The U.S. Navy Submarine Fleet: Construction and Maintenance Issues

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Introduction: The United States Navy has had a fleet of submarines since 1901, when it commissioned its first. The fleet quickly grew to ninety-one in 1919, just after the end of World War I. The fleet shrank to forty-nine by 1936, but swelled to 232 by the end of World War II in 1945. Through 1951, all U.S. Navy submarines were attack submarines (Naval History and Heritage Command, 2025). In 2025, the Navy had fifty-three attack submarines (Naval History and Heritage Command, 2025).

Starting in 1951, the U.S. Navy began adding a new kind of submarine, ballistic missile, to its fleet. Ballistic missile submarines are the sea-based leg of the so-called "Nuclear Triad" of deterrence (the other two legs being land-based Inter Continental Ballistic Missiles [ICMBs] and air-based heavy bombers). By 1967, the Navy's ballistic missile submarine fleet had reached forty-one vessels, a size it maintained until 1979. Since 2004, this fleet has had a constant size of fourteen vessels (Naval History and Heritage Command, 2025) because "the 1994 Nuclear Posture Review determined that the United States needed only 14 of its 18 SSBNs to meet the nation's strategic force needs. Therefore, starting in 2003, the Navy added a third type of submarine, the guided missile submarine. These were ballistic missile submarines converted in two ways: a larger armory of cruise missiles (about four times as many as an attack submarine) and "lockout chambers" (a type of airlock, used only underwater) to release and recover Special Operation Forces personnel while submerged (America's Navy, 2023a). The Navy currently maintains a fleet of four guided missile submarines (Naval History and Heritage Command, 2025).

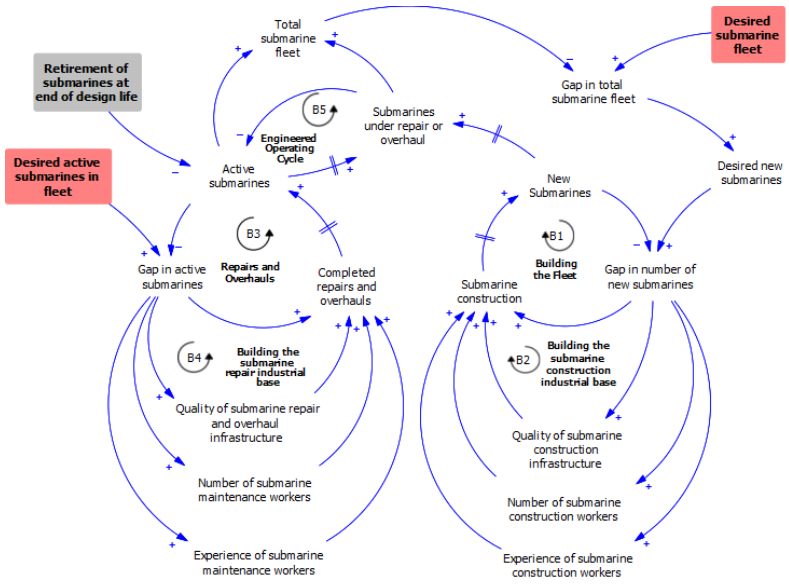
In 2025, the U.S. Navy's submarine fleet numbered 71 vessels: 53 attack submarines, 14 ballistic missile submarines, and 4 guided missile submarines. All seventy-one vessels are nuclear powered (Nuclear Threat Initiative, 2024). The Navy's first nuclear submarine, the USS Nautilus, joined the fleet in 1954 (Naval History and Heritage Command, 2026). Since 1959, only nuclear-powered submarines have been built, and since 1990 the entire fleet has been exclusively nuclear powered (Suciu, 2023).

Construction Issues: In the United States, two private companies perform all submarine construction: General Dynamics's Electric Boat (Groton, Connecticut) and Huntington Ingalls Industries' Newport News Shipbuilding (Newport News, Virginia) (Weisgerber, 2026). The U.S. Navy has a goal of producing two attack submarines and one ballistic missile submarine per year by 2028, with sustained production at that level for the foreseeable future (Taylor, 2025). However, many observers have noted that the two shipyards have lagged far behind that level of production. The newest ballistic missile submarine was, as of late 2025, twelve to eighteen months behind schedule (Taylor, 2025). The Department of the Navy announced in 2024 that it would procure one attack submarine in its 2025 budget, half the number of the objective (Hendrix, 2024). Submarine production pressure is exacerbated by the AUKUS agreement, in which the United States has agreed to sell three nuclear powered attack submarines to the Australian navy sometime in the 2030s

while Australia develops its own attack submarines, with the possibility of selling a maximum of two more if Australian submarine development lags (Australian Submarine Agency, 2024).

Observers point to a depleted "industrial base" as the major impediment to building more submarines in a timely way. This depletion is a combination of constrained capacity at Electric Boat and Newport News Shipbuilding shipyards and, perhaps more importantly, a reduction in the number and experience level of the workforce (Hendrix, 2024; United States Government Accountability Office, 2025).

Maintenance and Overhaul Issues: Because of the structural and mechanical stress of operating at sea, and to ensure that they achieve their design life, submarines need repairs approximately every four to six years (United States Government Accountability Office, 2020). For various reasons, the Navy has missed most of its repair time goals in recent years (Hendrix, 2024; Taylor, 2025). Its four maintenance shipyards have insufficient physical capacity (ten drydocks when at least fifteen are needed to meet maintenance time goals) and worker capacity needed to achieve the repair and overhaul time goals listed earlier (Buckby, 2026; Hendrix, 2024; Latham, 2025). The four public shipyards employ a total of 43,500 workers, although three of the yards (Norfolk, Puget Sound, and Pearl Harbor) dedicate roughly half their workers to ships other than submarines, such as aircraft carriers and surface combatants; consequently, their workforce dedicated to submarine repair is roughly 25,000. An obvious side effect of these maintenance and overhaul delays is that the Navy's fleet of *active* submarines is significantly lower than the *overall size* of its submarine fleet. This obviously creates a national security threat (Buckby, 2026; Hendrix, 2024; Latham, 2025; MacDonald, 2025).



Dynamic Hypothesis: The figure above shows a dynamic hypothesis of the United States Navy submarine fleet and its industrial base. Please note: the structure of this dynamic hypothesis holds for each of the three types—attack, ballistic missile, and guided missile—submarine. The variable shaded in gray in Figure 2 captures how submarines have a limited "design life." This varies by type of submarine, but all submarines have a finite lifespan. The rigors of operating at sea will eventually wear out even the best-designed and best-maintained submarine.

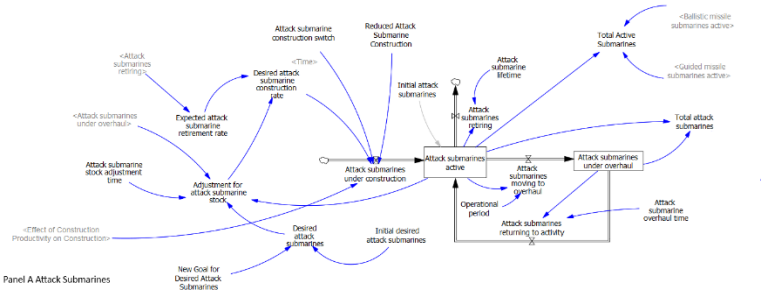
The variables in red shading in Figure 2 show the two key policy choices made by the Navy's civilian and military policymakers:

- The desired overall size of the submarine fleet.
- The desired number of *active* submarines in the fleet.

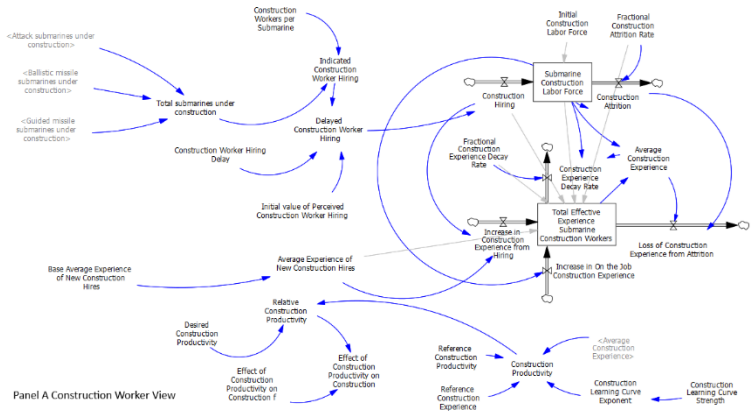
Since 1950, which is the scope of the present paper, these two policy decisions, particularly the first one, have driven the overall size of the fleet and its number of active submarines.

Stock and Flow Model: The figure below shows the systemic structure for construction and overhaul of attack submarines (the other two types of submarines have the same structure); the structure acts as follows:

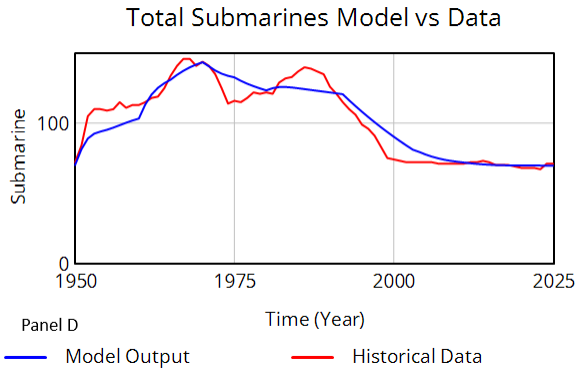
1. Policymakers decide to increase or decrease the size of the fleet for a type of submarine.
2. Construction increases the stock of a type of active submarine. Retirement reduces the stock of a type of active submarine.
3. Sending a type of submarine to overhaul or maintenance also reduces its stock of active submarines. Completing the overhaul or maintenance increases that stock of active submarine.
4. Construction and overhaul of submarines are affected by the size and quality (in terms of experience) of their respective workforces.



The figure below shows the structure for the construction labor force view of the stock and flow model (the structure for the maintenance workforce is similar). Changes in the desired number of submarines trigger hiring (for increases) or increased attrition (for decreases). In a co-flow structure, changes in hiring and attrition produce changes in the average experience of the workforce.



The figure below shows how the model's output compares to data for the total number of submarines. The comparisons between model output and historical data are not perfect, but they are plausibly close.



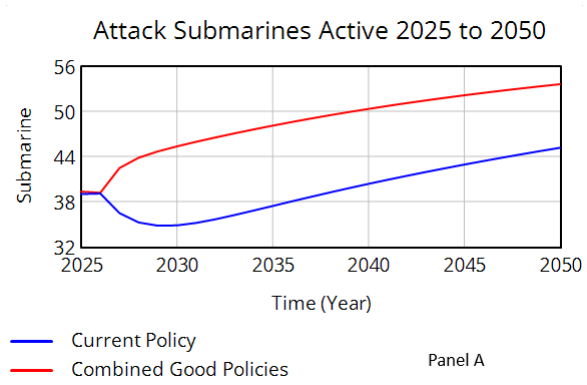
Policy Experiments and Recommendations: The author ran several policy experiments. From them, we can discern a mix of worthwhile policies:

- Continuing the current production policy that leads to three attack submarines manufactured per year by 2050
- Overhaul time of one year for attack subs
- Overhaul time of sixteen months for the new ballistic missile submarines
- Maintaining the current realistic worker attrition rates of no more than ten percent
- Hiring pulses of 10,000 for construction and 4,200 for overhaul workers each year over the next twenty-five years
- Better workforce training

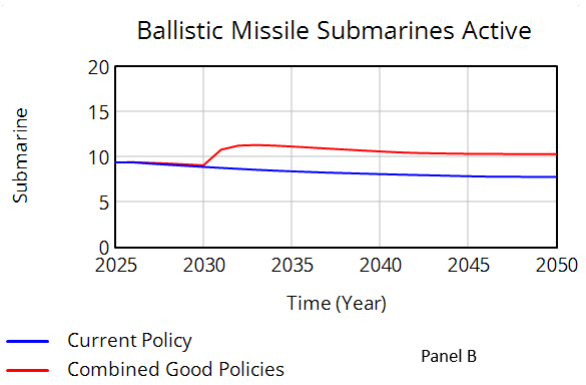
The figure on the next page shows the results of a simulated run containing all six of these worthwhile policies. The resulting best combination of policies seems to be as follows:

- Continuing, and achieving, the current production policy that leads to three attack submarines manufactured per year by 2050
- Achieving an overhaul time of one year for attack subs
- Achieving an overhaul time of sixteen months for the new ballistic missile submarines
- Maintaining the current realistic worker attrition rates of no more than ten percent
- Hiring pulses of 10,000 for construction and 4,200 for overhaul workers each year over the next twenty-five years, even though this might dilute the experience level of the workforces
- Better workforce training, to offset the dilution of experience level.

The Navy appears to be trying to do things very similar to these recommendations. The way is clear for them, but the implementation, as always, will be challenging.



Panel A



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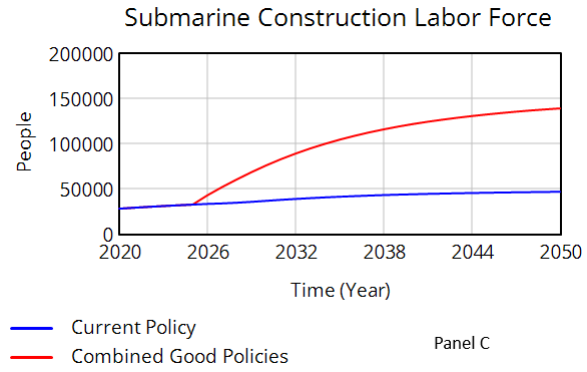

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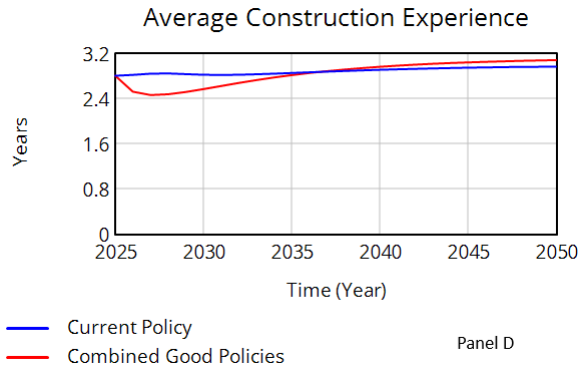

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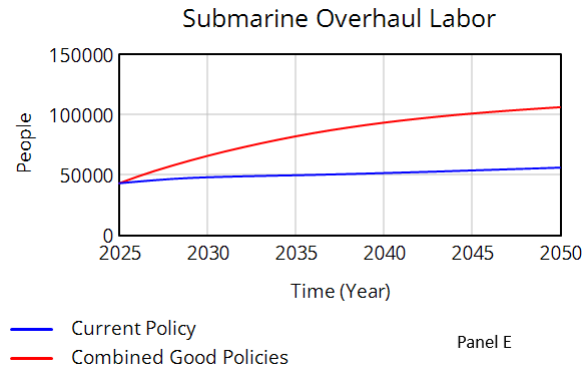

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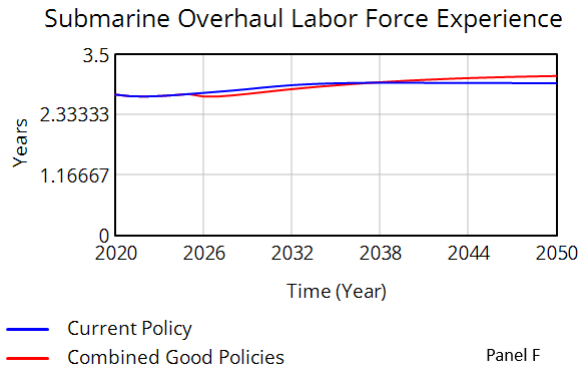

Panel F

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