NPS-AM-25-245

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How Acquisition Decisions Impacted Fleet Readiness in the LCS Platform

June 2024

LT James S. Talbert Jr., USN

Thesis Advisors: Jeffrey R. Dunlap, Lecturer
Raymond D. Jones, Professor

Department of Defense Management

Naval Postgraduate School

Prepared for the Naval Postgraduate School, Monterey, CA 93943.

ACQUISITION RESEARCH PROGRAM
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The research presented in this report was supported by the Acquisition Research Program of the Department of Defense Management at the Naval Postgraduate School.

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ABSTRACT

The Littoral Combat Ship (LCS) program was initiated to address the U.S. Navy's need for improved capabilities in littoral environments. This study examines how acquisition decisions impacted the LCS program's ability to enhance naval readiness. The research combines an in-depth literature review of official documents and reports with the author's firsthand experience serving on the USS Freedom, USS Fort Worth, and at Littoral Combat Squadron 1. The findings reveal that the LCS program encountered significant operational challenges, cost overruns, and delays in meeting initial capability requirements. Inadequate acquisition and sustainment strategies, including a lack of thorough testing before production and overreliance on contractor support, contributed to these issues. While the Navy has taken steps to address the shortcomings, the LCS's limitations have strategic implications for littoral power projection and fleet readiness. The study concludes that the LCS program provides valuable lessons for balancing innovation and practicality in naval acquisition. Recommendations include re-evaluating the LCS's role, enhancing acquisition practices, investing in technology and training, strengthening oversight, and exploring alternative solutions. By applying these lessons, the Navy can improve future acquisition efforts to develop a more agile and cost-effective fleet capable of meeting complex maritime challenges.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOPS	Assistant Operations Officer
ASW	Anti-Submarine Warfare
CMAV	Continuous Maintenance Availabilities
COMLCSRON 1	Littoral Combat Squadron 1
DOTE	Director, Operational Test and Evaluation
DT&E	Developmental Testing and Evaluation
GAO	Government Accountability Office
ISIC	Immediate Superior in Command
IG	Inspector General
LCS	Littoral Combat Ship
MCM	Mine Countermeasures
MMSC	Multi-Mission Surface Combatant
PEO USC	Program Executive Office Unmanned and Small Combatants
PMAV	Preventative Maintenance Availabilities
RMMV	Remote Multi-Mission Vehicle
SUW	Surface Warfare
USD (A&S)	Under Secretary of Defense for Acquisition and Sustainment
USN	United States Navy

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EXECUTIVE SUMMARY

The Littoral Combat Ship (LCS) program, initiated by the U.S. Navy in the early 2000s, was developed to address the evolving global threats and the need for a versatile, agile, and smaller class of ships capable of operating effectively in littoral regions. LCS was designed to provide a fast, flexible platform that could support various mission packages tailored for mine countermeasures, anti-submarine warfare, and surface warfare. However, the program faced significant challenges throughout its development and deployment, impacting its ability to enhance naval readiness as initially envisioned.

The purpose of this research is to examine how the acquisition decisions made during the development of the LCS program impacted naval readiness. The study applies a comprehensive approach, combining an in-depth literature review with real world experiences onboard the USS Freedom (LCS 1), USS Fort Worth (LCS 3), and while assigned to the squadron, Littoral Combat Squadron 1 (COMLCSRON 1). The literature review consisted of official documents and reports from key stakeholders, including the Department of Defense, the U.S. Navy, and independent oversight bodies such as the Government Accountability Office. These sources provided insights into the program's objectives, acquisition strategy, operational challenges, and sustainment concepts. My firsthand experience offered unique perspectives on the day-to-day operations, challenges, and crew perspectives not fully captured in official reports.

The findings revealed that the LCS program encountered significant operational challenges and cost overruns throughout its acquisition life cycle and deployment. Technical issues with both the Freedom and Independence variants led to increased maintenance downtime and operational costs. The LCS was also challenged with its ability to meet their initial capability requirements due to delays in the development and integration of mission modules degrading its ability to perform intended roles effectively. The LCS program's acquisition strategy, particularly the "block buy" approach, was criticized for its lack of thorough testing and evaluation before proceeding with full-scale production. The reliance on contractor-based support for maintenance and logistics also presented challenges in terms of cost and efficiency.

The study serves as a cautionary tale about the importance of thorough testing and evaluation before making significant investment decisions. The Navy's efforts to adapt and address these shortcomings demonstrate a commitment to improving the ships' capabilities and mitigating risks. However, the effectiveness of these measures will need to be closely monitored and evaluated. The limitations of the LCS program have significant strategic implications for the Navy's ability to project power effectively in littoral regions and a cascading effect on fleet operational readiness. The constraints on flexibility and responsiveness due to LCS limitations have already impacted the Navy's operational capabilities. The financial implications and opportunity costs associated with the program are also significant, with high costs draining the Navy's budget and potentially shifting resources from other priorities.

To address the challenges facing the LCS program and to ensure its effective contribution to Navy operations, several recommendations are proposed. These include re-evaluating the LCS's role within the Navy's strategic objectives, enhancing acquisition and sustainment practices, investing in technology and training, strengthening oversight and accountability, and exploring alternative solutions. By implementing these recommendations, the Navy can leverage the lessons learned from this program to inform future naval acquisition efforts, promoting a more agile, adaptable, and cost-effective fleet capable of meeting the complex challenges of the modern maritime environment.

LCS represents a bold attempt by the Navy to transform its littoral warfare capabilities in response to emerging threats and operational requirements. Although the program faced major challenges and setbacks, it also provided valuable lessons and insights for future naval acquisition and force structure decisions. As the Navy continues to evolve its littoral warfare strategy and capabilities, it will be important to build upon the information gained from the LCS program to ensure that future naval warships are designed and acquired with a clear understanding of their operational requirements, technical feasibility, and long-term sustainability. The LCS legacy will likely be one of innovation, experimentation, and adaptation to complex problems but, also will be one that paved the way for a more capable and effective future naval fleet.

I. INTRODUCTION

Chapter I introduces my research study of how the impacts of acquisition decisions made during the Littoral Combat Ship (LCS) program development on naval readiness. The chapter begins by offering background information on the LCS program, explaining how it was initiated to address the U.S. Navy's need for a versatile, agile ship capable of operating effectively in littoral regions. The problem statement highlights the significant challenges faced by the LCS program, such as cost overruns, mechanical failures, and limited survivability, which have all hindered the ships' ability to fulfill their envisioned missions and ultimately degrading operational readiness. The purpose of the research is clearly stated as an examination of how the LCS program's acquisition decisions have impacted naval readiness, with specific research questions focused on the Navy's littoral limitations before the LCS, the ways in which the LCS was designed to mitigate identified gaps, and the anticipated operational capabilities of the LCS. The chapter also discusses the potential benefits of the study, such as providing context for the LCS program's strategic rationale and contributing to a broader understanding of naval acquisition strategies, as well as acknowledging the limitations of the research, including the limited availability of detailed operational data and the dynamic nature of naval threats and technologies.

A. BACKGROUND

The LCS program was initiated by the U.S. Navy (USN) in the early 2000s to address the evolving global threats and the need for a versatile, agile, and smaller class of ships capable of operating effectively in littoral regions. Prior to the LCS, the U.S. Navy's readiness and operations were primarily centered on large-scale operations, with large, multi-mission warships, such as cruisers and destroyers, equipped with the Aegis Combat System. These vessels were designed for open-ocean warfare and global power projection, but their effectiveness in shallow waters and complex maritime environments was limited (Sapien, 2023).

As the USN constantly projects into the future, they recognized that the changing global security environment, characterized by the rise of asymmetric threats, the advancement of innovative technologies amongst our adversaries, and the increasing importance of littoral regions demanded a new approach to naval modern warfare. The LCS was projected to be the answer to many of these challenges, which aimed to provide a platform that could conduct various mission areas. In addition to the LCS program introducing a new class of small, fast, multi-mission ships to the fleet capable of operating in littoral waters, the platform also granted operational flexibility to senior leadership with roll-on/roll-off mission packages. These mission packages were designed to be interchangeable, allowing a single LCS to be reconfigured for different roles, including surface warfare (SUW), anti-submarine warfare (ASW), and mine countermeasures (MCM) (Lobner, 2016; Lagrone, 2013; U.S. Navy [USN], n.d.).

SUW mission package is equipped with a 57 mm main deck gun, twin 30 mm Bushmaster cannons, a surface-to-surface missile, and MH-60R helicopter capabilities. It is designed to convert the ships into close-combat fighters in order to defend against attacking swarms of small boats close to shore (Lagrone, 2013). ASW mission package provides capabilities to detect and engage enemy submarines. It includes systems like variable depth sonar, multi-function towed array, and additional portable sonar equipment that did not required installment into the ship (Director, Operational Test and Evaluation [DOTE], 2015). MCM mission package equips the ship with various systems, like the Remote Multi-Mission Vehicle (RMMV) paired with the AQS-20A sonar, all essential for mine hunting and minesweeping operations. However, problems with the RMMV have delayed the MCM package more than any other component (Lagrone, 2013). The initial intention of equipping LCS with a MCM package was to replace the aging Avenger-class mine countermeasures ships.

Through the acquisition life cycle, the LCS program adopted an innovative acquisition strategy that involved two competing ship designs, a single monohull design called the Freedom-class and an aluminum trimaran design called the Independence-class (Figure 1).

Figure 1. Freedom Class (Top) and Independence Class (Bottom). Source: O'Rourke (2019, p.7).

The Navy's initial plan was to procure a total of 55 LCS between Lockheed Martin and General Dynamics, which later became Austal USA, each building their respective designs (Sapien, 2023). The theory behind the dual-design approach was to foster competition, drive innovation, and reduce costs through economies of scale. The Navy also implemented a unique manning concept for this particular platform. They were going to be manned with a rotating core crew of 40 sailors supplemented by an additional crews based on the mission package and an aviation detachment. This minimal manning concept was made possible due to the extensive built-in automation on the ship, and was designed to reduce operating costs (Sapien, 2023). Crews were meant to be only operators while maintainers would come onboard to conduct maintenance.

However, the program faced significant challenges from the start. Cost overruns, schedule delays, and performance issues plagued the development and construction of both LCS variants. The Government Accountability Office (GAO) repeatedly raised concerns

about the LCS program's cost growth, lack of combat survivability and lethality, and untested operational concepts (Sapien, 2023). One of the most significant issues was the failure of the multi-mission module concept. The Navy envisioned the LCS as a "plug-and-fight" platform with the ability to rapidly switch between mission modules in a matter of hours. Unfortunately, this concept proved to be more challenging than anticipated. The development of the different modules fell behind schedule, and their integration with the LCS seaframes encountered technical difficulties (Lobner, 2016). From personal experience, the process for a mission module swap generally took weeks depending on the module to fully integrate the systems onboard the ship.

As a result, the Navy was forced to adjust its plans for the LCS. In 2014, the Secretary of Defense directed the Navy to conduct a review of the LCS program and explore alternative options. This led to the decision to modify the LCS design into a more heavily armed and survivable frigate variant, now known as the Multi-Mission Surface Combatant (MMSC) or the Constellation-class frigate (Sapien, 2023).

The Navy also made changes to the LCS manning and operational concepts. The original 3–2-1 manning model (See Figure 3), which involved three crews rotating between two ships with one ship always forward deployed, proved to be unsustainable. The Navy transitioned to a blue-gold crewing model, and eventually, they decided to shift towards a single-crew concept, similar to other traditional surface ships (Stancy, 2023; Reiher, 2020).

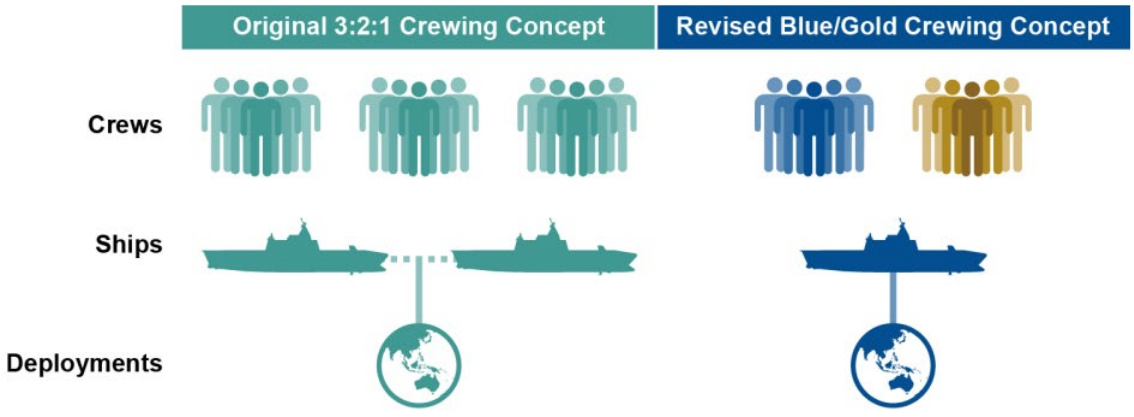

Figure 2. LCS Rotating Crew Concept. Source: GAO (2022, p.18).

Despite these challenges and adjustments, the LCS program has made progress in recent years. As of 2021, the Navy has commissioned 23 LCS with 11 more under construction or in the pre-commissioning phase. The LCS has conducted successful deployments to the Western Pacific, Fourth, Fifth and Sixth Fleets, demonstrating they ability to operate independently across open-ocean and in littoral environments to engage with international allies.

The LCS has also played a role in the counter-drug operations in the Caribbean and Eastern Pacific by leveraging its speed capabilities and shallow draft to intercept drug smugglers. In 2020, USS Detroit (LCS 7) and USS Gabrielle Giffords (LCS 10) seized over $200 million worth of cocaine during their deployments to the U.S. Fourth Fleet area of operations. On April 7, 2021, USS Freedom seized over 1,500 kilograms of cocaine off the coast of Mexico with the help of the embarked U.S. Coast Guard (The Maritime Executive, 2021).

Figure 3. USS Freedom Conducting Counter-Drug Operations. Source: The Maritime Executive (2021).

However, questions remain about the LCS's long-term effectiveness and sustainability. The ships have experienced numerous mechanical failures and maintenance issues, which has led to reduced operational availability. LCS's combat capabilities,

particularly its ability to survive in high-intensity conflicts against near-peer adversaries, have also been called into question. The Navy has acknowledged these concerns and is actively working to address them through various initiatives. The implementation of a comprehensive maintenance and sustainment plan between ship's force and the maintenance community, improving crew training and readiness with heavy involvement from the squadron, and investing in capability upgrades for the LCS fleet are a few examples of initiatives (Government Accountability Office [GAO], 2022).

One of the key takeaway from the LCS program is the importance of setting realistic requirements and expectations for new ship classes. LCS's ambitious goals of modularity, speed, and affordability proved to be difficult to achieve while also leading to compromises in design and performance (Lobner, 2016). My personal LCS experience have also highlighted the challenges of introducing radical innovations in naval acquisition. While the LCS program's original vision of a flexible, multi-mission platform was compelling, the execution encountered significant technical, operational, and budgetary setbacks (Sapien, 2023). Despite these challenges, the LCS program has provided valuable insights and lessons for future naval acquisition efforts. The Navy has applied some of these to the development of the Constellation-class frigate, which is designed to be a more operationally capable, lethal, and survivable compared to the LCS (Sapien, 2023).

The LCS program has also demonstrated the importance of adaptability and flexibility in naval operations. The ability to rapidly reconfigure ships for different missions and to operate in diverse combat environments are becoming increasingly critical in the face of future global threats (Sapien, 2023). As the Navy continues to refine its littoral warfare capabilities, LCS will likely play a significant role in shaping the fleet's operational strategy. While the LCS may not have fully lived up to its original promise, it has paved the way for a new generation of small, agile, and multi-mission ships that can operate effectively in the complex littoral environment (Sapien, 2023).

In conclusion, the LCS program represents a bold attempt by the Navy to transform its littoral warfare capabilities in response to emerging threats and operational requirements. Although the program has faced significant challenges and setbacks, it has also provided valuable lessons and insights for future naval acquisition and force structure

decisions. LCS's impact on naval readiness has been rather mixed. Some ships have demonstrated their success in conducting independent operations and supporting maritime security missions, but the majority have also experienced reliability and maintainability issues that have hindered their operational availability (Sapien, 2023). As the Navy continues to develop its littoral warfare strategy and capabilities, it will be very important to build upon the lessons learned from the LCS program to ensure that future ships are designed and acquired with a clear understanding of their operational requirements, technical feasibility, and long-term sustainability. The LCS program's legacy will likely be one of innovation, experimentation, and adaptation in the face of adverse challenges. LCS has played a significant role in shaping the Navy's approach to littoral warfare and has laid the foundation for a more capable and effective future fleet.

B. PROBLEM STATEMENT

Before the LCS, the capability to maintain full operational control in littoral zones was limited due to the inabilities of larger ships that were not originally designed for combat in the near-shore environments. The lack of dedicated platforms for littoral operations suggested a potential vulnerability in areas where adversaries could leverage shallow waters and complex geography (Sapien, 2023).

The LCS program was the solution to this issue, however, both platform designs faced significant challenges that dramatically affected its operational capabilities to meet mission tasking and ultimately affecting naval readiness. Cost overruns, continuous mechanical failures, and limited survivability in high-intensity combat scenario have hindered the ships' ability to fulfill their missions effectively. If these issues remain unresolved, LCS will continue to negatively impact naval readiness fleet wide degrading the near-shore operational capabilities and forcing senior leadership to modify their strategic planning efforts against the new upcoming global threat.

C. PURPOSE STATEMENT

The main purpose of this research is to examine how the acquisition decisions made during the LCS program life cycle have impacted naval readiness. By evaluating the limitations of the Navy's readiness in littoral environments before the LCS with the

understanding that LCS were designed to mitigate the identified capability gaps with specific anticipated operational capabilities, this study aims to provide a comprehensive understanding of the program's impact on the Navy's ability to operate effectively in near-shore environments and integration into the fleet.

D. RESEARCH QUESTIONS

The main research question guiding this study is:

1. How have the acquisition decisions made during the LCS program acquisition life cycle impacted naval readiness?

To support this main question, the following sub-questions will be addressed:

1. What were the limitations of the Navy's readiness in littoral environments before the LCS was introduced?
2. In what ways was the LCS designed to mitigate the identified gaps in littoral operations and enhance naval readiness?
3. What operational capabilities were anticipated from the LCS to improve the Navy's performance in littoral waters?

E. BENEFITS AND LIMITATIONS OF THE RESEARCH

1. Potential Benefits

By understanding and evaluating the state of readiness of the Navy's littoral readiness prior to the LCS, this research will provide valuable context for the strategic rationale behind the LCS program and a baseline for assessing the ship's success in achieving its intended objectives. It is essential to clarify the specific capability gaps identified prior to the development of the program to fully understand the operational challenges that the LCS was intended to achieve. Additionally, this research will allow for further insight into how effective the program is in addressing identified capability gaps to enhance the Navy's performance in the coastal regions.

The LCS program represents a significant case in the history of naval acquisition and the involvement is has on naval readiness. After examining the acquisition decisions made during the program's development and their consequences to naval operations, it will become apparent the broader understanding of the complexities and the interplay between acquisition strategies, technological innovation, and operational readiness in the naval context.

Additionally, the program has led to develop many best practices and discover potential pitfalls, which offer highly valuable lessons for future naval acquisition efforts that any good program office can utilize. By analyzing the program's trajectory, including its design philosophy, acquisition approach, and operational outcomes, a program office can take way these lessons learned and incorporate them into their planning process and even in the execution phase of future naval acquisition programs. Not only can this research benefit the acquisition planners, but also senior leadership in our organization. My findings can provide a foundation for evidence-based decision-making in naval strategy and resource allocation. By offering a comprehensive assessment of the LCS program's impact on naval readiness particularly in the coastal region, it can help naval leaders and policymakers to make informed decisions about the future direction of the LCS program, as well as broader investments in future warfare capabilities and readiness initiatives.

2. Potential Limitations

One potential limitation of this research is the limited availability of detailed operational data related to the Navy's littoral readiness and the LCS program. Some aspects of naval operations, particularly those involving sensitive or classified information, are not be fully accessible to all readers. This could constrain the depth and specificity of the analysis, especially when assessing the LCS's operational performance and its impact on specific mission areas.

Another limitation would be the naval domain, which is characterized by rapidly evolving threats and technologies. It can become complicated to accurately assess readiness and capability gaps over time. The specific challenges and requirements that informed the LCS program's creation could have possibly shifted in the years since and

making it difficult to fully capture the program's relevance to current and future littoral security environments. To expand on the idea of shifting requirements, on-going changes in naval strategy and readiness are also correlated. LCS has evolved considerably since its initial development, and the Navy's approach to littoral warfare has continued to adapt in response to emerging threats and operational experiences. As a result, the research's focuses more on the pre-LCS timeline, which may not account for the full range of factors shaping the program's status and future trajectory.

My research may also be subject to potential biases and limitations in the available sources of information on the LCS program and the Navy's littoral readiness. Official Navy documents are very valuable providing a vast amount of insight, but it could represent a particular perspective on the program's rationale and achievements. Media reports and external analyses do offer additional insights but they could also reflect specific editorial stances or focus on certain aspects of the program at the expense of others.

As previously mentioned, assessing the specific impact of the LCS program on naval readiness was a challenging task due to the complex array of factors beyond the introduction of a single ship class. Factors can include broader changes in naval strategy, force structure, training, maintenance practices, and budgetary priorities. Isolating the LCS's contributions to readiness improvements or setbacks may require careful analysis and acknowledgment of the broader context in which the program has operated. Despite these limitations, my research has the potential to offer valuable insights into the LCS's impact on naval readiness and the dynamics of government acquisition. By carefully navigating these constraints and leveraging the available evidence, the study provides a better understanding of the program's successes, major issues, and lessons learned ultimately improving future acquisition efforts to enhance the Navy's capabilities and readiness in complex environments through well-developed, planned, and executed acquisition programs.

II. LITERATURE REVIEW

Chapter II provides a comprehensive literature review that establishes the theoretical foundation for understanding the LCS program's challenges and contributions to naval acquisition and readiness. It begins by examining key organizational theories, such as systems theory, contingency theory, and institutional theory, which offer valuable insights into the dynamics of defense acquisition programs. It then dives into acquisition theory, systems engineering principles, and readiness and sustainment models, highlighting their relevance to the LCS program. The chapter also provides an overview of relevant defense acquisition policies, naval shipbuilding plans, and contracting and industry engagement strategies that shaped the program's outcomes. Past research, including program evaluations, lessons learned, and operational performance studies, is covered to identify gaps in understanding the long-term effects of acquisition decisions on readiness and the integration of innovative technologies in military platforms. The chapter concludes by discussing the research's unique contributions to the literature, offering new insights, policy recommendations, and theoretical advancements in defense procurement studies.

A. THEORETICAL FOUNDATION

1. Overview of Organizational Theories

Organizational theories provide frameworks for understanding how organizations operate, change, and develop. Systems theory views organizations as complex systems with interrelated parts, while contingency theory emphasizes the importance of situational factors in shaping organizational outcomes. Institutional theory examines how organizations are influenced by their institutional environments (Miles, 2012; Shafritz & Ott, 2001). These theories offer valuable insights into the dynamics of defense acquisition programs, such as the Littoral Combat Ship program, and how they are shaped by various internal and external factors.

2. Acquisition Theory

Defense acquisition theory provides a framework for understanding the complexities of military procurement emphasizing the importance of balancing cost, schedule, and performance. Insights from LCS program highlight the challenges of managing innovative projects within the constraints of government procurement processes (Arena et al., 2006). Acquisition theory highlights the importance of clear requirements, rigorous analysis, and effective risk management in ensuring the success of defense acquisition programs.

3. Systems Engineering

As a critical component to managing complex projects, systems engineering principles were applied in the LCS program to integrate various technologies and mission modules, or also known as mission packages. However, the program discovered the need for rigorous systems integration with closely monitored, extensive testing to ensure operational effectiveness (Department of Defense [DOD], 2018). Systems engineering approaches emphasize the importance of a holistic view of the project while considering the interactions between various subsystems for the overall system performance.

4. Readiness and Sustainment Models

Military readiness models assess the capability of forces to perform their missions, considering factors such as availability, reliability, and sustainability. The LCS program's sustainment, maintenance, and logistics issues create a domino effect on naval operations, readiness, and availability (GAO, 2020). Readiness and sustainment models provided a framework to understand the long-term consequences of known acquisition decisions on the operational effectiveness of military platforms.

B. POLICY OVERVIEW

1. Defense Acquisition Policy

The LCS program was influenced by defense acquisition policies aimed at streamlining procurement and encouraging innovation. However, the program led to many calls for policy reforms to improve oversight, risk management, and cost control in defense

acquisitions (Congressional Research Service [CRS], 2021). The defense acquisition policy plays a crucial role in shaping the outcomes of programs like the LCS, and reforms can help improve future acquisition efforts based on lessons learned.

2. Naval Shipbuilding Plans

The LCS program was a key component of the Navy's shipbuilding plan intended to increase the fleet's size and capabilities by building 55 more with LCS in attempts to reach the overall goal of a fleet of 355 ships. The program's challenges have prompted re-evaluations of shipbuilding priorities and strategies to ensure that future projects better meet operational requirements. The results of this re-evaluation, announced in 2019, included a drop in the total count down to 35 ships between the two variants. Although very ambitious, naval shipbuilding planners must balance the need for innovation with the realities of budgetary constraints and operational demands.

3. Contracting and Industry Engagement

The LCS program's contracting approach involved a substantial amount of industry engagement and the use of commercial off-the-shelf technologies. Evidently, this was an attempt to reduce costs and accelerate development to production. However, this approach also introduced risks related to contractor performance and technology integration (GAO, 2020). Effective contracting and industry engagement strategies are essential for managing risks and ensuring the successful delivery of defense acquisition programs.

C. PAST RESEARCH

1. Program Evaluations

Evaluations of the LCS program by the GAO and other entities have identified key issues with the program's acquisition strategy, cost estimates, and operational performance. These evaluations provide valuable insights for improving future defense acquisition projects (GAO, 2020). Program evaluations serve as important sources of lessons learned and best practices for the defense acquisition community.

2. Lessons Learned

The information gained from LCS program has generated many important lessons learned for the defense acquisition community, particularly regarding the importance of clear requirements, stakeholder engagement, and more robust testing and evaluation processes (CRS, 2019). These lessons address the need for a comprehensive approach to acquisition that considers the entire life cycle of the platform from initial requirements definition in the Initial Capabilities Documents (ICD) to sustainment and finally, the decommissioning of the platform.

3. Operational Performance

Studies of the LCS fleet's operational performance have highlighted the inability of the platform to achieve its desired capabilities requirements and the need for continuous improvement and adaptation in defense acquisition programs. Operational performance assessments provided valuable feedback for acquisition decision-makers to make informed decision regarding future investments and program management strategies.

D. CONTRIBUTION TO LITERATURE

1. Gap Analysis

This study helps to identify gaps in the literature regarding the long-term effects of acquisition decisions on naval operations, readiness, and the integration of innovative technologies in military platforms. Attempting to address these gaps is crucial for further improvements to the future defense procurement strategies used by the program office. The results from my examination of the LCS program's acquisition theory, systems engineering, and readiness models provided a more comprehensive understanding of the complexity between acquisition decisions and operational outcomes

2. New Insights

The analysis offers new insights into the relationship between acquisition decisions and operational readiness. It demonstrates the need for a holistic approach to defense procurement that balances innovation with risk management and cost control. This research also feeds into the ongoing body of knowledge on defense acquisition's best practices,

which emphasize the importance of clear requirements, rigorous testing, and effective stakeholder engagement.

3. Policy Recommendations

Based on the LCS program's overall result, my research recommends some minor policy reforms to enhance the outcomes of major defense acquisition projects. Improved more-defined requirements to address identified capabilities gaps, continuous stakeholder engagement throughout the entire life cycle from all entities involved, and proper life cycle cost estimation from development to sustainment and up until decommissioning. They are targeted to support the effective development of more capable and cost-effective naval forces. The only effective way to achieve the overall goal and avoid another questionable program, like LCS, is to pass new policy changes based on recommendations gathered to improve the way the government executes the defense acquisition processes.

4. Theoretical Advancement

By applying acquisition and readiness theories to LCS, my research will contribute to the theoretical advancement in defense procurement studies. It provides a framework for analyzing the complexities between acquisition decisions, technological innovation, and operational readiness in military projects. It expands the understanding of how organizational theories, such as systems theory and contingency theory, can be applied to the study of defense acquisition programs.

5. Summary

To conclude, this comprehensive analysis provides a better understanding of the LCS program's challenges and contributions to major government defense acquisition programs and naval readiness. By integrating theoretical insights with practical lessons learned, this study can offer valuable recommendations for enhancing future defense acquisition strategies and ensures the operational effectiveness of naval forces that benefit from these programs. Additionally, it addresses the known gaps in understanding the long-term effects of acquisition decisions made during the development stages of the acquisition process on operational readiness and the integration of innovative technologies into the

future of military warfare. New insights into the dynamic relationship between acquisition and operations, recommendations for policy reforms, and advances theoretical understanding in defense procurement studies are possible outcomes that one can gather from my research.

III. METHODOLOGY AND ORGANIZATIONAL CONTEXT

Chapter III describes the methodology and organizational context for researching the LCS program. The research approach combined an in-depth review of official documentation, such as Selected Acquisition Reports, GAO reports, and Navy publications, with invaluable firsthand experiences and observations from time spent onboard LCS vessels, USS Freedom and USS Fort Worth, and at the supporting Littoral Combat Squadron 1 (COMLCSRON 1). This multifaceted methodology provided a comprehensive understanding of the LCS program's objectives, structure, operational concepts, and real-world challenges. It continues to detail the dual-variant program structure with the Freedom and Independence variants, the modular mission package operational concept, oversight and support organizations, and an analysis of significant issues encountered such as engineering failures, modular mission package change-out delays, and crew fatigue. The combination of official documents and on-the-deckplate experience offers a unique perspective on the complex challenges facing the LCS program in achieving its ambitious goals.

A. HOW WAS THE DATA EVALUATED?

The strategy that I employed for this research utilized a more comprehensive approach, combining an in-depth literature review with my first hand experiences onboard the USS Freedom (LCS 1) and USS Fort Worth (LCS 3) and my time attached to the squadron, COMLCSRON 1, in San Diego, CA. This multifaceted strategy ensured a more thorough understanding of the LCS program, the challenges they face, and the potential for future naval operations if corrected.

The literature review encompassed a wide array of official documents and reports from key stakeholders, including the DOD, the USN, and independent oversight bodies, such as the GAO. These sources provided a solid foundation for understanding the LCS program's objectives, defense acquisition strategy, operational challenges, and sustainment concepts.

Among the critical documents reviewed were the Selected Acquisition Reports (SARs), which gave explicit detailed insights into the program's cost, schedule, and performance metrics (DOD, 2022). Official Navy publications, such as fact sheets and web pages, were also utilized to gather information on the LCS's capabilities, mission sets, and operational status (USN, 2022a, 2022b). GAO reports played a significant role in my research since they have conducted independent assessments on the LCS program's progress, identified areas of concern, and offered recommendations for improvement (GAO, 2022). These reports were particularly critical in re-emphasizing and confirming the challenges that plague the program. The mission module integration, maintenance, and sustainment problems continue to hunt these platforms as improvements take time to implement.

To complement the findings from the literature review, the research incorporated my on-the-deckplate experiences gained from my three years spent onboard USS Freedom and USS Fort Worth as Assistant Operations Officers and my short few months attached to Littoral Combat Squadron 1 (COMLCSRON 1) as the ship's Mission Liaison Officer. This valuable experience offered unique insights into the day-to-day operations, challenges, and crew perspectives that are not always fully captured in official reports. One thing is to comprehend the information written in reports and manuals, but another is to live and breathe the life of what it means to be a LCS sailor.

Observations from USS Freedom and USS Fort Worth have provided me with a realistic perspective of the operational realities of the LCS program, including the impact of engineering failures on ship readiness, the complexities of mission module change outs, and the toll on crew morale and well-being. Executing the schedule was constantly questionable due to the status of the engineering plant, and whether it was capable of going underway more than a few days without breaking down. Mission packages took more than a week to install. Crews were overworked because they felt the pressure to maintain the same duties and responsibilities as fellow cruisers and destroyers but with fewer personnel. All these factors combined lead to multiple cascading events impacting operational schedules, mission tasking, and overall capabilities available to senior leadership. My time spent at COMLCSRON 1 further enriched the understanding of the unique challenges

faced in maintaining the readiness and sustainability of the LCS fleet while attempting to meet tasking from the fleet commanders.

The combination of the literature review and personal hands-on experience allowed for this exclusive comprehensive analysis of the program. By triangulating data from multiple sources, the research aimed to provide a balanced and accurate assessment of the LCS's current state, its challenges, and its potential for future success.

B. ORGANIZATION DESCRIPTION

The LCS program was a complex and ambitious initiative started by the USN in order to develop a new class of warships designed to operate in littoral region. The program was managed by the Navy and overseen by various offices within the DOD, including the Under Secretary of Defense for Acquisition and Sustainment (USD (A&S)) and the Program Executive Office Unmanned and Small Combatants (PEO USC) (DOD, 2022; USN, 2022c).

One of the defining features of LCS was the dual-variant approach. As discussed in chapter one, the program involved two distinct ship variants, the Freedom and the Independence, each designed and built by different industry teams. Lockheed Martin led the team responsible for the Freedom variant, while Austal USA spearheaded the development of the Independence variant (USN, 2022a). This unique strategy was implemented to foster competitive utilizing the latest in modern innovation, to explore and test different design philosophies, and finally, to enhance operational flexibility. At the center of the program was the concept of modularity. LCS ships were designed and built to accommodate a variety of interchangeable mission modules, or also known as packages that allowed them to adapt to different operational requirements (USN, 2022b). Ideally, these mission packages would enable the ships to provide various warfare capabilities for the complex near-shore operating environments, which enhanced flexibility in responding to evolving threats and mission demands. The more combat capable the ship is, the more lethal and valuable it becomes in a fight.

However, the implementation of this modular concept has not been without challenges. The complexity of integrating and maintaining these mission packages has led

to delays, increased costs, and reduced operational availability (GAO, 2022). The process of swapping out mission modules has proven to be more time-consuming and resource-intensive than initially anticipated, affecting the LCS's ability to rapidly adapt to changing mission requirements. Additionally, it does not take into consideration the advancement and the upgrades to the equipment, which will be addressed in later chapters regarding the findings.

To support the sailors onboard the LCS ships, the Navy established two squadrons located on the east and west coasts, COMLCSRON 1 in San Diego, CA and COMLCSRON 2 in Mayport, Florida. Freedom class ships are primarily stationed in Florida with the exception of USS Fort Worth, a designated test platform, that is located with the entire Independence class in San Diego, CA. These squadrons play a vital role in the operational support and management of the ships, and also help alleviate the unique problems associated with maintaining their readiness and sustainability (USN, 2022a). Due to the decision made during the acquisition development stage of minimal manning onboard ships, a small portion of the duties and responsibilities of a traditional platform are executed at the squadron level, as designed. They are responsible for coordinating maintenance, on and off hull training requirements, logistics support, and the operational schedule, ensuring that the LCS ships are prepared to execute their assigned missions timely and effectively.

Unfortunately, the program has been subject to close scrutiny and oversight from various stakeholders, including Congress and independent agencies such as the GAO. The GAO has conducted numerous reviews and assessments of the program, stressing the areas of concern and providing recommendations for improvement (GAO, 2022). These evaluations have been critical in identifying and mitigating the many obstacles faced by the LCS program, such as issues with reliability, maintainability, and cost-effectiveness.

Despite the well-known problems, the LCS remains a key component of the U.S. Navy's future fleet architecture. They have taken steps to isolate these identified issues, implementing changes to improve the program's management, maintenance practices, and operational concepts (USN, 2022a). As it continues to develop and mature, the Navy continues to leverage the lessons in order to enhance the LCS operational effectiveness and

to ensure its successful integration into the fleet operations through the direction and guidance of Task Force LCS (Fuentes, 2023).

C. PERSONAL INSIGHTS AND ANALYSIS

The incorporation of personal, firsthand experience and observations from my time spent onboard two LCS ships and at the squadron level provided a valuable complement to the findings from the literature review. These real-life insights offer a unique perspective on the operational challenges and human factors that shape the program's success.

One of the most significant challenges observed during my time spent on USS Freedom and USS Fort Worth was the impact of engineering failures on ship readiness and mission capability. Combing gear, diesel and gas turbine engines, and waterjet failures were only some engineering examples that frequently occurred but does not include the combat system and navigation failures that also haunt the platform. GAO has reported that LCS fleet wide has experienced a range of technical issues, from propulsion system failures to problems with the ship's computer networks (GAO, 2022). These failures have led to extended and unplanned maintenance periods, reduced operational availability, increased costs, inability to complete mission tasking, and over exhausted and unmotivated sailors working day in and day out attempting to correct the issue. My experience brought light to the real-world consequences of these technical challenges, as crews struggle to maintain the ships' readiness and adapt to changing maintenance schedules. To add to the difficulty in identifying and correcting these engineering failures, hesitation from the maintenance community to fund repairs lingered. Particularly with USS Freedom prior to its decommissioning only 13 years after commissioning, the project managers in charge of maintenance and sustainment of the ship delayed making any major repair decisions due to the fact that the ship was on the decommissioning list and only was awaiting for the final approval date. This prevented any major repairs from occurring, but allowed minor work to be conducted in order to meet all minimum requirements to go underway. Two years passed in this limbo, and then finally the decision to decommission the ship was approved in December of 2021.

Another key insight gained from my time with the LCS community ties directly to the complexities of the LCS mission module concept. While the "plug-in and fight" approach was intended to provide flexibility, adaptability and lethality, the reality of swapping out mission modules proven to be more challenging than anticipated. The process of switching mission packages is time-consuming, labor-intensive, and requires significant logistical support (GAO, 2022). Observations from USS Fort Worth and their ASW mission module revealed the negative impacts on crew's workload, fatigue, and morale, as sailors work long hours to reconfigure the ship for different mission sets. Theoretically, the augmented crew for that particular mission module would take primary lead, alongside the core crew, and execute the embarkment and disembarkment of the equipment, but always it ended up to be an all hands on deck to accelerate the process. What was initially proposed to take days turned into weeks for full installment and integration into ship's operations.

My experience also shed light on the human factors that shape the LCS program's uphill battle. Crew fatigue and frustration emerged as significant concerns during time spent onboard the ships and at the squadron. The demanding operational tempo, combined with the challenges of maintaining and operating the complex LCS systems, takes a toll on the sailors' well-being and job satisfaction. These observations underscore the need for improved support structures, training, and resources to ensure that crews are adequately prepared and supported to carry out their missions effectively. Coming previously from USS Cole, a destroyer, to LCS, the traditional platforms possess a large crew size of sailors that are trained and qualified to conduct with own maintenance and repairs. Sailors did not have to rely on contractors to fix their equipment, nor did they have to wear multiple hats to get the job done operationally. LCS sailors with their minimal manning endure a heavy burden to meet the same objectives and requirements as the rest of the fleet. The rotating crew are at an advantage compared to the single crew ships because they are granted time off-hull to conduct the necessary continuous training and to enjoy a little bit of downtime. However, the single crew ships must maintain training requirements forcing ship's leadership to flex their capabilities to continue operating while sending sailors off to training.

Insights gained from time spent at squadron level further painted the picture of the unique difficulties faced in maintaining the readiness, sustainability, and operational tempo of the LCS fleet. As mentioned, the LCS squadrons play a critical role in coordinating maintenance, training, logistics support and scheduling for the ships' operations, but they must also carefully navigate the complexities of the program's dual-variant approach and evolving operational requirements (USN, 2022a). With the split between the two designs to east and west coasts, the squadrons are more dedicated to focusing and addressing the concrete issues affecting a single variant. My experience revealed the perseverance and resilience of the COMLCSRON 1 team in attacking these difficulties, and it also demonstrated the need for continued improvements to maintenance strategies, supply chain management, and organizational support for the ships.

These years of experience with LCS have provided me with a valuable supporting evidence to the official reports and assessments of the LCS program. While the literature review offers a comprehensive overview of the program's objectives, challenges, and progress, my observations added depth and expansion to their analysis confirming the good and not so good components of LCS. By combining these two perspectives, the research aims to provide a more complete and accurate picture of the LCS program's current state and future potential to naval operations.

D. CONCLUSION

The LCS program continues to represent a bold and innovative approach to major government acquisition projects and naval warfare, aiming to supply the USN with a versatile and adaptable platform for operations in littorals. However, the program's ambitious goals were met with a complex array of challenges, ranging from technical issues and maintenance difficulties to human factors and limit organizational support.

The methodology employed in this research combines a thorough literature review with on-the-deckplate experience offering a unique and comprehensive perspective on the LCS community. By drawing on official documents, reports, and assessments, as well as my real-life observations from time spent onboard LCS vessels and within the squadron,

the analysis provides a balanced and thorough understanding of the program's challenges and opportunities.

The findings from this research emphasize the need for continuous efforts to address the identified problems and enhance the operational effectiveness and sustainability of the LCS fleet operations. Mitigating issues such as reliability, maintainability, and crew support will be critical to ensuring the ships' success in fulfilling their intended roles in the USN's future operational landscape. As the LCS program continues to evolve and mature, it will be essential to capitalize on the lessons learned by combining these insights and work collaboratively across the Navy with our defense industrial partners and governing officials. By doing so, the LCS program can chart a course towards a platform with improved performance capabilities, enhanced readiness, and successful integration into the fleet operations. Ultimately, the LCS represents a significant investment in the future of the USN and its ability to respond to the complex challenges of the 21st century. By embracing innovation, adaptability, and continuous improvement, the LCS program can overcome its current challenges and reach its full potential as a key component of the Navy's future fleet architecture.

IV. FINDINGS AND ANALYSIS

Chapter IV presents the comprehensive analysis of my findings related to the LCS program. It begins by diving into the operational challenges, cost overruns, and failure to meet initial capabilities that have plagued the program throughout its life cycle. It examines the inadequate acquisition and sustainment strategies that have contributed to the program's difficulties and highlights the Navy's efforts to address these shortcomings. The chapter discusses the complexities and risks involved in developing new innovative naval platforms and emphasizes the importance of thorough testing and evaluation before making significant investment decisions. The implications of the findings include the strategic consequences for the Navy's ability to project power in littoral regions, the financial burden of the program, and concerns about the Navy's acquisition practices. The chapter concludes with a set of recommendations to solve the problems identified, such as re-evaluating the ship's role, enhancing acquisition and sustainment practices, investing in technology and training, strengthening oversight and accountability, and exploring alternative solutions.

A. INITIAL FINDINGS

1. Operational Challenges and Cost Overruns

Over the years from the initial concept development to present day operations, the LCS program has encountered several significant operational challenges and cost overruns. Technical issues have been identified with both the Freedom and Independence variants, which have led to increased maintenance downtime and operational costs (GAO, 2021). These technical problems included issues with the ships' combining gears in the waterjet propulsion systems, electrical systems, and other critical components, resulting in reduced operational availability and higher than anticipated maintenance requirements (CRS, 2022a). This issue has not only haunted LCS but this lack of ability to meet maintenance deadlines and create unwanted delays also feed into a fleet wide problem. Navy, with the help from the GAO, has conducted extensity research on the factor that are causing these maintenance delays. (See Figure 4).

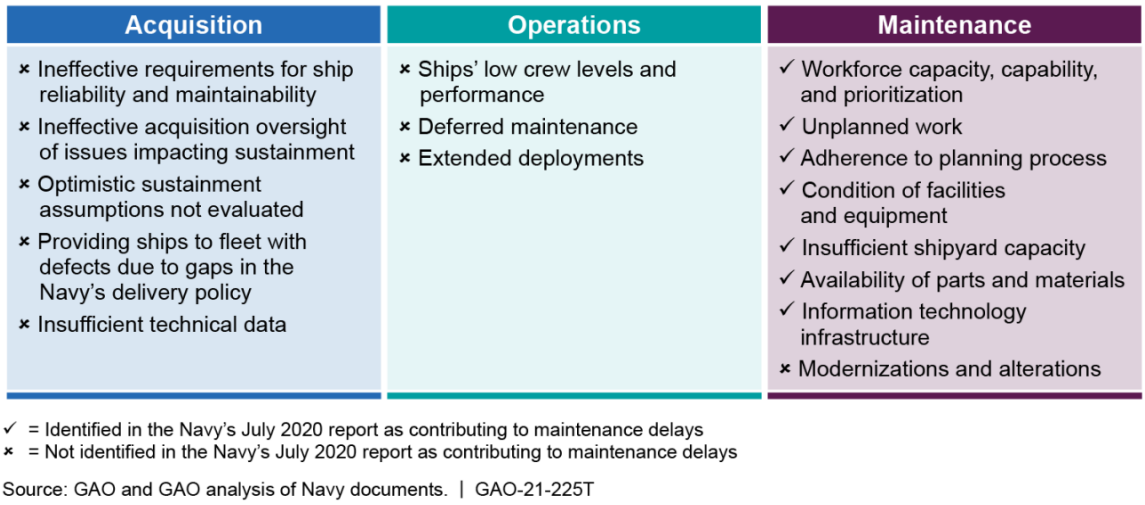

Figure 4. Factors Leading to Maintenance Delays. Source: GAO (2021, p.7).

The increased maintenance requirements and operational costs have raised concerns about the longevity, sustainability, and cost-effectiveness of the LCS ships. They have required more frequent and extensive maintenance coordination than initially planned, leading to extended periods of unavailability and reduced operational readiness (DOD, 2020). Unforeseen mechanical failures, unplanned maintenance, scheduling conflicts between monthly Preventative Maintenance Availabilities (PMAV) and quarterly Continuous Maintenance Availabilities (CMAV) with operational tasking or priorities are only a few examples from my time within the LCS community. Cost overruns have been attributed to various factors, like design changes, production delays, and underestimated sustainment costs (O'Rourke, 2019). These costs have put additional strain on the Navy's budget and have led to scrutiny of the program's financial management and oversight (CRS, 2022b).

2. Failure to Meet Initial Capabilities

Upon completion of my research, it is to state that the LCS program has failed in meeting its initial capability requirements and goals. Delays in the proper development and integration of mission modules hindered the ships' ability to perform their intended roles effectively (USN, 2021). They were designed to provide the LCS with specific capabilities, such as mine countermeasures, surface warfare, and anti-submarine warfare, but rather they

experienced unexpected technical difficulties and multiple integration issues (CRS, 2022a). These delays limited the ships' ability to fulfill their envisioned roles associated with littoral region and have raised the questions about its operational effectiveness in naval operations (GAO, 2020).

Additionally, there are valid concerns about the survivability in contested environments due to its limited self-defense capabilities (Naval Technology, 2021). The ships' light armor, limited weaponry and constant mechanical failures degrading recoverability have led to questions about their ability to withstand attacks from adversaries in high-threat scenarios (CRS, 2022b). These limitations have sparked many discussions about the LCS's role in future naval operations and its ability to operate effectively in contested littoral regions (U.S. Naval Institute [USNI], 2022).

3. Personal Insight and Analysis

A highly valuable component that strengthens the fidelity of my research is the personal on the deck plate experience that I gained from my time onboard two similar platforms and at the squadron level supporting the ship. As previously mentioned, I served onboard USS Freedom as the Assistant Operations Officer (AOPS) for my second Division Officer tour. My primary duties and responsibilities combined the roles of First Lieutenant, working with the Boatswain's Mates in Deck Division, and Combat Information Center Officer, working alongside the Operation's Specialist in Operations Intelligence Division. Due to the authorization of a brand new AOPS billet, the training pipeline was not funded, and I checked in directly into the ship, which was not usual. Typically, sailors would check into the squadron where they are placed into a long training pipeline, which could be up to one year, prior to reporting onboard. My conclusion was that basic training required for all personnel assigned to the ship was not consistent onboard between the enlisted and officer communities. The only clear consensus between all the sailors was that the required time length we not necessary and a bit excessive. Since the sailors were not fully gained by the ship, their timelines to be assigned to the ship never began, creating some unexpected moral issues.

During my time onboard USS Fort Worth, I was assigned the same role as AOPS assisting the Operations Officer to the best of my abilities. Both ships exhibited similar characteristics with regard to meeting maintenance requirements and operational tasking. Although I never received any official LCS training, I quickly discovered the severe problem within their maintenance and sustainment plans. The sailors always begin discussing this topic by stating that ship's forces barely does maintenance, and that it all conducted through PMAVs and CMAVs, which is very accurate. There is a small percentage of the equipment checks that are completed by ship's force, but the large majority of the work is completed by contractors during the maintenance availabilities. The impacts were both position at times but also negative. On one hand, it reduced the responsibilities of the maintenance checks to an outside entity, but on the other, issues were found in some major life saving equipment that could have resulted in a major shipboard mishap or worse, a death. Additionally, since that work was being conducted by contractors, the equipment required was no longer needed to be onboard nor qualifying the sailors becomes a requirement. Eventually, the sailors onboard were forced to verify the contracted work being completed for every check and occasionally, redo the job if deemed necessary, which resulted in a heavy workload on each division. Event with the limited manning assigned to the crews, there was still plenty of maintenance checks that sailors needed to complete in order to meet the mission. This created a cascading effect on the moral of the ship and our operational tempo. Officers fall into a role of maintenance officer repairing a broken ship vice a Surface Warfare Officer assigned to a warship ready for combat. Enlisted sailors become over-worked and at times overwhelmed with the demand placed upon them to maintain equipment, meet the professional standards, pursue their qualifications, stand their required watches, etc. All these factors also contributed to our ability to complete mission tasking.

Onboard both ships, I realized the difficulty to maintain and prepare the ship to go underway to support flight operations, basic and advance exercise, drills, and certifications. USS Freedom was faced with a multitude of mechanical failures ranging from combat systems equipment to engineering that forced us to return to port after a few hours or cancel the underway completely. Additionally, the leadership, during my first initial months

onboard, did not have the confidence in the sailors to conduct the repairs out at sea and preferred the subject matter experts from the company to trouble shoot. Afterwards, my second commanding officer had a different philosophy and preferred the opposite. Between the two command leadership styles, we were more effective in complete operational tasking from our Immediate Superior in Command (ISIC), COMLSCRON 1. This re-emphasizes the importance of trusting and relying on your sailors to learn their equipment in order to make the necessary repairs when the time come. Heavily relying on contracted maintenance inhibits the crew from accomplishing that goal and does not support the initial sustainment plan that LCS envisioned.

Although the crews became more effective at maintain their equipment, mechanical failures continued to haunt the platform. Several times, the ships were unable go underway due to certain red line items not being met, which are associated with essential equipment required to safety navigate and operate out at sea. These frequent fail to sail events forced our ISIC to reschedule any operational commitments that we might have had planned. Ultimately, it was stated that the systems onboard Freedom were not reliable and that decommission was only a matter of time, which became another issue for the crew. With the long-term planners in the maintenance community aware of Freedom's decommission, operational priorities shifted and funding for major repairs became scare to the point that only one essential for underway tasking were conducted. As the reliability and material readiness of the ship grew, the operational tasking also increased accordingly. The ship was then selected to assist in Fourth Fleet's drug interdiction missions in the Southern Command area of operations for their final deployment prior to their official decommissioning, which was executed successfully.

With regard to my time onboard USS Fort Worth, the mission was to support developmental testing and evaluation for a new prototype for a tactical towed array sonar system. It was designed to be a part of the new ASW mission module for LCS. An augmented mine detachment along with team of civilian technicians were embarked to assist with all testing and operation of the equipment. USS Freedom, however, also had a mine detachment embarked but no mine equipment to operate defeating the support of the additional crewmembers. It was unique experience to work alongside industry while we

supported their testing efforts. Similar issues and challenges, like on Freedom, continued to prevent Fort Worth from executing their orders to support testing. Mechanical failures and multiple red line items degraded our abilities to go underway, adding more pressure on the Commanding Officer. As Fort Worth's Mission Liaison Officer at COMLCSRON 1, I worked alongside the Operations Officer and the Program Manager to schedule all testing and evaluation periods, PMAVs, CMAVs, and any additional tasking like Deck Landing Qualifications for the helicopter squadrons, underway certifications, drill exercises, or even Commanding Officer's discretionary underway training time. The constant challenge that we faced was the material readiness of the ship. Like Freedom, I was forced to constantly change the ship's schedule for maintenance availabilities in order to conduct essential repairs, which resulted in delayed testing for the program. Considerations to remove and install the equipment onto another LCS was discussed and discarded due to the time and cost associated with the move. Frustration grew for all parties involved and stress levels were sky rocketing. Unfortunately, I did not experience the completion of the developmental testing and transferred to a new command prior to, but my time in the LCS community was very enlightening and rewarding.

4. Inadequate Acquisition and Sustainment Strategies

The acquisition strategy, particularly the "block buy" approach, executed for the LCS program has been criticized by the GAO for its lack of thorough testing and evaluation before proceeding with full-scale production (GAO, 2021). This approach involved committing to the purchase multiple ships before the design was fully validated through rigorous testing and evaluation (CRS, 2022a). As a result, costly retrofits and modifications have been necessary to correct these design flaws and performance issues that were identified late in the acquisition process (DOD, 2020).

The reliance on contractor-based support for maintenance and logistics has also presented criticism for the increased cost and poor efficiency. The LCS construct has relied heavily on contractor support for both corrective and periodic maintenance repairs during the scheduled CMAVs and PMAVs, supply chain management, and logistics. This approach took the responsibility away from the sailors and entrusted it to contracted work,

which has led to concerns about the long-term sustainability and affordability of the support structure (O'Rourke, 2019). Although the sailors onboard were initially planned to be operators conducting minor maintenance checks, the ownership still fell onto ship's crew. The Navy has recognized the need to transition towards a more sustainable maintenance approach that involves greater involvement of Navy personnel onboard and reduces dependence on contractor support (USN, 2021). The shift from relying on contractor maintenance to more core crew involvement is already in motion. From personal experience, sailors know the importance of being about to conduct repairs internally vice an outside entity doing their job especially when the ship is underway. On one hand, the crew liked how it reduced the amount of work required of them, but on the other, there was no real accountability if the maintenance check was not done correctly. There has been several cases when ship's forces found discrepancies in the work conducted by contractors, especially one that involve lifesaving equipment. Therefore, crews are taking upon themselves to conduct or redo essential maintenance on specific equipment checks than placing their health and safety in the hands of contractors. Occasionally, some work requires outside entities due to the qualification and limited tools available onboard. These are all factors feed into the conclusion that the initial LCS sustainment plan was not suitable nor properly forecasted out to meet the maintenance requirements for the design results in the issues known today.

5. Efforts to Address Shortcomings

Over the years, the USN has taken several major leaps to address the deficiencies from the LCS shortfalls. More rigorous operational testing has been implemented to identify and resolve these issues related to the ships' performance, reliability, and maintainability (CRS, 2022b). This enhanced testing schedule aims to re-evaluate LCS's capabilities and ensure that the ships are able to assist the Navy in achieving its overall strategic goals (USN, 2021).

In 2021, the LCS program's acquisition strategy was restructured to allow for incremental testing and development (GAO, 2021). This approach enabled the Navy to incorporate lessons learned from earlier ship deliveries and make necessary modifications

before proceeding with subsequent production (CRS, 2022a). The restructured acquisition strategy aimed to mitigate risks and to ensure that LCS delivered the required capabilities and performance standards, from which it was designed for (DOD, 2020).

Enhanced training pipelines for LCS crews have proven quite beneficial due to the improvement in proficiency and readiness (Naval Technology, 2021). The Navy has recognized the importance of providing comprehensive training to the crews in order to ensure that they are efficient at operating and maintaining the ships (USN, 2021). Efforts have been made specifically to improve training curricula, to increase on the job training opportunities, and to provide more realistic simulation-based training enhancing crew competencies (CRS, 2022b). Some of the drawbacks to this new improved training pipeline is the time requirement. Many sailors have personally addressed their concerns to me regarding the year they spent training prior to be fully gained by the command, which means their time assigned to the ship does not officially begin. What they presumed to be four years onboard a LCS turns into five or more years all because of the new and improved training requirements, for example. Sailors also introduced the concern of how being a LCS sailor would impact their future in the USN and possibility of being "stove-piped" for only these particular platforms. The Navy has been addressing the sailors' concerns, and they are actively attacking this problem head on by reassuring that no sailor will be automatically resigned to a LCS only because of the previous experience.

The Navy has also focused their efforts on improving maintenance practices, supply chain management, and increasing Navy personnel involvement in sustainment activities. Initiatives have been implemented to streamline maintenance processes, improve spare parts availability, and to enhance logistics support (O'Rourke, 2019). The Navy strongly emphasized the need to build organic maintenance capabilities and reduce reliance on contractor support to improve the long-term sustainability and affordability of the LCS program (USN, 2021). As mentioned in the previous section, the transition has already begun. Core crew and augmented personnel are being directed to conduct more periodic maintenance checks compared to previous years. Depending on the warranties of the equipment, major repairs are still being executed by the expert technicians from the manufacturer to meet operational requirements, but ship's force is always alongside for

continuous learning and development from the company, like Lockheed Martin. A warship that is self-sufficient to conduct their own maintenance and repairs out at sea is a highly valuable strength of our Navy's capabilities to win wars. However, this transition is leading to a heavy burden on the sailors, impacting morale, mental stress, and productivity.

B. FURTHER DISCUSSION

The findings of this study highlight the complexities and risks involved in developing this innovative naval platform. LCS represented a significant departure from traditional naval ship designs that incorporated advanced technologies and flexible modular capabilities (CRS, 2022a). However, the challenges encountered during the development and deployment phases emphasized the difficulties in balancing innovation and practicality in naval procurement (USNI, 2022).

The LCS program serves as a cautionary tale about the importance of thorough testing and evaluation before making significant investment decisions (GAO, 2021). The "block buy" approach used in the acquisition strategy, which committed to the purchase of multiple ships before fully validating the design, led to costly retrofits and modifications (CRS, 2022b). This concluded the need for a more incremental and risk-based approach to naval procurement, where proper testing and evaluation are being conducted thoroughly before proceeding with full-scale production decision (DOD, 2020).

The Navy's efforts to adapt and address these discrepancies from the program demonstrate their commitment to improving the ships' capabilities and mitigating risks (Naval Technology, 2021). The implementation of more rigorous operational testing, restructuring of the acquisition strategy, enhancement of training programs, and improvements in maintenance practices and logistics support are positive steps towards addressing the identified challenges (USN, 2021). However, the effectiveness of these measures will need to be closely monitored and evaluated to ensure that they result in the desired outcomes (O'Rourke, 2019).

C. IMPLICATIONS

The limitations discovered from the LCS program have major strategic implications to the Navy's ability to effectively project power and maritime superiority in littoral regions and worldwide. LCS was envisioned to be a key platform for conducting multi-mission operations in near-shore environments. However, delays in the development and integration of mission modules, along with concerns about the ships' survivability in contested environments, have introduced the questions about the LCS's ability to fulfill its intended roles (USNI, 2022).

The constraints on flexibility and responsiveness due to its limitations have already impacted Navy's operational capabilities in littoral regions (GAO, 2021). The limited self-defense capabilities and the issues in deploying mission modules quickly and effectively hinder the Navy's ability to respond to emerging threats and adapt to changing operational requirements (Naval Technology, 2021). This creates a domino effect with critical implications to the Navy's overall force structure and its ability to maintain a strong presence in strategically important littoral regions (CRS, 2022b).

The financial concerns and opportunity costs associated with LCS are also weighty. The cost overruns and the need for costly alterations and modifications have drained on the Navy's budget (DOD, 2020). The resources allocated to the LCS program could have been redirected towards other major priorities or used to procure alternative platforms that may have been more effective in meeting the Navy's capability gaps (O'Rourke, 2019). As previously mentioned, the long-term sustainment costs of the LCS, including maintenance, logistics support, and personnel training, also present ongoing financial stress on the Navy.

My findings also revealed broader concerns for the Navy's acquisition practices and decision-making processes. More robust oversight, improved risk management, and greater accountability in naval procurement (CRS, 2022a) are reoccurring themes throughout this research. It is critical to ensure that acquisition decisions by our senior leaders both civil and military are based on sound analysis, realistic assessments of technological readiness levels, and a clear understanding of operational requirements (USNI, 2022). Transparency and effective, continuous communication with stakeholders,

including Congress, the warfighter, and the public, are essential to maintain trust and confidence in the Navy's acquisition processes (GAO, 2021).

D. RECOMMENDATIONS

1. Re-Evaluate the LCS's Role

Conducting a comprehensive strategic review of the LCS program, considering the evolving threat, landscape, and operational requirements, is crucial in the future of the platform. This review should involve a thorough assessment of the current and future capabilities, limitations, and potential contributions to the Navy's overall force structure (CRS, 2022b). Additionally, the desired end state should determine the optimal utilization of LCS to effectively support and align with the Navy's operational needs, strategic priorities, and overall strategic objectives while capitalizing on the ships' strengths and mitigating their weaknesses (USNI, 2022; GAO, 2021).

2. Enhance Acquisition and Sustainment Practices

Adopting rigorous acquisition strategy that prioritizes thorough testing and evaluation before committing to full-scale production is the bottom line up front. The Navy should implement a more incremental approach to any major defense acquisition program, where design validation and risk reduction are given adequate attention before proceeding with large-scale procurement (CRS, 2022a). This approach can help identify and address potential issues early in the acquisition process, reducing the likelihood of costly modifications later on (DOD, 2020).

Implementing a sustainable maintenance approach primarily focused on increased Navy personnel involvement is another critical aspect of improving acquisition and sustainment practices. The Navy must direct their efforts towards building organic maintenance capabilities and reducing the heavy reliance on contractor support. This can only be achieved through targeted investments in training, infrastructure, and logistics support to enable Navy personnel to perform maintenance and sustainment activities more effectively (O'Rourke, 2019). Additionally, the manning requirements for the core crews must change accordingly in order to effectively take on a large number of maintenance

checks once done by the contractors. By increasing sailor involvement, manning, the long-term sustainability and affordability of the LCS program can be improved (USN, 2021).

3. Invest in Technology and Training

Integrating advanced technologies into the LCS platform can enhance mission effectiveness and adaptability. The Navy should prioritize investments in technologies that can augment the LCS's capabilities, such as improved sensors, communication systems, and defensive measures (Naval Technology, 2021). These technological enhancements can help mitigate some of the ship's limitations and improve its ability to operate effectively in various operational scenarios (CRS, 2022b).

Prioritizing comprehensive training programs for the crews is fundamental to ensure proficiency and readiness in operating and maintaining the ships. The Navy must allocate a sufficient amount of resources to develop and implement robust training curricula that cover all aspects of LCS operations, to include mission module deployment, maintenance procedures, and emergency response (USN, 2021). Realistic simulation-based training, like the ones used for the Officer of the Deck (OOD) or Junior Officer of the Deck (JOOD) courses, and on-the-job experience should be emphasized to enhance crew competencies and prepare them for the complexities of operating LCS in contested environments (GAO, 2021).

4. Strengthen Oversight and Accountability

Implementing regular audits, requiring detailed status reports, and establishing clear performance metrics can enhance oversight and accountability in the future acquisition projects. The Navy has to establish a robust oversight framework that includes regular reviews of the program's progress, cost, and performance (CRS, 2022a). This oversight should involve independent assessments by external entities, such as the GAO or the DOD Inspector General (IG), to provide objective evaluations of the program's effectiveness and help identify areas for improvement (U.S. DOD, 2020).

Transparency should be a key priority in the oversight process. The program office responsible for developmental testing and evaluation (DT&E) must regularly communicate

the status of the LCS program to stakeholders, including Congress and the public, by providing accurate and timely information regarding the ships' capabilities, challenges, and progress (Naval Technology, 2021). Any issues or concerns identified through oversight process should be promptly addressed, and corrective actions should be taken to ensure that the program remains on track according to the schedule and is aligned with the Navy's objectives (O'Rourke, 2019).

5. Explore Alternative Solutions

Developing new ship designs that incorporate lessons learned from the LCS program can provide more effective solutions for the Navy's littoral warfare needs. The Navy should leverage the knowledge gained from LCS to inform the design and development of future platforms, like the upcoming Constellation-class frigates (USNI, 2022). This may involve exploring alternative hull forms, propulsion systems, and modular architectures that can enhance the ships' adaptability, survivability, and cost-effectiveness (CRS, 2022b).

Continuous collaborating with allies and coalition partners who have experience in littoral operations can offer valuable insights and expertise. The Navy should actively engage with other nations that have successfully developed and deployed littoral combat y capabilities for additional assistance. By sharing knowledge, best practices, and lessons learned, the USN can benefit from the collective experience of its allies and partners and identify potential solutions to the challenges faced by the LCS program (GAO, 2021).

Considering the acquisition of proven platforms from other sources may be a viable alternative to address the Navy's littoral warfare needs. The Navy have already explored the possibility of procuring existing platforms that have demonstrated success in littoral operations, either from other branches of the U.S. military or from foreign navies (U.S. DOD, 2020). This approach can potentially provide a more cost-effective and timely solution compared to developing entirely new platforms from scratch (CRS, 2022a).

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V. SUMMARY, CONCLUSION, AREAS FOR FURTHER RESEARCH

Chapter V provides a comprehensive summary and conclusion of my thesis on the LCS program, highlighting the key findings and implications of the research. The chapter begins with an overview of the program's goals and challenges, including its innovative modular design, operational issues, technical problems, cost overruns, and delays. It then breaks down the program's operational performance and readiness concerns, acquisition and sustainment strategy criticisms, and the Navy's efforts to address these shortcomings. The conclusion discusses the complexities of modern naval acquisition, the broader implications for the Navy's force structure and power projection, and offers recommendations for addressing the challenges and ensuring the program's effectiveness. Finally, the chapter identifies several areas for further research, such as comparative analysis of naval acquisition programs, the impact of modular design on naval operations, long-term strategic implications, technological innovations and future capabilities, and economic analysis of naval acquisition.

A. SUMMARY

The Littoral Combat Ship program, a cornerstone of the U.S. Navy's fleet modernization efforts, aimed to introduce a new class of surface vessels designed for speed, flexibility, and operations in challenging coastal environments. The program's innovative modular design intended to enable rapid adaptation to various mission requirements, from mine countermeasures to anti-submarine warfare, with interchangeable mission modules. Unfortunately, despite these ambitious goals, the program was forced to confront many significant challenges, to include operational scheduling issues, technical engineering failures, cost overruns, and delays, that sparked questions about the ship's ability to meet its planned strategic objectives and its impact on the Navy's overall operational readiness (ProPublica2023).

The LCS program's operational obstacles are multifaceted, encompassing both technical reliability issues and higher-than-anticipated operational costs. Both the Freedom

and Independence variants have experienced propulsion system failures, hull cracks, and corrosion issues, all leading to increased unexpected maintenance delays and operational expenses (Director, Operational Test and Evaluation [DOT&E], 2016). These problems have not only affected the ships' availability for deployment or any execution of orders, but also came to questions their longevity, sustainability and cost-effectiveness. Additionally, the LCS has continuously struggled to meet its initial design capabilities, with multiple delays in the development and integration of mission modules and limited self-defense capabilities, undermine its effectiveness as a versatile combat vessel (Robertson, 2023).

The program's acquisition and sustainment strategies have also been criticized across the industry. The high-risk "block buy" approach of committing to ship production prior to fully testing the design and capabilities along with an optimistic cost estimates and insufficient oversight only resulted in detrimental cost overruns and delays (GAO, 2022). Furthermore, the sustainment strategy's heavy reliance on contractor-based support has proven to be more costly and less effective than anticipated, impacting the ships' readiness and availability to the fleet commanders.

In response to these challenges, the Navy has already taken action on several initiatives to address the program's discrepancies, to include conducting operational testing to better understand the ships' capabilities and limitations, restructuring the acquisition strategy to allow for more incremental testing and development, and enhancing training programs for LCS crews (O'Rourke, 2019, DOT&E2010). The Navy has also worked to improve maintenance and sustainment practices, targeting the improvements to the ships' operational availability and reduce overall costs.

B. CONCLUSION

The LCS program's journey from conception to deployment highlights the inherent challenges of innovating naval capabilities needs within the complex framework of defense acquisition process. The operational difficulties and financial overruns experienced by the LCS fleet call the attention to the critical need for the alignment between strategic vision, technological feasibility and fiscal discipline. Although the program has faced criticism, it

also presented an opportunity for learning and adaptation. The Navy's efforts to address the LCS's shortcomings through operational testing, design modifications, and strategy adjustments demonstrate a commitment to refining the concept of modular, adaptable ships for future naval operations (Panter & Falcone, 2021). Ultimately, the LCS program's legacy may be defined not by its initial setbacks but by its contributions to evolving naval warfare and improving acquisition strategies.

As discussed previously, the challenges haunting LCS have broader implications for the Navy's ability to project power and maintain maritime superiority in littoral regions, which are increasingly contested areas by peer and near-peer adversaries. The program's difficulties also question the Navy's future force structure and its capacity to meet emerging threats head-on (USNI, 2014, 2022). Furthermore, the cost overruns throughout the entire program life cycle represent not only a significant financial burden but also a missed opportunity to allocate resources to other critical defense priorities, highlighting the importance of accurate cost estimation and fiscal discipline in defense procurement (GAO, 2016).

To address these problems and ensure the LCS effectiveness, several recommendations should be considered. First, a strategic re-assessment of the LCS's role within the Navy's fleet construct is essential, considering the evolving threat landscape and the ship's unique capabilities (Salisbury, 2021). Hopefully with the guidance and direction from Task Force LCS, the Navy can attack these issues and better incorporate these warships into combat operations. Second, the program office should adopt more rigorous acquisition practices, including thorough testing and evaluation before committing to large-scale production, and develop a more sustainable approach to maintenance and sustainment (USNI, 2023a). In order to avoid life repeating itself, this become a critical component for the next upcoming Constellation-class frigate. Third, investing in advanced technologies and comprehensive training programs can enhance the LCS's mission effectiveness and ensure that crews are fully prepared to exploit the ships' capabilities (Oversight Review, 2016). Fourth, enhanced oversight mechanisms, including regular audits and transparent reporting to Congress, throughout the entire acquisition life cycle are crucial for ensuring accountability and effective management of the program

(McLeary, 2022). Finally, the Navy should explore alternative platforms that can fulfill the LCS's intended missions more effectively and at a lower cost, potentially collaborating with international partners and leveraging commercial off-the-shelf technologies, which they have with the decision to move forward with a proven Italian design. (GAO, 2022, 2005).

By implementing these recommendations, the Navy can shift the tides to be in favor of correcting the issues facing the LCS program, ensuring that it provide substantial contributions to naval readiness and overall strategic objectives. The information we gathered from LCS will be able to influence future naval acquisition efforts, promoting a more agile, adaptable, and cost-effective fleet capable of meeting the complex challenges of the 21st-century maritime environment.

C. AREAS FOR FURTHER RESEARCH

Given the findings and implications of my LCS analysis, several areas for further research emerge:

1. Comparative Analysis of Naval Acquisition Programs

A study comparing the LCS program with other naval acquisition programs, both domestically and internationally, could provide insights into best practices and lessons learned in naval shipbuilding and procurement (USNI, 2023b). This research could potential extend to international comparisons, offering additional insights into how different nations approach the challenges of naval innovation and fleet modernization.

2. Impact of Modular Design on Naval Operations

Further investigation into the operational effectiveness and logistical implications of modular ship designs could provide valuable lessons for future naval platforms. This research could examine case studies of LCS deployments, evaluating the practical benefits and limitations of the modular concept in real-world scenarios.

3. Long-Term Strategic Implications

An in-depth exploration of how the LCS fits into the broader strategic plans of U.S. naval power projection, particularly in light of shifting geopolitical dynamics and emerging maritime threats, would be crucial. It could further assess the role of LCS in the Navy's distributed lethality construct and its potential contributions to maintaining maritime superiority in contested regions.

4. Technological Innovations and Future Capabilities

Investigating the potential for integrating advanced technologies, such as unmanned systems, cyber capabilities, and artificial intelligence, into LCS and other current and future platforms could offer a roadmap for enhancing its effectiveness in naval operations. However, a limiting factor would be the timeline that controlled by the government procurement office to incorporate innovative technologies into our fleet, which our adversaries do not have. In order to keep our competitive advantage, we need to invest in technologies that are innovative and could provide future potential capability gains. This research could explore how such innovations might address current limitations and expand the LCS's mission profile, along with other active platforms.

5. Economic Analysis of Naval Acquisition

A comprehensive economic analysis of the LCS program, from initial budget projections to actual life cycle costs, could provide critical insights into the economics of naval shipbuilding. This research could include a cost-benefit analysis of the modular design, an assessment of the program's impact on the defense industrial base, and recommendations for improving cost efficiency in future acquisitions.

By investigating further into these areas, researchers can contribute to a better understanding of the challenges and opportunities encountered throughout this program. Such analysis could also improve future naval strategy, acquisition policy, and the development of next-generation naval capabilities, ensuring that lessons learned from the LCS program pave the way for more effective and efficient naval forces in the 21st century.

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LIST OF REFERENCES

Arena, M. V., Leonard, R. S., Murray, S. E., & Younossi, O. (2006, July 12). *Historical cost growth of completed weapon system programs.* RAND Corporation. https://safe.menlosecurity.com/doc/docview/viewer/docN9109AEF30BD9b460d0727838e5f41ffd555266777fd57ced9f578d2a35d5c18430bff162056f

Department of Defense. (2018). *Systems Engineering Guide for Systems of Systems*

Department of Defense. (2020). *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2020*. Office of the Secretary of Defense. https://media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF

Department of Defense. (2022, December). *Littoral Combat Ship (LCS) Selected Acquisition Report (SAR)*. https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Selected_Acquisition_Reports/FY_2022_SARS/LCS_MM_SAR_DEC_2022_final.pdf

Director, Operational Test and Evaluation. (2010). *FY 2010 Annual Report.* https://www.dote.osd.mil/Portals/97/pub/reports/FY2010/navy/2010lcs.pdf?ver=2019-08-22-112820-177

Director, Operational Test and Evaluation. (2015). *FY 2015 Annual Report.* https://www.dote.osd.mil/Portals/97/pub/reports/FY2015/navy/2015lcs.pdf?ver=2019-08-22-105642-770

Director, Operational Test and Evaluation. (2016). *FY 2016 Annual Report.* https://www.dote.osd.mil/Portals/97/pub/reports/FY2016/navy/2016lcs.pdf?ver=2019-08-22-105304-133

Fuentes, G. (2023, November 8). *Navy Keeps Expanding Littoral Combat Ship Missions Even as Both Classes Shrink*. U.S. Naval Institute News. https://news.usni.org/2023/11/08/navy-keeps-expanding-littoral-combat-ship-missions-even-as-both-classes-shrink

Government Accountability Office. (2005, March 1). *Defense Acquisitions: Plans Need to Allow Enough Time to Demonstrate Capability of First Littoral Combat Ships* (GAO-05-255). Government Accountability Office. https://www.govinfo.gov/content/pkg/GAOREPORTS-GAO-05-255/html/GAOREPORTS-GAO-05-255.htm

Government Accountability Office. (2016, June). *Littoral Combat Ship: Need to Address Fundamental Weaknesses in LCS and Frigate Acquisition Strategies* (GAO- 16–356). Government Accountability Office. https://www.gao.gov/assets/gao-19-356.pdf

Government Accountability Office. (2020. March). *Navy Shipbuilding: Increasing Focus on Sustainment Early in the Acquisition Process Could Save Billions* (GAO-20-2). Government Accountability Office. https://www.gao.gov/assets/gao-20-2.pdf

Government Accountability Office. (2020, December 2). *Navy and Marine Corps: Rebuilding Ship, Submarine, and Aviation Readiness Will Require Time and Sustained Management Attention* (GAO-21-225T). Government Accountability Office. https://www.gao.gov/assets/gao-21-225t.pdf

Government Accountability Office. (2021, April). *Littoral Combat Ship: Unplanned Work on Ships and Design Changes Present Significant Risks to the Program* (GAO-21-172). Government Accountability Office. https://www.gao.gov/assets/gao-21-172.pdf

Government Accountability Office. (2022, February). *Littoral Combat Ship: Actions Needed to Improve Operating Cost Estimates and Mitigate Risks in Implementing New Concepts* (GAO-22-105387). Government Accountability Office. https://www.gao.gov/assets/gao-22-105387.pdf

Lagrone, S. (2013, August 21) *LCS mission packages: The basics.* U.S. Naval Institute News. https://news.usni.org/2013/08/21/lcs-mission-packages-the-basics

Lagrone, S. (2014, April 12). *Document: John McCain Speech on the Littoral Combat Ship Program.* U.S. Naval Institute News. https://news.usni.org/2014/04/10/document-john-mccain-speech-littoral-combat-ship-program

Lobner, P. (2016, December 18). *The Navy's troubled Littoral Combat Ship (LCS) program is delivering a costly, unreliable, marginal weapons system.* The Lyncean Group of San Diego. https://lynceans.org/all-posts/the-navys-troubled-littoral-combat-ship-lcs-program-is-delivering-a-costly-unreliable-marginal-weapons-system/

McLeary, P. (2022, July 15). *20 years later, the Navy says its littoral combat ships 'kind of' work.* Politico. https://www.politico.com/news/2022/07/15/20-years-later-the-navy-says-its-littoral-combat-ships-kind-of-work-00046137

Miles, J. A. (2012). *Management and organization theory.* Jossey-Bass.

Naval Technology. (2021). U.S. *Navy's Littoral Combat Ship: A Controversial Program*. https://www.naval-technology.com/features/us-navys-littoral-combat-ship-a-controversial-program/

O'Rourke, R. (2019, December 17). *Navy Littoral Combat Ship (LCS) Program: Background and Issues for Congress* (CRS Report No. RL33741). Congressional Research Service. https://crsreports.congress.gov/product/pdf/RL/RL33741

O'Rourke, R. (2024, March 1*). Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress* (CRS Report No. RL32665). Congressional Research Service. https://crsreports.congress.gov/product/pdf/RL/RL32665

Oversight Review of the U.S. Navy's Littoral Combat Ship (LCS) Program. Hearing before Committee on Armed Services Subcommittee on Oversight and Investigations. U.S. House of Representatives. (2016, December 8) https://docs.house.gov/meetings/AS/AS06/20161208/105447/HHRG-114-AS06-Wstate-ORourkeR-20161208.pdf

Panter, J. & Falcone, J. (2021, December 28). *The Unplanned Costs of an Unmanned Fleet.* War on the Rocks. https://warontherocks.com/2021/12/the-unplanned-costs-of-an-unmanned-fleet/

Reiher, D. (2020, January). *It is time to single-crew the LCS* (Vol. 146/1/1,403). U.S. Naval Institute Magazine. https://www.usni.org/magazines/proceedings/2020/january/it-time-single-crew-lcs

Robertson, Noah. (2023, October 4). *Can the U.S. Navy save money by accepting the LCS as a sunk cost?* Defense News. https://www.defensenews.com/naval/2023/10/04/can-the-us-navy-save-money-by-accepting-the-lcs-as-a-sunk-cost/

Salisbury, E. (2021, November 12). *Lessons from the Littoral Combat Ship.* War on the Rocks. https://warontherocks.com/2021/11/lessons-from-the-littoral-combat-ship

Sapien, Joaquin. (2023). *How the Navy Spent Billions on a Littoral Combat Ship That Doesn't Work*. ProPublica. https://www.propublica.org/article/how-navy-spent-billions-littoral-combat-ship

Shafritz, J. M., & Ott, J. S. (Eds.). (2001). *Classics of organization theory (5th ed*.). Harcourt College Publishers.

Shelbourne, M. (2022, May 13). *Navy's Cancellation of ASW Mission Package for Littoral Combat Ship Triggers Nunn-McCurdy Breach.* U.S. Naval Institute News. https://news.usni.org/2022/05/13/navys-cancellation-of-asw-mission-package-for-littoral-combat-ship-triggers-nunn-mccurdy-breach

Stancy, Diana. (2023, November 8). *Navy Changing LCS Maintenance and staffing practices.* Navy Times. http://www.navytimes.com/news/your-navy/2023/11/08/navy-changing-lcs-maintenance-and-manning-practices/

The Maritime Executive, (2021, April 11), *First-in-Class LCS USS Freedom Sees Success in Counter-Smuggling Role.* https://maritime-executive.com/article/first-in-class-lcs-uss-Freedom-sees-success-in-counter-smuggling-role

The Oversight, Acquisition, Testing, and Employment of the Littoral Combat Ship (LCS) and LCS Mission Module Programs. Hearing before the Committee on Armed Services United States Senate. 114th Congress, 2nd Session. (2016, December 1) https://www.govinfo.gov/content/pkg/CHRG-114shrg28323/html/CHRG-114shrg28323.htm

U.S. Naval Institute. (2022). *The Littoral Combat Ship: A Misunderstood Platform.* https://www.usni.org/magazines/proceedings/2022/april/littoral-combat-ship-misunderstood-platform

U.S. Navy. (n.d.). *Littoral Combat Ship Class – LCS.* https://www.surfpac.navy.mil/Ships/By-Class/Littoral-Combat-Ship-Class-LCS/

U.S. Navy. (2022a). *Littoral Combat Ship Class – LCS.* https://www.surfpac.navy.mil/Ships/By-Class/Littoral-Combat-Ship-Class-LCS/

U.S. Navy. (2022b). *Littoral Combat Ships – Mission Modules.* https://www.navy.mil/Resources/Fact-Files/Display-FactFiles/Article/2167494/littoral-combat-ships-mission-modules/

U.S. Navy. (2022c). *Program Executive Office Unmanned and Small Combatants.* https://www.navsea.navy.mil/Home/PEO-Unmanned-and-Small-Combatants/

U.S. Navy. (2023). *Littoral Combat Ship Class – LCS.* https://www.navy.mil/Resources/Fact-Files/Display-FactFiles/Article/2171607/littoral-combat-ship-class-lcs/

Van Atta, R., Kneece, R.R., Lippitz, M.J. (2016, September). *Assessment of Accelerated Acquisition of Defense Programs* (IDA Paper P-8161). Institute For Defense Analyses. https://apps.dtic.mil/sti/tr/pdf/AD1028525.pdf

Wills, S.T. (2023, December). *Confessions of a Former LCS Champion* (Vol. 149/12/1,450). U.S. Naval Institute Magazine. https://www.usni.org/magazines/proceedings/2023/december/confessions-former-lcs-champion

Work, R.O. (2014, January 1). *The Littoral Combat Ship: How We Got Here, and Why* (DTIC Report No. ADA594372). Defense Technical Information Center. https://apps.dtic.mil/sti/citations/ADA594372

Acquisition Research Program
Naval Postgraduate School
555 Dyer Road, Ingersoll Hall
Monterey, CA 93943

www.acquisitionresearch.net