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Distributed Maritime Logistics for Theater Undersea Warfare

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DISTRIBUTED MARITIME LOGISTICS FOR THEATER UNDERSEA WARFARE

EXECUTIVE SUMMARY

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Project Summary

Logistics has always been the means to victory or a primary factor in defeat. Logistics does not just *happen* but must be planned. A very close relationship exists between *what* is in the fight (the platform, weapon, technology, people) that generates needs and the ability to fulfill those needs. As we move from wars in the Middle East and start realizing the potential power and projection of peer competitors' national will, it becomes obvious that a shift in both force structure and means to support that force structure must change. Logistics are primary targets of adversaries, and thus the domain in which logistics activities occur is also a major consideration. In this research, we look specifically at the undersea domain. The undersea warfare environment is in a state of evolution towards unmanned and autonomous vehicles. Challenges to logistics are complex and include the development of how and when needs arise for different platforms doing myriad duties in undersea and seabed warfare. We are leaving the manned submarine component aside in this research to focus on this evolution. What the research seeks is an understanding of this new architecture in a framework like the *internet of things*. Thus, on one side is the complexity of the physical technologies in the water and on the other is the need to distinguish needs and support them in an optimized way, which is also related to the context of the conflict environment. This research is the continuation of a first year's effort seeking primary thinking and plans for distributed maritime operations (DMO) with undersea included. This year extends that effort to optimization of logistics in the oncoming new reality of undersea warfare. Deliverables include a technical report and possible solutions.

Keywords: *logistics, undersea logistics, seabed warfare logistics, autonomous undersea warfare, internet of things, distributed maritime operations, DMO*

Background

Transforming ways in which the navy will engage near-peer competitors in the grey zone and beyond has already begun. There is still work needed to obtain the right naval surface force structure, and that debate is ongoing. However, where there is little disagreement is in the oncoming future use of autonomous sensors. Many small things distributed widely versus a few big things that are visible and targetable is an obvious and practical choice. One dimension of warfare where this is becoming increasingly important is in the undersea domain. Undersea and seabed warfare have been under-appreciated in the past (excepting manned submarines) because the ocean is a very difficult environment in which to gather information and get that data where it needs to go. This research explores the logistics problem of support to the "many small things" in undersea and seabed warfare from which huge amounts of valuable data can be drawn.

How should shortcomings in the current logistics design change to reflect today's realities while enabling the fight forward? Lacking in these discussions is the most overlooked area of conflict in this new peer competitive environment—undersea warfare. Undersea warfare is largely defined by the physics of the environment and its ability to cover over a lot of devices that are unseen and unheard, with a lot of mission variety.

It is very difficult to have a one model approach to seabed and undersea warfare. Equipment is optimized for its role. Communications are very difficult, exposure on the surface can be a problem, and they are likely to continue along a path of pure autonomy with little human interaction (excepting human-in-the-loop for prioritizing needs). This research details the common categories for two undersea systems that might need logistical planning. For example, energy needs will be

different for an autonomous undersea vehicle looking for unique objects on the seafloor, than a wave-glider that is partially submerged and generates power from its wave action environment. Thus, a framework of vehicle type, mission and unique system needs on the *x* side of the matrix and the capabilities available to service needs on the *y*-axis produces a table in which we can put an "X" or an "O".

Nonetheless, this is only part of the story. Knowing the needs of these new devices must be meshed somehow with the availability of sustainment capabilities afloat and ashore. Moreover, there are mitigating circumstances for sustainment such as covertness, undersea or surface services, offload of data and uploading to a waiting subscriber, authorities that generate priorities supporting commander's intent, and more.

This is a complex mathematical problem, one that LCDR Stephen Cone characterizes as "capacitated team orienteering problem with time windows and synchronization" in his 2022 thesis. The thesis shows an optimization method to best route various medical evacuation assets in contested environments to casualties with various severities. Except in our case, we have different service vessels routing to various customers (sensors) with different needs and various time constraints.

As the second year of a two-year effort, this research will finalize "needs" vs. sustainment, with sustainment being divided into subsets of varying constraints as well. This problem will be considered in multiple scenarios using the mathematics of optimization. The result will be a much better idea of what is needed in the chief of naval operations' transformative vision.

Findings and Conclusions

Midway through the two-year problem we have identified different classes of undersea sensors and weapons that should be considered, as they are possible in the near term. Multiple concepts out to 2045 are not going to be included in this study. We advocate for the near terms as this will set a new evolutionary path for how to deal with a navy approach of "many things," versus that of a "few things." New ways of understanding the problem space are the primary objective of this research, and secondarily to re-focus on the intrinsic need to include undersea and seabed warfare in warfare at all phases. It is expected that as we clarify the current means for approaching this complex problem, it can be adapted further to include other systems of systems of the same logical type.

Recommendations for Further Research

Undoubtedly there will be follow-on research to advance and refine these optimization techniques and make them part of an artificial intelligence system that can build logistics and sustainment plans based on the current context and commander's intent. Eventually, the shore side of the problem would become less about planning and more about availability for what is needed. Logistics of the past simply will not work in our near-peer competitive and grey zone environment. At the same time, we push forward with autonomous systems that simply need to be provisioned for a logistics mission and then launched with its internal command and control already set.

References

Cone, S. (2022). *Casualty evacuation optimization in a conflicted environment* [Master's thesis, Naval Postgraduate School].

Acronyms

DMO distributed maritime operations
EABO expeditionary advanced base operations