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Increasing Aircraft Carrier Forward Presence

Changing the Length of the Maintenance Cycle

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Summary

The U.S. Navy currently maintains a fleet of 11 aircraft carriers. These ships, which are among the most powerful and versatile elements of U.S. naval forces, allow the Navy to undertake a wide range of tasks. They are also among the most complex weapon systems operated by the Navy. The carriers themselves need continuous and regularly scheduled maintenance. Their crews require a great deal of training to attain and sustain readiness levels. The *length* of the training, readiness, deployment, and maintenance cycle (defined as the period from the end of one depot maintenance period to the end of the next), the *type* of maintenance needed (i.e., docking or non-docking), and the *timing of events* within the cycle affect the carrier's availability to meet operational needs.

The length of the cycle for aircraft carriers has changed several times in the last two decades. Currently, the Navy uses a 32-month cycle. This cycle has increased a carrier's ability to provide additional forward presence as requested by theater commanders (this additional presence is called "surge"). However, the combination of a 32-month cycle length with the personnel tempo policy limit of one 6-month deployment per cycle has reduced the proportion of time that a carrier is deployed. The reduction in the percentage of time that each carrier is deployed, coupled with the decrease in the number of carriers in the fleet, makes it difficult for operational planners to meet the forward-presence requirements of theater commanders.

Recognizing the challenge, the Navy asked RAND to assess the implications of different cycle lengths and their effect on the forward

presence of *Nimitz*-class aircraft carriers. We assume a deployment length of six months and, in accordance with personnel policies in place under the 32-month cycle, also assume that the time between deployments will equal twice the length of the previous deployment. We assess several one-deployment cycles as well as potential two-deployment options. We also analyze the impact of different cycles on managing shipyard workloads.

Cycles and Operational Availability

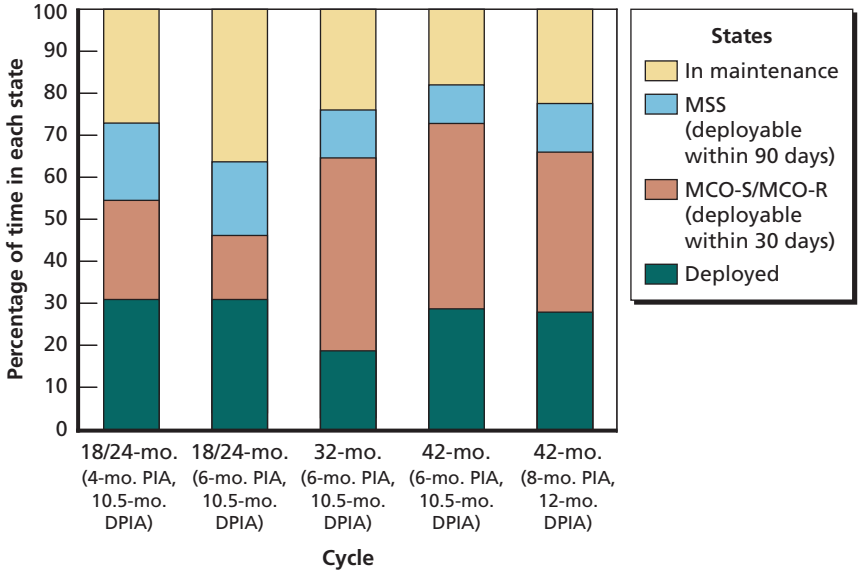
Given a fixed number of months for scheduled maintenance, deployments, and the time between deployments, Navy planners face a three-sided tradeoff in setting a carrier's cycle length. They must balance the goals of

- deploying carriers and generating forward presence
- holding carriers in reserve and keeping them surge-ready to meet emerging needs
- maintaining the materiel condition of the ships.

This is a zero-sum tradeoff in which improving one goal can adversely affect the others. Under the current 32-month, one-deployment cycle, for example, a carrier is deployed 19 percent of the time, at Major Combat Operations–Surge (MCO-S)/Major Combat Operations–Ready (MCO-R) status (i.e., able to deploy within 30 days) 46 percent of the time, at Maritime Security Surge (MSS) status (i.e., able to deploy within 90 days) 11 percent of the time, and in depot maintenance 24 percent of the time. This is depicted in the third column of Figure S.1. This carrier thus contributes to the "6+1" fleet response plan goal by being available to serve as one of the six ships 65 percent of the time and as the seventh ship 11 percent of the time.[1]

[1] This goal is to have at least six carriers deployed (or able to deploy) within 30 days, and a seventh carrier deployed (or able to deploy) within 90 days.

Figure S.1
The Impact of Different Maintenance Cycles on the Operational Availability of a Notional Carrier



NOTE: PIA = planned incremental availability. DPIA = docking planned incremental availability.

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Reducing the cycle length to 18 months increases deployment to 31 percent of the time but decreases MSS or higher readiness to 33 percent. It also increases the time in scheduled maintenance to 36 percent of a carrier's life. This is depicted in the second column of Figure S.1.

Lengthening the cycle to 42 months and adding a second deployment in the cycle results in a carrier being deployed 29 percent of the time and at MSS or higher readiness an additional 53 percent of the time. This is depicted in the fourth column of Figure S.1. This would allow the fleet to meet the 6+1 fleet goal 100 percent of the time.

Reducing the length of PIAs for depot maintenance repair from six to four months—as may be possible under a cycle featuring 18 months between PIAs (i.e., in an 18/24-month cycle)—increases the proportion of time a ship is able to surge. This is shown in the first column of Figure S.1. Alternatively, extending the length of PIAs—as may be

required under a 42-month cycle—reduces the amount of time a ship is able to surge. The fifth column of Figure S.1 shows a 42-month cycle with an 8-month depot maintenance period. Extending the maintenance period beyond a 6-month duration increases training time and decreases the amount of time a carrier is able to surge.

Cycles and Shipyard Workload

We also assessed the technical feasibility of maintenance cycles shorter or longer than the current 32-month cycle. Prior to the current 32-month cycle, *Nimitz*-class carriers operated on 24–27 month cycles. This suggests that shorter cycles, by offering more frequent opportunities to accomplish depot work, are technically feasible. Shorter cycles may also help level-load work at the shipyards, with more frequent depot visits resulting in smaller work packages.

Norfolk Naval Shipyard and Puget Sound Naval Shipyard are the two public shipyards that perform depot-level maintenance for aircraft carriers during availabilities. These shipyards can efficiently execute approximately 30,000 man-days per month during a typical availability in the 32-month, one-deployment cycle. We assume that the PIAs for the 18/24-month, one-deployment cycle would range from 15,000–25,000 man-days per month. As such, they could, perhaps, be accomplished within four months, as suggested above.

Extending the maintenance cycle beyond the current 32 months raises several questions of feasibility. Certain maintenance tasks must be performed at specified times to ensure that a carrier reaches its operational life of approximately 50 years. Some of these tasks could perhaps be performed earlier or later than currently planned; engineering studies, such as those conducted when the cycle was extended from 27 to 32 months, would be required should the Navy consider extending the cycle beyond 32 months. Some of the longer, two-deployment cycles could require that up to 375,000 man-days of work be accomplished within a 6-month availability—this amount of work is more than twice what Navy depots could be expected to accomplish in that

period of time. This could require extension of the PIA beyond the nominal six months, as noted above.

Longer cycles with large work packages lead to larger peaks and deeper valleys in the carrier workload at a shipyard. These peaks and valleys make it difficult to efficiently manage the depot workforce and can lead to higher workforce costs. The longer, two-deployment cycles could result in long periods (of several months to more than a year) when there are no carriers at a shipyard for depot maintenance. These gaps could lead to a loss of learning or currency in maintenance tasks that are performed infrequently. This loss of learning could increase the size of the work packages and lead to higher costs.

Stretching depot availabilities beyond their notional lengths to handle larger workloads could help level-load the shipyard, but would also require more training (or retraining) for the ship's crew after maintenance. Extended maintenance and training would reduce the time a ship is at MCO-S or higher readiness, thereby negating a chief advantage of the longer, two-deployment cycles.

Findings and Recommendations

On balance, our analysis suggests that shortening the one-deployment cycle will increase the forward presence of the carrier fleet but reduce its ability to meet the 6+1 fleet goal. Table S.1 summarizes the advantages and disadvantages of each notional cycle examined above.

Shorter cycles may help level workloads at the shipyards. While longer, two-deployment cycles may increase forward presence while sustaining higher levels of readiness for longer periods of time, they could complicate workforce management at public shipyards. The Navy's 30-day continuous maintenance availabilities between deployments may not provide the deep maintenance needed between deployments, and a backlog of deferred work is likely to develop. Even if the carrier depot workload were to remain unchanged in the two-deployment cycle, fewer opportunities for depot maintenance would lead to larger work packages. Our workload estimates suggest that the PIA, docking planned incremental availability, and carrier incremental availability

Table S.1
The Effects of Cycles Shorter or Longer Than the Baseline 32-Month Maintenance Cycle

Metrics	Shorter Cycle (e.g., 18/24-mo., one-deployment)	Longer Cycle (e.g., 42-mo., two-deployment)
Time a carrier is deployed	Increased	Increased, if maintenance workload can be managed
Surge readiness (deployable within 30–90 days)	Decreased	Increased
Ability to meet 6+1 fleet goal	Decreased	Increased
Ability to level-load work across time at shipyards	Increased	Decreased
Maintenance demands	More frequent	May create deferred-work backlogs

work packages could grow to the point where they could not be executed in the time we assumed. The Navy could perform engineering studies to examine the impact of increased maintenance demands in two-deployment cycles.

The Navy has adjusted personnel tempo policies to better provide carriers where and when needed. Current plans to meet demands for aircraft carrier presence include extending deployment lengths, reducing turnaround times, and, in some cases, including two deployments per cycle. Deployments may be longer or shorter than six months and carriers may redeploy more quickly. Increased operational tempo may adversely affect the Navy's ability to meet the maintenance demands of the carriers and retain and recruit personnel. Our analysis offers options for increasing carrier forward presence while keeping previous personnel tempo policies intact.