's ***Skjold*** "littoral combat corvette," a small, state-of-the-art surface effect ship that forms the basis for one of the current Flight 0 LCS designs.[571] And the Office of Naval Research is building a 1,000-ton Littoral Support Craft-Experimental (LSC-X) to test drag reduction and ship structure technologies for high speed craft, as well as modular mission technologies.[572]

As opposed to buying or leasing LCS surrogates, the Navy could also convert existing ships to serve the same role. Norman Polmar believes that the ***Perry***-class FFG could be easily converted into a LCS test bed. In this regard, he recommends that the ship's Mk-13 Standard missile launcher could be replaced by a Rolling Airframe Missile launcher, modifications be made to allow handling of UUVs and USVs, and that a UUV/USV recovery ramp be notched into the starboard side of the stern. In Polmar's judgment, an FFG/LCS test bed would permit the deployment of LCS surrogate ships and squadrons in relatively short order.[573]

Using new or converted ships as LCS surrogates is attractive because this approach would likely be cheaper than building two small operational squadrons. However, it seems unlikely that any of the aforementioned approaches would allow US shipbuilders to develop cost-effective LCS construction techniques, or help fleet operators to conclusively prove whether the benefits of battle modularity are worth its overhead costs. Thus, the development of several purpose-built LCSs and the formation of one or two operational prototype squadrons would still seem to be attractive.

A counter argument is made by those who believe the fleet is too small for its current global commitments, particularly those associated with the global war on terror. They argue that the

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[569] Richard F. Burns, "Sea SLICE Demonstrates Multi-Mission Flexibility," ***Sea Technology***, November 2002, pp. 19-22.

[570] Erwin, "Littoral Combat Ship Sensors Pose Integration 'Challenges'," p. 2.

[571] Fred J.Klinkenberger, "Is the KNM ***Skjold*** the Future of the Littoral Combat Ship?" ***Fathom.*** January-March 2003, found at http://www.safetycenter.navy.mil/media/fathom/issues/JanMar03/isskjold.htm. See also Hewish, "Navies Ask: Is the Coast Clear?" p. 43, and Scott, "Norway's New-Model Navy Looks Beyond Its Borders," p. 11.

[572] David Foxwell and Richard Scott, "X-Craft Catamaran Will Test New Technologies," ***Jane's Defence Weekly***, March 12, 2003, p. 65. The Congress is also supporting the LSC(X), increasing by $20 million the Navy's request for the demonstrator. "Littoral Combat Ship," Title II (RDT&E), Other Matters of Interest, Navy, in the House Armed Services Committee Report , 108-106, for the Fiscal Year 2004 Defense Authorization, HR1588, pp. 181-182.

[573] Polmar, "Getting the LCS to Sea, Quickly," pp. 106-107.

LCS is needed *now*, in numbers. However, the Chief of Naval Operations undercut this position when he recently elected to retire some older ships early, and to accept a smaller fleet in the near term in order to free up the resources required to build up the fleet over the long term.[574] Moreover, current strategic circumstances do mirror the interwar period in one key respect: the Navy appears to have some time before having to confront a serious naval competitor in the littorals.[575] As a result, delaying the final LCS production run for a short period while squadron prototypes are tested would appear to appreciably lower the program's developmental risk without appreciably raising the fleet's operational risk.

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[574] Freidman, "New Roles for Littoral Combat Ships," p. 6. Crawley, "Navy Has Fewest Ships Since Before World War I."

[575] The CNO himself implicitly made the judgment that near-term risk is manageable when he decided to retire the remaining *Spruance* destroyers early to free up resources for the Navy's transformation plans. See "Down to the Sea in Ships," *Sea Power,* April 2003, p. 9.This decision caused the TSBF to dip below 300 ships, long thought to be an important psychological floor for fleet planners. Malina Brown, "Navy Falls Below 300-Ship Threshold For First Time in Decades," *Inside the Navy,* August 25, 2003, p. 2.

IX. AFTERWORD

WHAT'S IN A NAME?

Since 1889, the Navy has introduced many different types and classes of warships. As technology evolved and the numbers of ship types and missions proliferated in the battle fleet, the Navy sought to adopt a logical ship classification system. After a period of experimentation, in 1920 it adopted the basic system still in use, although it periodically had to update or modify it to account for new fleet missions and ship types (see Appendix A). As discussed, the last time the Navy modified its combatant classification guidelines was in 1975, when it adjusted them to account for the lessons learned during the carrier era. Similarly, the new capabilities promised by the battle network combatants that make up the DD(X) family of ships may warrant a new reappraisal of surface combatant classification categories.

Although changing ship classifications may seem to be a trivial affair, it is taken quite seriously in a Navy with over 225 years of precedent and tradition. In this regard, the key questions are: What lineage should the small LCS claim? What lineage should the large DD(X) claim? And, for that matter, what about the second-generation carrier era combatants that will fight along side of them in a new battle fleet operational model and architecture?

While the descriptive title "littoral combat ship" may be appropriate as a broad ship title used for any vessel designed to fight in close-in littoral waters, it is a poor choice to describe any particular first generation battle network combatant. It turns out that "LCS" was the designator for a previous family of small combatants—the Landing Craft, Support—designed during World War II to perform the close-in fire supportmission.[576] The new LCS can perform this mission, but it can also perform many more. Moreover, isn't the DD(X)—a powerful 14,000-ton warship with a 28 foot draft (only two feet greater than the much smaller FFG-7) and great staying power—also a "littoral combat ship" in it own right? The Navy should consider adopting fresh new ship designations for its first 21st century combatants, and it seems more than appropriate to look to the past for some possible suggestions.

In World War II, the Navy designed a powerful "super cruiser" to protect the battle forces from enemy cruiser attacks and convoys from German surface raiders The resulting ships of the *Alaska* class carried a powerful main battery of nine 12-inch guns. These ships came in at 32,000 tons full load—much larger than a heavy cruiser, but much smaller than a contemporary ***Iowa***-class battleship. They were thus classified as part of the cruiser family, but were assigned a new ship type, "large cruiser," with a with ship designator of CB. However, these graceful ships were obsolete before their time. Of the six ships planned, CB-4 through 6 were never ordered, CB-3 was cancelled before being completed, and CB-1 and CB-2 did not survive to see 1950.[577]

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[576] Friedman, *US Amphibious Ships and Craft: An Illustrated Design History,* Chapter 8, throughout.

[577] Friedman, *US Cruisers: An Illustrated Design History,* Chapter 10, throughout.

It would seem appropriate that the large 14,000-ton "DD(X)"—the first combatant built with a high degree of ship survivability since World War II, and one designed to sail with Expeditionary Strike Groups and to stand and engage the enemy's shore-based "battle line" in support of the Group's embarked Marines—deserves to claim the heritage of these powerful large cruisers. The Navy thus might consider re-designating the first DD(X) to be the USS ***Zumwalt***, CBL-4, for large littoral cruiser, and fourth in the large cruiser series. The follow-on CG(X) would be a CBG—for large guided missile cruiser, possibly with hull numbers in the same series.

At the same time, the 84 AEGIS/VLS ships of the second-generation carrier era might then all be retyped as guided missile destroyers, or DDGs. The differences between the ***Ticonderoga*** CGs and ***Burke*** DDGs are more in form than in function. Indeed, recall that the ***Ticonderoga***-class CG was originally typed as a DDG. While all of these second generation carrier era ships remain unequalled contemporary combatants and are quite capable of sailing in independent surface action groups, their lineage is more closely aligned to the battle force screening heritage of past destroyers than to the powerful independent cruisers of previous eras.[578]

Similarly, the foregoing analysis makes clear that the LCS—a battle force capable combatant with a battle line screening mission that can trace its roots to the torpedo boat destroyers originally designed in the late 19th century—should also take its pride of place in the proud fleet "destroyer" family. However, it will represent a class of destroyer unlike any yet seen. When performing the battle force screening and scouting missions, the LCS resembles a littoral DD. When performing in the mine countermeasures role, the LCS resembles the fast destroyer minesweeper, or DMS. When performing the protection of shipping mission it resembles a destroyer escort, or DE. And when performing in the SOF support role, the LCS resembles a littoral APD, itself a converted destroyer. Therefore, while it seems fitting that the LCS be identified with the proud heritage of past US destroyers, it also seems apparent that it marks a new ***class*** of destroyer. Accordingly, the LCS's unique form and function might best be described by the designation "DRL," for Reconfigurable Littoral Destroyer. The inevitable fleet appellation "Drill" also seems appropriate, since these ships will among the first battle network combatants to penetrate narrow littoral seas.

Assuming that the Navy chooses two different Flight 0 prototypes, perhaps they should name DRL-1 the *USS Cebrowski* and DRL-2 the *USS Wayne P. Hughes*. Although the Navy continues to distance the LCS from the *Streetfighter*, its connection with the early conceptual program is crystal clear. It would seem fitting for the Navy to honor the two officers perhaps most responsible for prodding it into accepting small surface combatants in the 21st century Total Force Battle Network by naming the first DRLs after them.

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578 Freidman, *US Cruisers: An Illustrated Design History*, p. 1.

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Finally, as both proponents and critics marshal their arguments for and against the Littoral Combat Ship, one final bit of history may be instructive. Every single ship of the carrier era's second-generation of combatants was roundly criticized before entering fleet service. In the order they were introduced, the *Spruance* DDs were panned because of their large size (8,000 tons) and seemingly light armament.[579] The *Perry* FFGs were ridiculed as the "low end" ship of Admiral Zumwalt's "high-low" fleet mix, with no large bow sonar, a 76mm "popgun," and no ASROC Capability.[580] The *Ticonderoga* CGs were lampooned for being too expensive, too top heavy, and their AEGIS system as being unreliable and ineffective. And although the first *Burke* DDGs were planned to be 75 percent of the cost of a Ticonderoga class cruiser, they proved to be nearly as expensive, and they carried less armament and no helicopter hangers.[581]

These criticisms all proved to be wrong. Each of these ships, having a high level of construction modularity to aid in their mid-life modernization, were continually improved through successive ship flights and are now recognized as among the best of their types in the world. Moreover, every single ship type in the generation except the *Spruance* DD suffered wartime-like damage: the *Princeton*, a *Ticonderoga* CG, struck a mine; the *Stark*, a *Perry* FFG, was struck by two Iraqi anti-ship cruise missiles, and the *Samuel B. Roberts*, another *Perry* FFG, struck a mine; and the *USS Cole*, a *Burke*-class DDG, took a massive waterline hit as the result of a suicide boat attack. Every single ship survived to fight another day, a testament to their toughness. US ships have always been designed to bring their Sailors home, and in this regard, these ships proved to be no different.

Over the past six decades, experience has thus proven that the US Navy and the US shipbuilding industry are quite capable of designing and building excellent (and expensive) large and intermediate size warships. The question today is: Will they be as successful building small, designed-to-cost combatants in the 21st century? With the LCS—or DRL—the answer to this question should be revealed. It's time to build a few and find out.

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579 Freidman, *US Destroyers: An Illustrated Design History*, pp. 368 and 377.

580 Friedman, *US Destroyers: An Illustrated Design History*, p. 381.

581 Polmar, *Ships and Aircraft of the US Fleet*, 17th edition, p. 145.

APPENDIX A: SHIP CLASSIFICATION: CATEGORIES, TYPES, CLASSES, AND FLIGHTS

The U.S. Navy's system of alpha-numeric ship designators and associated hull numbers was for several decades a unique method of categorizing different types of ships. Today, the Navy's ship classification system remains a useful tool for organizing and keeping track of vessels in the Navy's Total Ship Battle Force. It also provides the basis for the identification numbers painted on the bows of most ships, and for the ship descriptions used throughout this paper.[582]

Though modified to account for evolving technology and to accommodate new ships designed for new battle fleet missions, the classification current system remains essentially the same as the one formally implemented on July 17, 1920. At that time, the U.S. Navy adopted six ***general ship categories***. General ship categories were used to identify those ships that performed the same broad battle fleet mission. Each ship category utilized a specific letter prefix to help identify them. Battleships were identified by the letter "B;" Cruisers, "C;" Destroyers, "D;" Submarines, "S;" Patrol Vessels, "P;" and Auxiliary Vessels, "A."[583]

The number of general ship categories expanded and changed over the years. During the interwar period, aircraft carriers came into fleet service and were assigned the double letter prefix, "CV." During World War II, two new categories were added: Amphibious Warfare Ships and Craft, with a prefix "L;" and Ocean Escorts, with a two letter prefix of "DE." In 1955, the Navy made Mine Warfare Vessels a separate category, designated by the prefix of "M." Finally, in 1975, the Navy renamed the ocean escort category. The new "Frigate" category—with a prefix of "FF"—was adopted to accommodate the new large ocean escorts characteristic of the carrier era, Cold War Navy.[584]

The Navy uses a minimum of two letters in a ship's prefix to identify ships in its Total Ship Battle Force. Sometimes, the second letter does not stand for anything in particular. For example, "BB" denotes a battleship, "DD" denotes a destroyer, "FF" represents a frigate, and "SS" represents a submarine. However, other times the second letter is used to distinguish between special ***ship types*** within the same general ship category. For example, "CA" identifies a "heavy cruiser;" "CB" identifies a "large cruiser;" "CL" identifies a "light cruiser;" and "CG" identifies a guided missile cruiser.

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[582] From "US Navy Ships—Listed by Hull Numbers," found at http://www.history.navy.mil/photos/shusn-no/usnsh-no.htm.

[583] "US Navy Ships—Listed by Hull Numbers," found at http://www.history.navy.mil/photos/shusn-no/usnsh-no.htm, and from the history of mine warfare ship classifications at http://battle.netgate.net/nma/history.htm.

[584] "US Navy Ships—Listed by Hull Numbers," found at http://www.history.navy.mil/photos/shusn-no/usnsh-no.htm; from the history of mine warfare ship classifications at http://battle.netgate.net/nma/history.htm; Polmar, *Ships and Aircraft of the US Fleet*.

A third letter in the ship's prefix can be used to further distinguish a ship type. It can variously indicate the ship's primary armament, source of propulsive power, or even a specific ocean operating environment. For example, "DD*G*" and "FF*G*" represent a destroyer and a frigate armed with an area or local air defense system, respectively; "SS*N*" and "CG*N*" denote a fleet submarine and guided missile cruiser equipped with nuclear power plants, respectively; and MH*C* designates a mine hunter designed for coastal operations.

While not always true, a ship's hull number generally indicates the ship's place in the associated category and type lineage. For example, DD-963 is the nine hundred and sixty-third destroyer built by US builders for the US Navy or allied navies, and the CG-47 is the forty-seventh guided missile cruiser.

Ship classes are ships of the same type and design built in a serial production run. The class takes its name from the first ship in the production run. For example, the USS *Spruance* (DD-963) was the class namesake for the 31 destroyers built to the same basic design, and the USS *Arleigh Burke* (DDG-51) is the class namesake for the 62 guided missile destroyers now being built to the same basic design

Contemporary practice is to construct ships of the same design in different ***flights.*** Flights denote ships that are specially modified from the basic version of the ship. Later flights may introduce dramatically different capabilities than ships in earlier flights. For example, the first five of 27 *Ticonderoga*-class guided missile cruisers were equipped with above deck missile launchers and rotary missile magazines, while the remaining 22 entered fleet service with the vertical launch missile systems. Indeed, sometimes the capabilities of later flights are so dramatically different that they are, for all practical purposes, an entirely different class of ships. Thus the "CG-52 class" describes all 22 VLS-equipped cruisers.

The following is an incomplete but representative list of Navy ship types that have seen fleet service since 1920. All ship classifications used in this paper can be found on the list.[585]

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[585] A complete list can be found at http://www.history.navy.mil/photos/shusn-no/usnsh-no.htm.

Auxiliary and Amphibious Warfare ships (A & L prefixes) :

- **AB** -- Crane Ships
- **ACV** -- Auxiliary Aircraft Carriers
- **AD** -- Destroyer Tenders
- **AE** -- Ammunition Ships
- **AF** -- Store Ships
- **AFS** -- Combat Store Ships
- **AG** -- Miscellaneous Auxiliaries
- **AGB** -- Icebreakers
- **AGC** -- Amphibious Force Flagships
- **AGER** -- Environmental Research Ships
- **AGF** -- Miscellaneous Command Ships
- **AGMR** -- Major Communications Relay Ships
- **AGP** -- Motor Torpedo Boat Tenders
- **AGTR** -- Technical Research Ships
- **AH** -- Hospital Ships
- **AK** -- Cargo Ships
- **AKA** -- Attack Cargo Ships
- **AKS** -- Stores Issue Ships
- **AKV** -- Aircraft Ferries
- **AM** -- Minesweepers
- **AMc** -- Coastal Minesweepers
- **AMS** -- Motor Minesweepers

Carrier, Combatant, Patrol and Mine Warfare Ships and Submarines (B, C, CV, D, F, M, P and S prefixes):

- **BB** -- Battleships
- **"C"** -- Protected Cruisers
- **CA** -- Armored Cruisers
- **CA** -- Heavy Cruisers
- **CAG** -- Heavy Cruisers (armed with guided missiles)
- **CB** -- Large Cruisers
- **CBC** -- Large Tactical Command Ship
- **CC** -- Battle Cruisers
- **CC** -- Command Ships
- **CG** -- Guided Missile Cruisers
- **CGN** -- Guided Missile Cruisers (nuclear powered)
- **CL** -- Light Cruisers
- **CLG** -- Light Cruisers (armed with guided missiles)
- **CLAA** -- Antiaircraft Light Cruisers
- **CLC** -- Tactical Command Ship
- **CLK** -- Cruiser-Hunter Killer Ship
- **CM** -- Minelayers
- **CV** -- Aircraft Carriers
- **CVA** -- Attack Aircraft Carriers
- **CVB** -- Large Aircraft Carriers
- **CVE** -- Escort Aircraft Carriers
- **CVL** -- Small Aircraft Carriers

- **AN** -- Net Laying Ships
- **AO** -- Oiler, or Fuel Oil Tankers
- **AOE** -- Fast Combat Support Ships
- **AOG** -- Gasoline Tankers
- **AOR** -- Replenishment Oilers
- **AP** -- Transports
- **APA** -- Attack Transports
- **APB** -- Self-Propelled Barracks Ships
- **APD** -- High-Speed Transports
- **AR** -- Repair Ships
- **ARS** -- Salvage Ships
- **AS** -- Submarine Tenders
- **ASR** -- Submarine Rescue Ships
- **AT** -- Ocean Tugs
- **ATA** -- Auxiliary Ocean Tugs
- **ATF** -- Fleet Ocean Tugs
- **ATO** -- Ocean Tugs, Old
- **AV** -- Seaplane Tenders
- **AVD** -- Seaplane Tenders (Destroyer)
- **AVG** -- Aircraft Escort Vessels
- **AVP** -- Small Seaplane Tenders
- **AVT** -- Auxiliary Aircraft Transports. Also Training Aircraft Carriers
- **AW** -- Distilling Ships
- **LCI(L)** -- Landing Craft, Infantry (Large)
- **CVN** – Aircraft Carrier (nuclear powered)
- **CVS** -- Antisubmarine Warfare Support Aircraft Carriers
- **CVT** -- Training Aircraft Carriers
- **DD** -- Destroyers
- **DDE** -- Antisubmarine Destroyers
- **DDG** -- Guided Missile Destroyers
- **DDR** -- Radar Picket Destroyers
- **DE** -- Escort Ships
- **DEG** -- Guided Missile Escort Ships
- **DER** -- Radar Picket Escort Ships
- **DM** -- Light Minelayers
- **DMS** -- High-Speed Minesweepers
- **FF** -- Frigates
- **FFG** -- Guided Missile Frigates
- **MMD** -- Minelayers, Fast
- **MSC** -- Coastal Minesweepers (nonmagnetic)
- **MSF** -- Minesweepers, Fleet (steel hull)
- **MSI** -- Minesweepers, Inshore
- **MSO** -- Minesweepers, Ocean (Nonmagnetic)
- **MSF** -- Minesweepers, Fleet (steel hull)
- **PC** -- Submarine Chasers

- **LCT** -- Landing Craft, Tank
- **LCU** -- Landing Craft, Utility
- **LKA(L)** -- Amphibious Cargo Ship
- **LPA** -- Amphibious Transports
- **LPD** -- Amphibious Transports Dock
- **LPH** -- Amphibious Assault Ships
- **LPR** -- Amphibious Transports, Small
- **LSD** -- Dock Landing Ships
- **LSI(L)** -- Landing Ships, Infantry (Large)
- **LSM** -- Medium Landing Ships
- **LSM(R)** -- Medium Landing Ships (Rocket)
- **LST** -- Tank Landing Ships
- **PCE** -- Patrol Escorts
- **PE** -- Eagle Boats
- **PF** -- Patrol Frigates, or Frigates
- **PG** -- Gunboats
- **PR** -- River Gunboats
- **PT** -- Motor Torpedo Boats
- **PY** -- Patrol Vessels, Converted Yacht
- **SC** -- Submarine Chasers
- **SS** -- Submarines
- **SSBN** -- Fleet Ballistic Missile Submarines
- **SSG** -- Guided Missile Submarines
- **SSGN** – Guided Missile Submarines (nuclear powered)
- **SSK** -- Antisubmarine Submarines
- **SSN** -- Submarines (nuclear powered)
- **SSR** -- Radar Picket Submarines

APPENDIX B: GLOSSARY

A2/AD	Anti-access/area-denial
AAW	Anti-air Warfare
ASW	Anti-submarine Warfare
ASuW	Anti-surface warfare
AUV	Autonomous Underwater Vehicle
CBO	Congressional Budget Office
CEC	Cooperative Engagement Capability
CIC	Combat Information Center
CIWS	Close-in Weapon System
CLDS	Contested Littoral Delivery System
CNAN	Capabilities for the Navy After Next project
CNO	Chief of Naval Operations
CNO SSG	Chief of Naval Operations Strategic Studies Group
COEA	Cost and Operational Effectiveness Analysis
ConOps	Concept of Operations (also: CONOPS)
CSBA	Center for Strategic and Budgetary Assessments
CSG	Carrier Strike Group
DAB	Defense Acquisition Board
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
DoN	Department of the Navy
EDS	Electronic Data System

ESG	Expeditionary Strike Group or Expeditionary Sensor Grid
ESSM	Evolved Sea Sparrow Missile
FAC	Fast Attack Craft
FDCS	Fully Distributed Component System
FY	Fiscal Year
GDM	Grid Deployment Module (for SEA LANCE)
HASC	House Armed Services Committee
HSV	High Speed Vessel
IDA	Institute for Defense Analysis
ISR	Intelligence, surveillance, and reconnaissance
JROC	Joint Requirements Oversight Council
JSF	Joint Strike Fighter
LAMPS	Light Airborne Multi-Purpose System
LCS	Littoral Combat Ship
LMSR	Large Medium Speed Roll-on, Roll-off ship
LRI	Long-range Prosecutor
LSC(X)	Littoral Support Craft (Experimental)
MCM	Mine Countermeasures
MFSD	Maritime Fire Support Demonstrator
MFSS	Medium Fast Support Ship
MSV	Manned Surface Vehicle
NAVSEA	Naval Sea Systems Command
NCW	Network Centric Warfare

NDP	National Defense Panel
NPGS	Naval Postgraduate School
NTDS	Navy Tactical Data System
NTU	New Threat Upgrade
NWC	Naval War College
NWDC	Navy Warfare Development Command
OMFTS	Operational Maneuver From the Sea
ONR	Office of Naval Research
OPNAV	Office of the Chief of Naval Operations
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
PD-IRD	Preliminary Design-Interim Requirements Document
PEO	Program Executive Officer
QDR	Quadrennial Defense Review
R&D	Research and Development
RDN	Royal Dutch Navy
RFP	Request for Proposals
RHIB	Rubber Hulled Inflatable Boat
RMS	Remote Minehunting System
ROV	Remotely Operated Vehicle
SAM	Surface-to-Air Missile
SASC	Senate Armed Services Committee
SC-21	Surface Combatant 21 program

SEA LANCE	Seaborne Expeditionary Assets for Littoral Access Necessary for Contested Environments
SFSC	Small Fast Surface Combatant
SFSS	Small Fast Support Ship
SRP	Short-range Prosecutor
STOM	Ship to Objective Maneuver
TFBN	Total Force Battle Network
TSBF	Total Ship Battle Force
TSV	Theater Support Vessel
UAV	Unmanned Aerial Vehicle
UCAV	Unmanned Combat Air Vehicle
USCG	US Coast Guard
USMC	US Marine Corps
USN	US Navy
USV	Unmanned Surface Vehicle
UUV	Unmanned Underwater Vehicle
VLS	Vertical Launch System
VTUAV	Vertical take-off and landing Tactical Unmanned Aerial Vehicle