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Cost Implications of Sea Swap

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Summary

- Cost implications of Sea Swap differ, depending on the type of program: sunset or sunrise
- There would be significant cost savings or cost avoidance from Sea Swap implementation for both types*
  - Sunset program example (DDG–51): $1.4 billion one-time and $700 million annual savings
  - Sunrise program example (LCS): $14 billion one-time** and $500 million annual cost avoidance
- These savings or cost avoidances are based on these assumptions:
  - Forward presence is requirements-driven and hence fixed
  - Hull usage increases under Sea Swap, whereas crew operating tempo stays the same; the result is fewer hulls and crews for the same amount of presence

* Relative to the program of record, the figures are rough order-of-magnitude estimates. 2

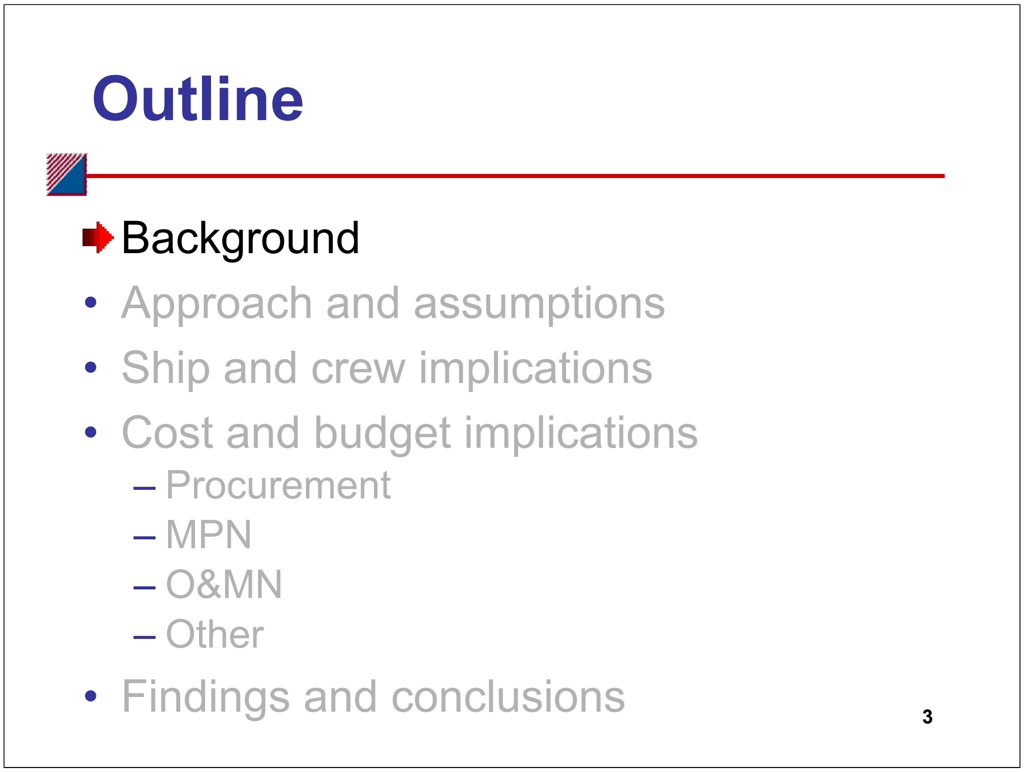
** This figure includes costs of both the LCS hull and the modules.

The Navy conducted an experiment to test a concept—called Sea Swap—that involves the rotation of crews on surface combatants. As part of that experiment, the Navy assessed cost savings; however, that assessment was preliminary, partial, and specific to the experiment.

This study examined the broad cost implications of Sea Swap. We recognized that the cost implications of Sea Swap would differ, depending on whether the program was mature (sunset) or new (sunrise). Although we focused more on the framework for assessing costs than on estimating the exact costs, we did develop some estimates based on sample cases. We found that significant cost savings or cost avoidance would result from implementing Sea Swap for both sunset and sunrise programs: a one-time savings of about $1.4 billion and $700 million in annual savings for a sunset program (DDG–51), and a one-time cost avoidance of roughly $14 billion and $500 million in annual cost avoidance for a sunrise program (Littoral Combat Ship (LCS)). The LCS figures include costs of both the hull and the modules. Because the program of record (POR) for the LCS assumes Sea Swap and hence fewer ships than otherwise, the "savings" are from avoiding costs that the Navy could have incurred under traditional crewing.

The savings would depend on underlying assumptions. For our purpose, we assumed that:

- Forward presence was requirements-driven and hence fixed.
- Hull usage would increase under Sea Swap, whereas crew operating tempo would stay the same; these would result in fewer hulls and crews for the same presence.



We will start by briefly discussing the background of the study and the Sea Swap experiment. We will then describe our approach and list the assumptions we used in our analysis. The analysis section begins with the computation of the number of hulls and crews that would be needed under both the traditional crewing approach and the Sea Swap approach. Cost analysis, by major budget categories, follows. We will wrap up with our findings and conclusions.

Sea Swap Cost Task

- OPNAV N8B asked CNA to examine the full costs of certain Navy initiatives and programs, including Sea Swap
- This report documents our analysis and findings for the Sea Swap costs
- Task: Analyze the cost implications of Sea Swap
  - Analyze all relevant costs, direct and indirect, that might arise from the Sea Swap implementation.
  - Our task would provide the framework for assessing the costs of different rotational crewing options

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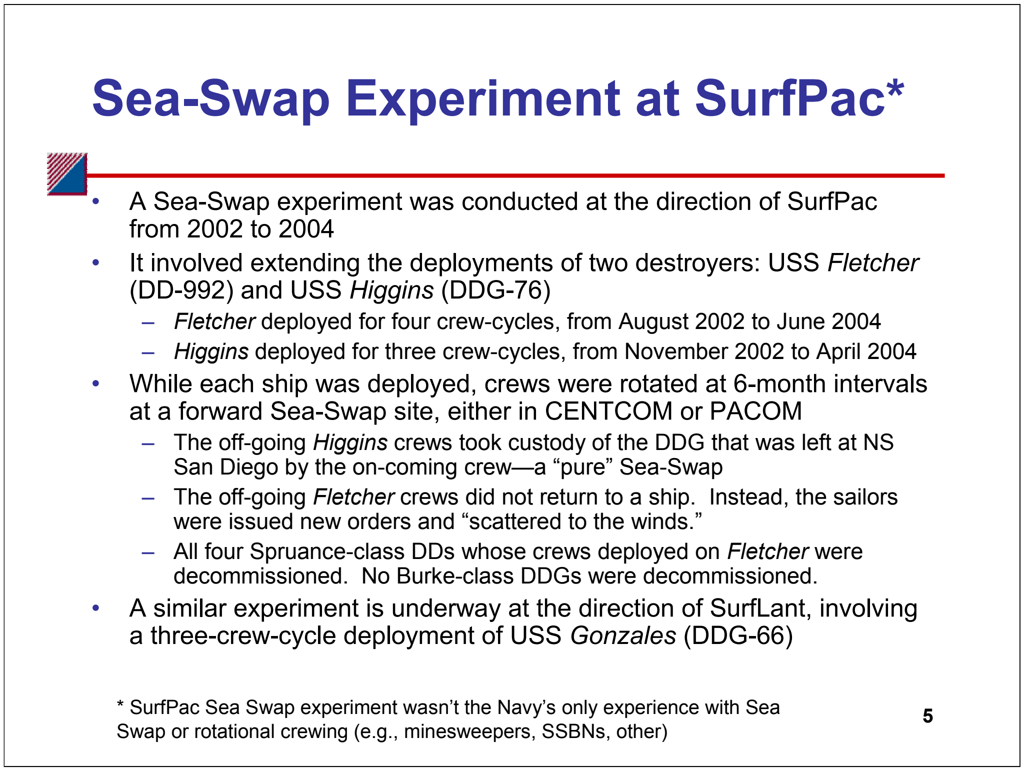
The Assistant Deputy Chief of Naval Operations (Resources, Requirements, and Assessment) asked us to examine the full costs of Navy initiatives and programs that could result in savings needed for recapitalization. One of those initiatives was Sea Swap. Specifically, we were asked to analyze Sea Swap in terms of its full cost implication.

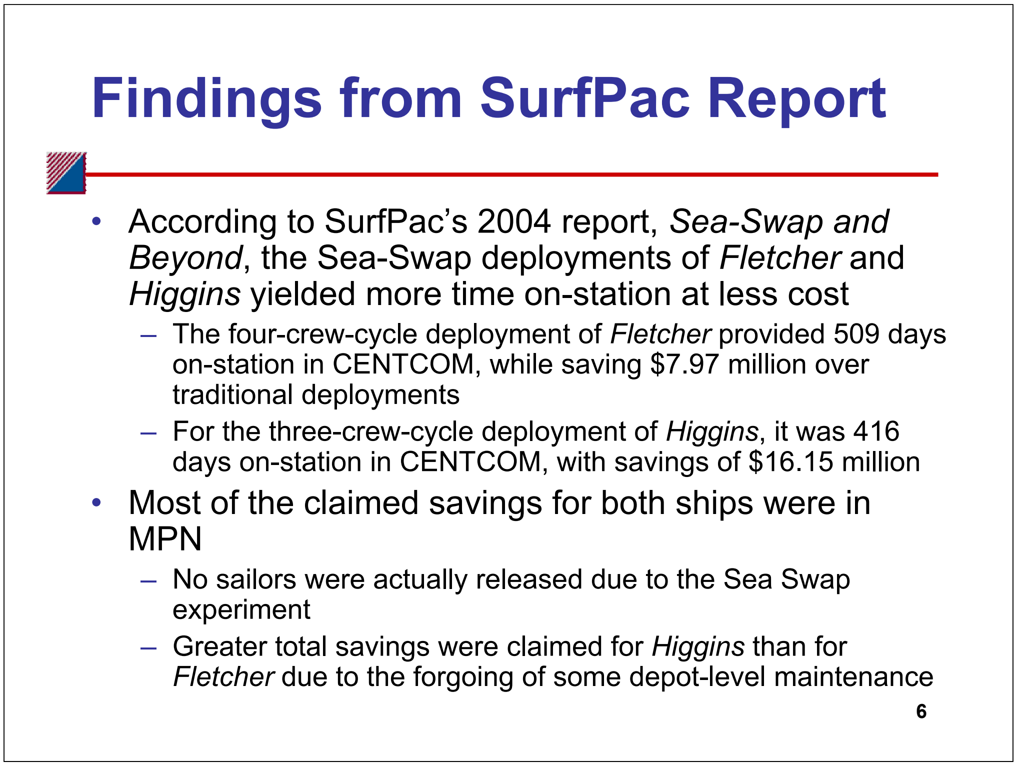
This report documents our analysis and findings for the full cost implications of Sea Swap.



After years of discussing the wisdom of using rotating crews on surface combatants, the Navy conducted an experiment—called Sea Swap—to test the concept. The experiment, which lasted from 2002 to 2004, was conducted under the supervision of Commander, Naval Surface Force, U.S. Pacific Fleet (SurfPac). It involved extending the deployments of two surface combatants from the Pacific Fleet: the Spruance-class destroyer, USS *Fletcher* (DD-992), and the Burke-class destroyer, USS *Higgins*. *Fletcher* deployed from August 2, 2002 to June 5, 2004—for four 6-month crew-cycles. Crews were swapped three times between *Fletcher* and other Spruance-class destroyers from the Pacific Fleet. *Higgins* deployed from November 2, 2002 to April 4, 2004—for three crew-cycles. Twice, crews were swapped between *Higgins* and other Pacific Fleet Burke-class destroyers. Five Sea-Swap turnovers were conducted in all. Four of the five turnovers were held in the Pacific Command (PACOM), and one took place in the Central Command (CENTCOM).

As an added twist, the Sea-Swap deployment of *Fletcher* took place within the context of the decommissioning of the Navy’s Spruance-class destroyer fleet. The four crews that deployed on *Fletcher* decommissioned four Spruance-class destroyers. Due to the decommissionings, the off-going *Fletcher* crews did not return to a ship. Instead, the crewmembers were issued orders to report to new duty stations.

No decommissionings were held in connection with the Sea-Swap deployment of *Higgins*. Crews returned from *Higgins* to take custody of another Burke-class destroyer. As such, the *Higgins* deployment could be said to be a purer test of the Sea-Swap concept.

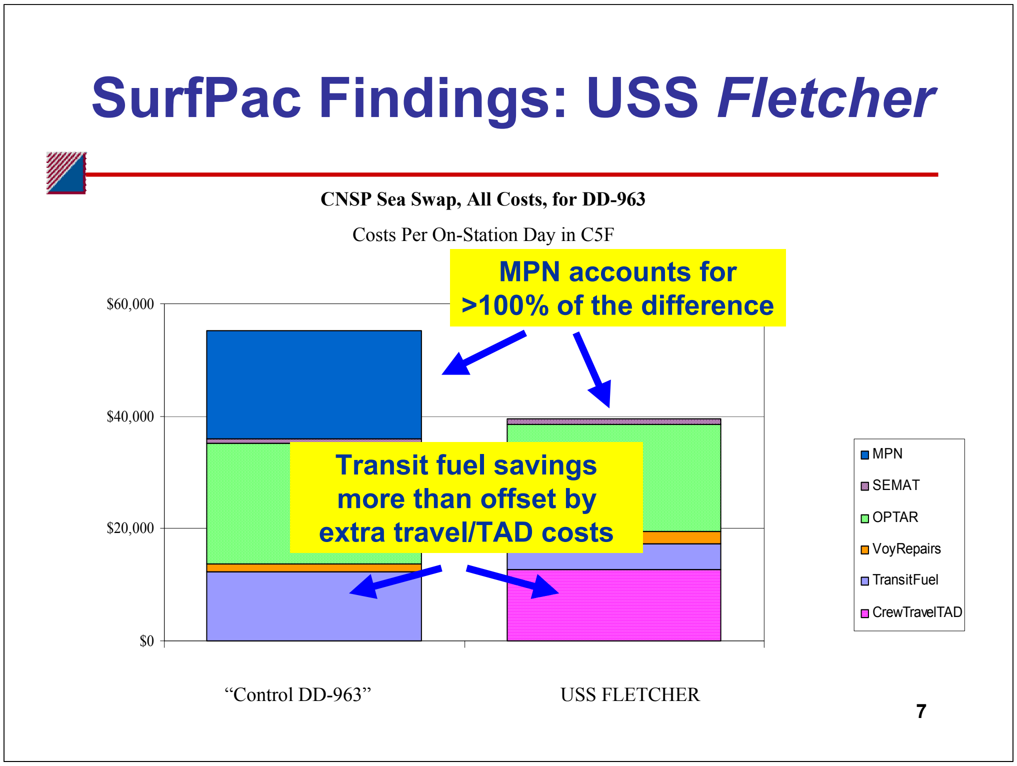


SurfPac issued its own assessment of its Sea-Swap experiment in its report, *Sea-Swap and Beyond*. The report was issued in June 2004. It concluded that the Sea-Swap deployments of *Fletcher* and *Higgins* yielded more time on-station in CENTCOM, and at less cost than traditional deployments.

The Sea-Swap deployment of *Fletcher* was credited with producing 509 days on-station in CENTCOM and a savings of $7.97 million. For *Higgins*, it was 416 days on-station in CENTCOM with a savings of $16.15 million. In all, the Sea-Swap deployments of the two ships were given credit for generating 925 days on-station in CENTCOM and yielding savings of nearly $25 million.

SurfPac's on-station-day findings agreed with those of the Center for Naval Analyses (CNA) in its September 2004 report to SurfPac. CNA's report did not include an estimate of savings. Most of the savings cited by SurfPac were in the Military Personnel, Navy (MPN) account. The remaining savings were split between the categories of transit fuel, depot-level maintenance, and operational target (OPTAR).

The MPN savings claimed in the SurfPac reports may be optimistic. For those savings to have been realized, sailors would have to have been released from the Navy. Yet, none were. The returning *Higgins* crews took custody of another ship, and the returning *Fletcher* crews were issued new orders. No sailors were released from active-duty due to Sea-Swap. SurfPac credited the Navy with savings from the extra on-station presence that was generated, holding that the Navy could get by with fewer ships and crews. Those savings would more accurately be described as potential, not actual, savings.



The SurfPac report, *Sea-Swap and Beyond*, estimated the savings from the Sea-Swap deployment of *Fletcher*. Those estimates are reproduced above.

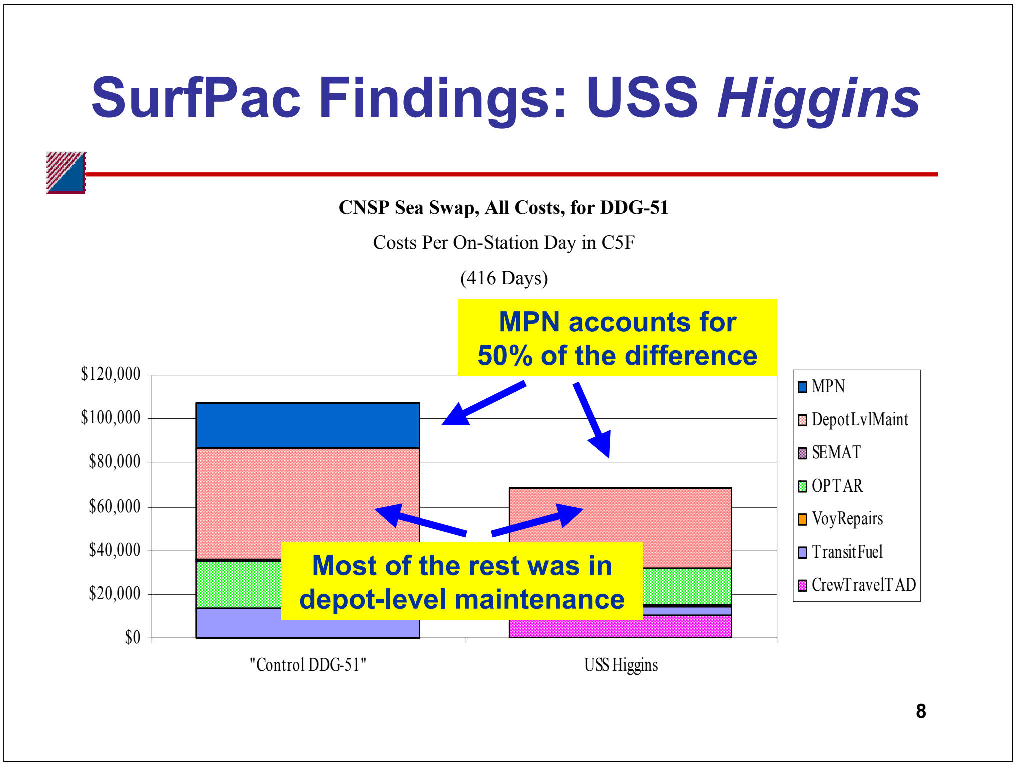
The Sea-Swap deployment of *Fletcher* was compared to a traditional 6-month deployment of a Spruance-class destroyer. Costs for each were normalized in terms of days on-station in CENTCOM. *Fletcher* spent 509 days on-station in CENTCOM during the ship's Sea-Swap deployment; by comparison, a notional 6-month deployment would provide 100 days of CENTCOM presence.

Relative to a traditional deployment, the Sea-Swap deployment of *Fletcher* was credited with yielding savings of roughly $16,000 per day on-station in CENTCOM. Over 100 percent of the savings were in the MPN accounts. The MPN accounts were credited with savings of nearly $20,000 per on-station day. It's questionable whether those savings were realized.

Savings were also credited for the category of transit fuel. Those savings stemmed from the three sets of US-CENTCOM transits that didn't happen because of *Fletcher*'s extended, four-crew-cycle deployment.

Offsetting the savings from Sea-Swap were additional costs in fuel, travel, and temporary additional duty (TAD). Those extra costs exceeded the transit fuel savings.

SurfPac provided an estimate of savings from depot-level maintenance for *Higgins*, but not for *Fletcher*. The rationale was that such a comparison wasn't practical due to the decommissioning of *Fletcher* and the three other Spruance-class destroyers that provided crews for *Fletcher*.



Also provided by SurfPac in its report were estimates of the savings from the Sea-Swap deployment of *Higgins*. Those estimates are reproduced above.

As for *Fletcher*, costs for *Higgins* were expressed in terms of on-station days in CENTCOM and compared with a standard 6-month deployment. *Higgins* provided 416 days of presence in CENTCOM during the ship's Sea-Swap deployment, compared with 100 days for a notional 6-month deployment of a Burke-class destroyer.

SurfPac credited *Higgins* with yielding roughly $40,000 in savings per day on-station, relative to a standard deployment. The MPN accounts accounted for half the savings—about $20,000 per day. As was the case with the *Fletcher* savings, those savings assume that Navy personnel end strength was reduced as a consequence of the additional presence provided by *Higgins*'s Sea-Swap deployment. It's questionable whether those savings were ever realized.

The remaining savings were in depot-level maintenance. SurfPac credited savings from the depot-level maintenance that wasn't performed on the two Burke-class destroyers—USS *Benfold* (DDG–65) and USS *John Paul Jones* (DDG–53)—because they didn't deploy. The reasoning was that had those two ships deployed, the maintenance would have been necessary. Instead, custody of those ships was taken by the off-going crews from *Higgins*.

What transit fuel savings occurred from the two sets of US-CENTCOM transits that didn't happen because of *Higgins*'s extended, three-crew-cycle deployment were offset by the extra crew travel and TAD costs.

Key SurfPac Assumptions in Report

- Costs were normalized to “C5F [CENTCOM] on-station days”
  - 509 days on-station in CENTCOM for *Fletcher*; 416 days for *Higgins*
  - Traditional 6-month West Coast DD/DDG deployments were assessed to yield ~100 days on-station in CENTCOM
  - Thus … it would require 5.09 traditional DD deployments and 4.16 traditional DDG deployments to yield the same time on-station
- Transit fuel savings included the two-way transits that didn’t happen, as well as the two-way transits outside of CENTCOM when the Sea-Swap site was in PACOM
  - Four of the five turnovers were held in PACOM (Singapore and Australia)
  - For purposes of calculation, fuel costs were fixed at $35.28 per barrel
- Crew travel/TAD costs for the Sea-Swap ships included crew per diem, hotels, and crew/equipment transportation
- The Sea-Swap ships’ per-day deployment costs were compared to those of a control group of other DD/DDG deployments
- Depot-level maintenance costs were compared for *Higgins* only. The DD decommissionings rendered such a comparison impractical.

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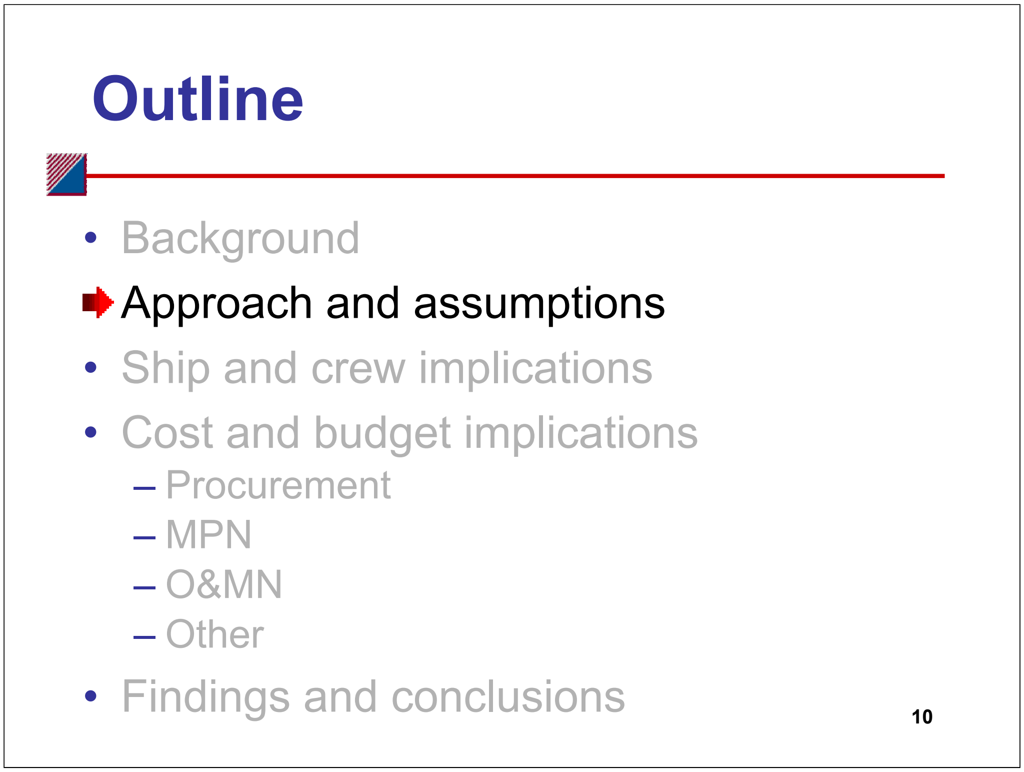
Certain key assumptions underlay the findings in SurfPac’s report.

In its estimates of savings, costs were normalized in terms of days on-station in CENTCOM. The Sea-Swap deployments of *Fletcher* and *Higgins* were credited with providing the same CENTCOM presence—925 days of total on-station time—as nine separate DD or DDG deployments that provided 100 days of presence each. In 2002 and 2003, during the lead-up to and the execution of Operation Iraqi Freedom (OIF), CENTCOM presence ought to be an appropriate standard of comparison. In the coming years, though, as OIF winds down and PACOM assumes greater importance to U.S. planning, a different standard may be necessary. PACOM presence may become the yardstick.

Costs for the Sea-Swap ships’ deployments were compared to those of a control group of other Pacific Fleet-based Spruance-class and Burke-class destroyers that had recently deployed. The decommissioning of the Spruance-class destroyers meant that there were fewer of those destroyers for the *Fletcher* comparison than there were Burke-class destroyers for the *Higgins* comparison. In fact, *Fletcher* was the last Pacific Fleet-based Spruance-class destroyer to deploy from a U.S. home port. (The subsequent deployment of the Japan-based USS *Cushing* (DD–985) doesn’t compare because the U.S. naval forces based in Japan use different funding and maintenance approaches.)

Due to the DD decommissionings—which included the decommissioning of *Fletcher*—SurfPac opted not to compare depot-level maintenance costs for *Fletcher* with those of the DD control group. Such a comparison was provided for *Higgins*. As such, the estimates of savings for *Higgins* may be more informative.



We will now describe our approach and discuss the assumptions we used for our analysis.

Approach: Examine Cost Implications

- How would each of the major appropriations be affected by Sea Swap?
  - How would SCN/OPN be affected by Sea Swap?
  - What would be the additional MPN costs or MPN savings?
  - What would be the effects on O&M?
  - Would it affect R&D?
  - How would other appropriations, including MILCON, be affected?
- Assess impacts quantitatively where we can, qualitatively elsewhere
- Focus more on framework than on exact costs—provide rough cost estimates of illustrated cases

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Our approach in examining the cost implications of Sea Swap was to begin as broadly as possible. We did that by analyzing the potential impact on every major appropriation. For example, would there be savings in ship building and conversion (SCN) and other procurement, Navy (OPN) due to a reduced number of ships and components? Would there be additional MPN costs or savings? How would a reduced number of ships to operate affect the operations and maintenance (O&M) account? How would maintenance differences affect O&M? Would there be any impact on research, development, test, and evaluation (RDT&E) costs? Would there be additional infrastructure requirements, leading to higher military construction (MILCON) costs?

We quantified the impacts where we could, but we also performed a qualitative assessment of some effects that are inherently too difficult to quantify.

Our focus was more on developing a framework for cost analysis, given that there are still many unanswered questions about some of the programs that may undergo the Sea Swap implementation and the Sea Swap itself. However, we will provide rough cost estimates of reasonable cases to illustrate the potential effects.

Approach: Examine Ship and Crew Implications

- Consider two types of programs to illustrate ship and crew implications under steady state—do not consider the transition period
  - DDG–51 as “sunset” program (ships already bought)
  - LCS as “sunrise” program (number of ships may change)
- For each type of program, estimate ship and crew requirements* using the following inputs—assuming the current level of forward presence is required
  - Crew turnaround ratio = 3.0
  - Sea Swap option = 8:6:2 (8 crews, 6 ships, 2 forward)
  - Deployment length = 182 days

** Although each option has a certain surge capability, we did not compare their respective surge capabilities*

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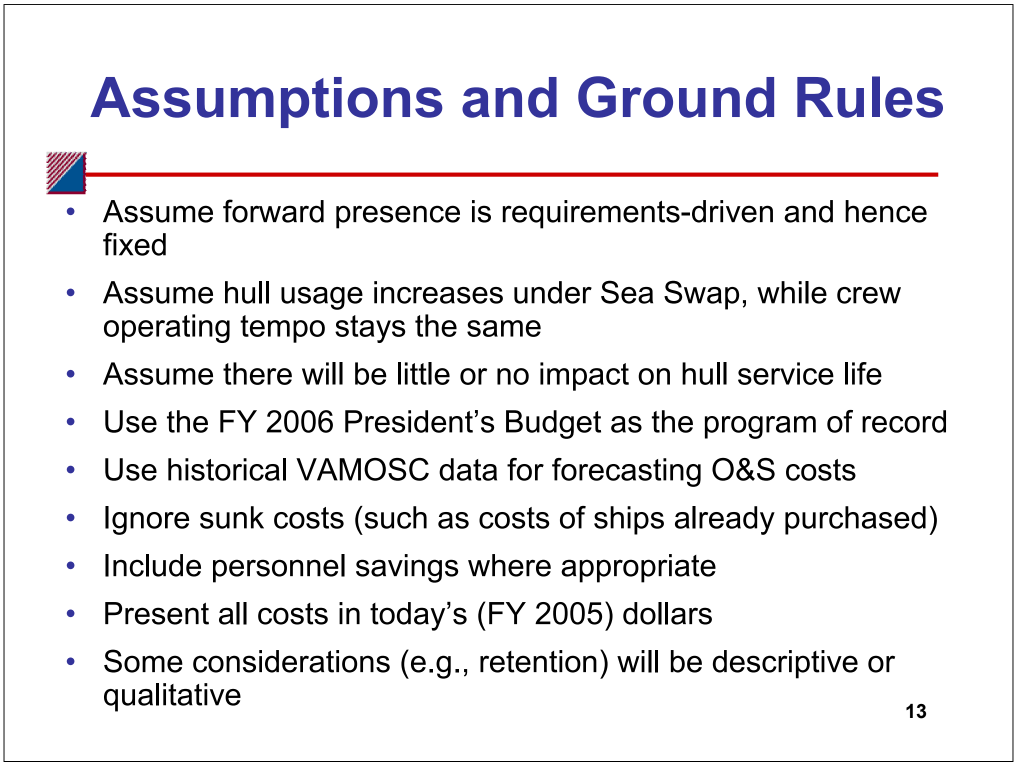
We will examine two different scenarios where the implications for Sea Swap are somewhat different. In the DDG-case, we will accept as a given that 62 ships have been bought. Under these circumstances, to adopt Sea Swap would imply that the Navy has to either increase the number of crews and keep the number of ships constant at 62 or decommission some ships before their expected 35-year lifespan. Because the Navy is actually looking to reduce overall manning numbers and 62 ships under Sea Swap actually yield far more presence than the Navy is interested in, we will focus on the case where ships are decommissioned early. Note that we ignore the transition phase. That is, we will concern ourselves only with the steady-state number of ships and crews under a traditional crew rotation versus Sea Swap.

The number of ships for LCS, on the other hand, is still open to some debate although the expectation is that 56 ships will be bought and a Sea Swap crew rotation will be implemented. In this case, we will compare this expected scenario to the traditional crew rotation scheme.

Finally, note that there are several Sea Swap regimes and crew TAR numbers that the Navy could adopt. For this paper, we accept a crew TAR of 3.0, a Sea Swap regime of 8 crews and 6 ships to keep 2 ships forward, and a deployment length of 182 days. Changes to any of these assumptions would change the cost implications.



Here is the set of assumptions and ground rules used in our analysis.

First, we assume that forward presence is requirements-driven, and hence fixed. If we allow the amount of forward presence to vary (and there could be multiple levels of presence), the results would vary accordingly.

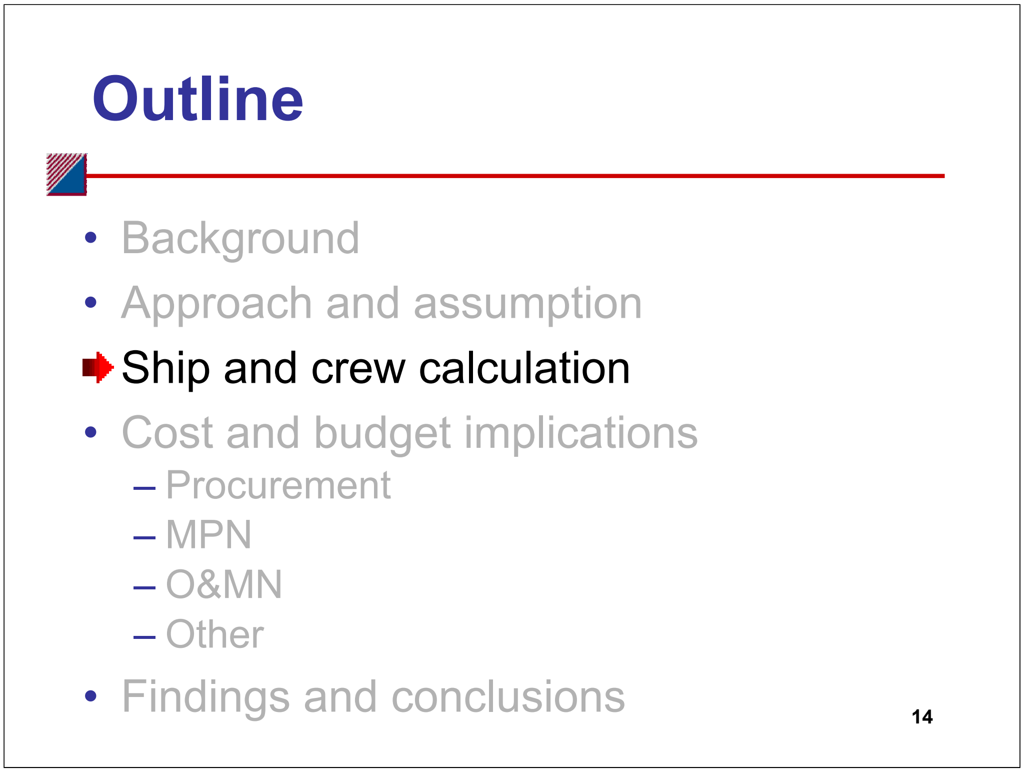
Second, we assume that the hull usage increases under Sea Swap, whereas crew operating tempo stays the same.

Third, we assume there would be little or no impact on hull service life, although we just made an assumption about the increased hull usage. This is because there is little solid evidence that greater usage will adversely affect the maintenance requirement of a ship, let alone the service life.

The remaining bullets from this slide are typical ground rules governing general cost analysis.

We define sunk costs not only as costs that have been incurred already, but also as costs that will be incurred due to an irreversible course of action. An example is the cost of decommissioning a ship. All ships will be decommissioned eventually. In some cases, fewer ships will be needed and consequently, some ships may be decommissioned sooner than had been anticipated. If so, the Navy would incur the decommissioning costs earlier rather than later. We do not include the opportunity cost of money as a part of this analysis.

We include personnel savings, where appropriate, without making explicit assumptions about reducing the number of personnel. This is based on our belief that those sailors released from a ship would be productive elsewhere, even if there is no reduction in force, and that would represent real economic gains (or savings).



We turn now to a discussion of our analysis. We start by describing our computation of the number of hulls and crews that would be needed under both the traditional crewing approach and Sea Swap.

Example: DDG Hull/Crew Requirements vs. Presence

Option	Total DDG hulls	Total DDG crews	DDG presence
Programmed	62 (7 FDNF)	62	15
8:6:2	34 (7 FDNF)	42	15
8:6:2 (N81 analysis)	49 (7 FDNF)	62	20

- **Navy requires a 20-ship presence**
- **POR with no Sea Swap yields a 5-ship presence gap with 62 ships**
- **Under Sea Swap, only 34 ships (and 42 crews) are needed to keep a 15-ship presence**
- **N81 analysis showed that 49 ships under Sea Swap would yield a 20-ship presence**
- **In this case, there are no implications for MPN in terms of the number of crews/personnel**

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In this slide, we show the hull/crew requirements for various crew rotation and presence combinations. The current program of record calls for 62 DDG–51 ships to be in the Navy's inventory by 2011. These 62 ships, under a traditional crew rotation schedule, will yield 15 ships forward. Seven of these ships will be Forward Deployed Naval Forces (FDNF) and stationed somewhere in the Western Pacific (WESTPAC) area (most likely Yokosuka Naval Base in Japan). The other 55 ships will be CONUS based and will yield eight ships forward (four from each coast) under the assumption that at any time three of them will be in some maintenance availability. Note, however, that the Navy would actually prefer to have 20 ships present. As a result, the program of record under traditional crew rotations will leave a five-ship gap in presence.

We calculated that, to keep the same 15-ship presence, only 34 ships and 42 crews would be necessary under an 8:6:2 Sea Swap crew rotation. In this scenario, we assumed the same seven FDNF ships using the traditional crew swap method for FDNF forces. The other 27 ships would be Sea Swapped and CONUS based. Assuming that three ships are under maintenance at any time, the other 24 ships yield 8 ships forward (4 from each coast).

N81 also did its own analysis on Sea Swap and found that a 20-ship presence could be had from 49 ships and 62 crews. This combination would satisfy the Navy's 20-ship forward requirement.

Note that all of these ships have already been paid for. So any move to a Sea Swap crew rotation would actually require the early decommissioning of several ships.

Example: LCS Hull/Crew Requirements vs. Presence

Option	Total LCS hulls	Total LCS crews	LCS presence
Programmed	56 (10 FDNF)	72	26
No Sea Swap	106 (10 FDNF)	106	26

- **Current POR calls for doing Sea Swap on the 56 hulls**
- **This would require 72 crews and yield a presence of 26**
- **To get the same presence with no Sea Swap would require 106 ships and crews**

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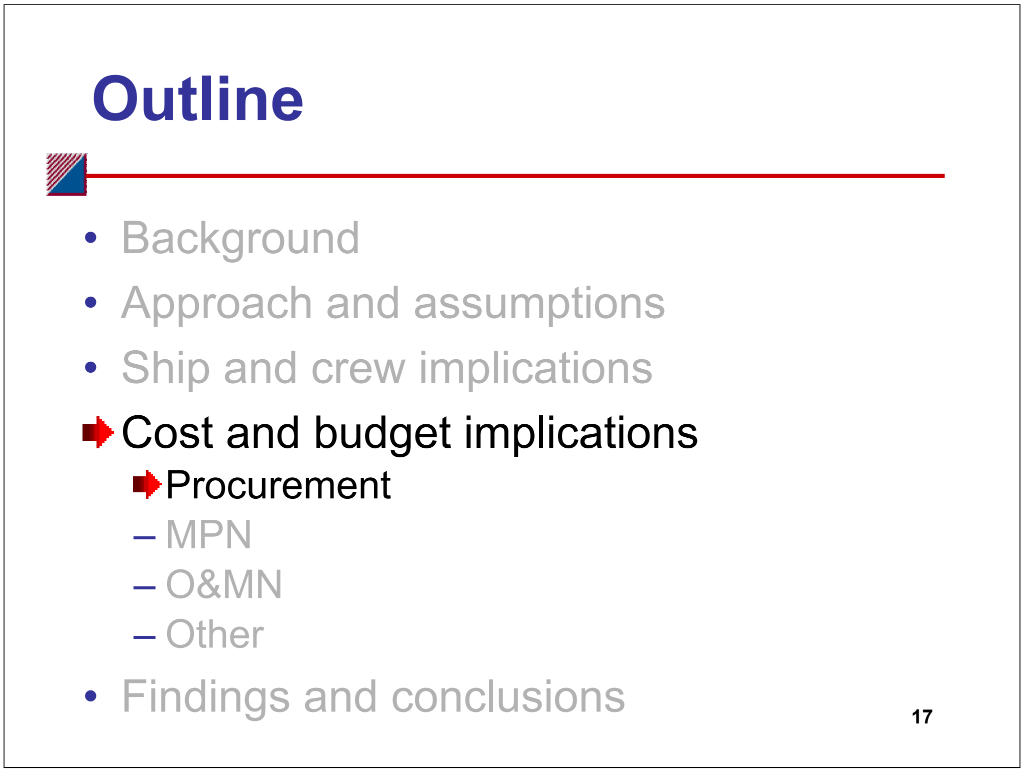
The current program of record for LCS shows a steady-state inventory of 56 ships. Ten of these ships will be FDNF whereas the rest are CONUS based and use an 8:6:2 Sea Swap crew rotation. Using a similar process as shown for the DDGs, we calculated that this will yield a presence of 26 ships forward with 72 crews. To get the same presence using a traditional crew rotation and 10 ships FDNF, we calculated that 106 hulls and crews would be required.



We turn now to a discussion of our cost analysis. We provide the analysis by major Navy budget categories: procurement (Shipbuilding and Conversion, SCN and Other Procurement, OPN), Military Personnel (MPN), Operations and Maintenance (O&MN), and other. First, we will discuss the impact of Sea Swap on procurement accounts.

Procurement Implications Under Sea Swap

- Sea Swap would affect SCN differently for sunset and sunrise programs
  - DDG: Sea Swap would reduce the number of ships required in modernization program and lower the SCN requirement
  - LCS: Fewer new ships would be needed and the SCN requirement would be less; also fewer modules would be needed and the OPN requirement would be less

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In the last section, we described the hull requirements under different crew rotation for both the DDG and the LCS cases.

For the DDG, the lower hull requirement would not reduce the ship purchases, simply because all of them would have been procured by FY 2005. The Navy plans to modernize the DDGs by retrofitting the older ships with the latest technologies installed on the newest DDGs. The lower hull requirements would mean reducing the number of retrofits. The DDG modernization program would be paid for with the SCN account.

For the LCS, the lower hull requirement would reduce the number of ship purchases. The LCS program is envisioned to provide flexibility in the littorals with three primary missions: littoral surface warfare, mine warfare, and littoral anti-submarine warfare. To provide the flexibility, the Navy plans to buy modular mission packages that would be integrated into the seaframe, depending on the mission needs. The Navy plans to buy the seaframe with the SCN money and the mission modules with the OPN money. Although the exact number of modules by the type is not well defined, the lower hull requirement would affect both the SCN and the OPN appropriations.

DDG–51 Procurement Cost

- POR for the DDG–51 calls for 62 DDG–51s
- Under Sea Swap, only 34 ships are needed to maintain the same presence
- However, all 62 were procured by FY 2005—this is a sunk cost, so there are no procurement savings
- DDG–51 is to undergo a modernization program
  - Only 34 of 62 need to be modernized; the rest may be decommissioned
  - Modernization costs are uncertain; assume $50 million per hull
    - CG conversion $50.1 million in FY 2002
    - DDG modernization $49.8 million in FY 2005
- Avoid cost of modernizing 28 DDGs => $1.4 billion savings

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Again, there will be no savings from the new ship purchases for the DDG program, because all 62 will have been procured by FY 2005. However, there would be savings from reducing the number of DDGs that would undergo modernization (from 62 to 34). The DDG modernization costs are uncertain and would vary depending on the specific hull to be modernized. Older ships would require more modernization and hence more money. We assumed the cost of modernization would average about $50 million per hull, based on the experience of a CG conversion in FY 2002 at $50.1 million and on the programmed DDG modernization in FY 2005 at $49.8 million. The total cost avoidance would be about $1.4 billion for the 28 DDGs that would be decommissioned early and hence would forego modernization.

As explained earlier, we do not include the costs to decommission these ships earlier because they would be incurred eventually.

LCS Procurement Cost

Option	Total LCS hulls	Total LCS hull cost ($ mil)	Difference from programmed	Difference incl. modules
Programmed	56 (10 FDNF)	$10,377	NA	
No Sea Swap	106 (10 FDNF)	$17,313	$6,936	$14,000

- Under Sea Swap, 50 fewer hulls would be needed to keep the same presence
- Use the N81 model to estimate costs of additional 50 LCS hulls => about $7 billion in cost avoidance
- The number and costs of modules are not well established
  - More modules than the number of hulls
  - Lower module unit cost than the hull cost
  - Modules procured with OPN appropriation => Total costs could be roughly the same as the hull costs (in SCN)

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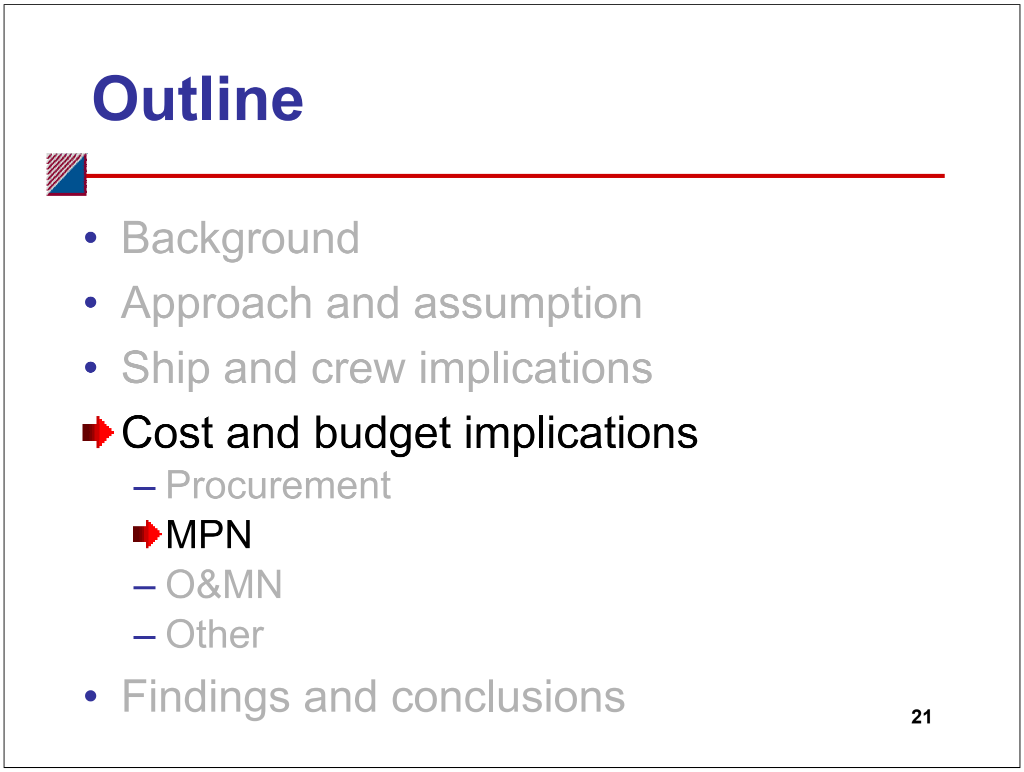
Under Sea Swap, 50 fewer LCSs would be needed to keep the same amount of presence. We estimated the cost of the additional 50 LCS hulls, using the N81 cost estimating model for LCS. The cost avoidance would be almost $7 billion for the hulls (or seaframe) alone.

Neither the number or the cost of the LCS mission packages is well established. In general, it is widely assumed that there would be more mission modules than the number of hulls and that a module would cost less than a hull. We assumed that the total cost avoidance from needing fewer modules would be roughly the same as what would result from buying fewer hulls. (As stated earlier, our focus is not to provide accurate costs, which is not possible at this stage, but to provide a framework for analysis.)

Hence the total cost avoidance may be around $14 billion (half in SCN and the other in OPN).



In this section, we discuss the impact of Sea Swap on MPN.

MPN Implications Under Sea Swap

Sea Swap could affect MPN in two ways:

- Fewer crews and ships would be needed to maintain a constant presence
- More stress on the crews could lead to retention problems

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There are two ways in which Sea Swap could affect the MPN accounts. First, the Navy could require a certain amount of presence. Working backward from this number, we can determine the number of hulls and crews needed under a Sea Swap versus a traditional crewing regime. Similarly, we could also take the historical presence as a given and work backwards to determine the number of hulls and crews needed.

There is a strong reason to believe that Sea Swap may contribute to higher attrition due to increased workloads, fewer quality port calls, and other quality-of-life issues. We look at an example of each of these factors in the following slides.

Example: DDG Crew Costs

Option	Total DDG crews	Total DDG crew costs ($ mil)	Difference from programmed
Programmed	62 (7 FDNF)	$945.5*	NA
8:6:2	42 (7 FDNF)	$640.5*	-$305*

- **VAMOSC showed that the average yearly crew cost for a DDG is roughly $15.25 million (2005 dollars)**
- **To achieve the same presence with Sea Swap requires only 42 crews => yearly MPN savings of $305 million**

* These figures include only direct personnel cost. An earlier CNA study indicated that there's almost 1-for-1 relationship between afloat and ashore manning. As such, the savings associated with crew reduction could be about twice as much. 23

In this slide we show the projected costs associated with crew manning for each of the hull/crew combinations. The program of record calls for 62 ships and crews. Data from the Navy's Visibility and Management of Operating and Support Costs (VAMOSC) database indicates that, historically, the average yearly cost for the crews has been about $15.25 million. For 62 crews, this yields a total yearly cost of $945.5 million.

To achieve the same 15-ship presence, we calculated that the Navy would need only about 34 ships with 42 crews using an 8:6:2 Sea Swap rotation. The total crew cost for manning these ships would be about $640.5 million yielding a $305 million yearly savings.

These figures include only direct personnel cost. An earlier CNA report[1] indicated that there is an almost 1-for-1 relationship between afloat and ashore manning. As such, the savings associated with crew reduction could be about twice as much.

1. See *Some New Estimates of the Navy's Indirect Manning Costs* by Henry Eskew, December 1995 (CNA Research Memorandum 2795020300).

Example: LCS Crew Costs

Option	Total LCS crews	Total LCS crew cost ($ mil)	Difference from programmed
Programmed	72 (10 FDNF)	$374	NA
No Sea Swap	106 (10 FDNF)	$551	$177

- **LCS manning costs are still being estimated**
- **Manning for LCS should be roughly 75 sailors => about one-third the cost of a DDG**
- **Manning costs under the POR should be about $374 million (this includes manning for the seaframe and the modules)**
- **If Sea Swap is not considered, 106 crews would be needed to keep the same presence => $551 million yearly bill for manning**

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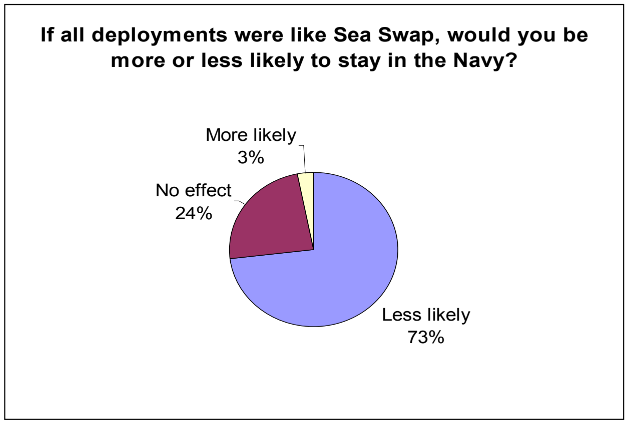
Under the current program of record, the 56 LCS ships will have a total manning of about 75 sailors. This includes the number of sailors necessary to manage the seaframe itself as well as the modules. We assumed that this mix of sailors would yield a yearly manning cost that is about one-third the yearly cost of operating a DDG which has about 230 sailors. Using these numbers, we estimated that the yearly manning bill under the program of record would be about $374 million. If Sea Swap is not considered, 106 crews would be needed. The yearly bill for these extra crews would be an additional cost of about $177 million.

Sea Swap and Retention

- CNA analysis of the Sea Swap exercises indicated that retention could become a problem*



* CNA research memorandum D0010343.A2 by D Zvijac, C Duquette, et al, Sep 2004

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Besides the actual number of crews required for a certain level of forward presence, the other factor that could affect MPN is that Sea Swap could raise attrition rates thus forcing the Navy to offer more incentives to keep sailors in the Navy.

The recent Sea Swap exercise done by SurfPac indicated that Sea Swap was not popular. In fact, a post-deployment survey taken by CNA showed that about 73 percent of the sailors that participated would be less likely to stay in the Navy if all deployments were like their recent Sea Swap experience.

We are still not certain just how unpopular Sea Swap was and what its over all impact on attrition might be. First, the SurfPac exercise was the first major Sea Swap initiative. As often happens, the first time a new initiative is tried, it is fraught with problems that eventually get ironed out with experience. In addition, we might attribute part of the response to the normal complaining associated with anything new. Finally, attrition is subject to many factors that are outside of the Navy's control—economic fluctuations, for example. In sum, it is fair to expect that Sea Swap will have some negative impact on attrition but how large the impact will be is largely unknown.

Factors Affecting Retention

- Previous CNA analysis identified many factors associated with deployments that affect retention
- The following factors would greatly change under Sea Swap
  - Longer port calls in more desirable locations decrease attrition
  - Longer work hours and increased workload while in port increase attrition
- Duration and quality of port calls as well as workload could worsen under Sea Swap
- More work needs to be done to determine these effects on attrition and what possible responses may exist

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CNA has done a great deal of previous analysis on factors that affect attrition.[2] After examining these factors, we noted that some of them would change under a Sea Swap regime.

Port calls in desirable locations are a part of the overall Navy experience that sailors like. Long port calls in these locations have actually been shown to reduce attrition. Further, under the usual deployment schedule, sailors usually get long port calls while transiting to and from their deployment areas. Unfortunately, under Sea Swap, the outgoing crew will get their port calls transiting out but will fly back home, thus missing out on their return port calls. Similarly, the crew that returns with the ship will also get only one chance for port calls. The two inner crews will not transit with the ship but will fly to and from the Sea Swap city. These crews will get no port calls except those during deployment which are often shorter in duration.

SurfPac also noticed that the workload increased during its Sea-Swap experiment, especially in the weeks just before the actual swap as the on-board crew tried to finish all necessary repairs in order to hand the ship over in good condition. Previous analysis by CNA indicates that this increased workload might also increase attrition, especially if it is done during one of the few port calls made during a deployment.

Unfortunately, we still cannot know from this previous analysis just how much the Sea Swap initiative will affect attrition.

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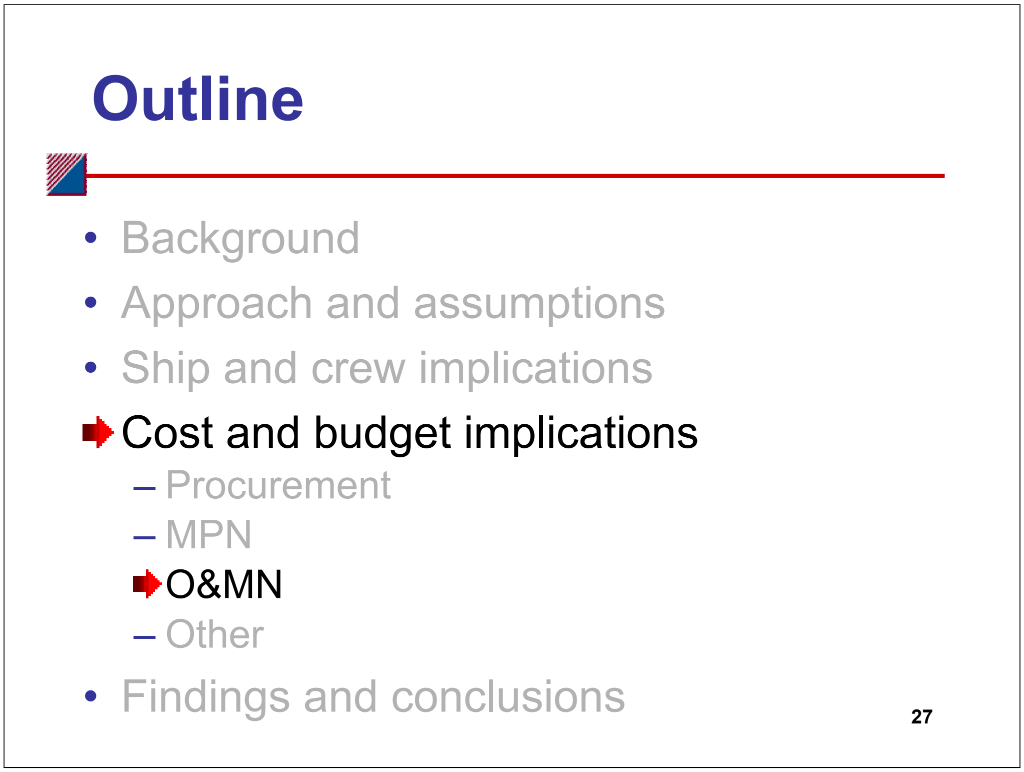
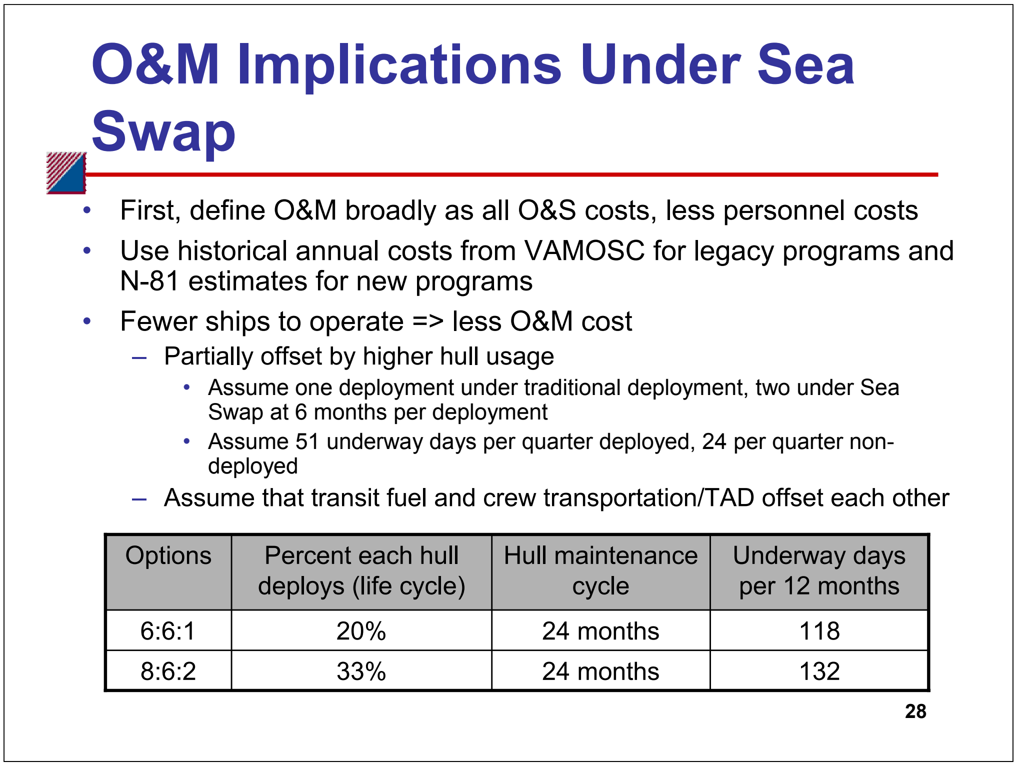
2. See, for example, *How Has PERSTEMPO's Effect on Reenlistments Changed Since the 1986 Navy Policy* by Heidi Golding and Henry Griffis, July 2004 (CNA Annotated Briefing D0008863.A2) and *Fleet Attrition: What Causes It and What To Do About It* by Heidi Golding et al., August 2001 (CNA Research Memorandum D0004216.A2).



In this section, we discuss the impact of Sea Swap on O&MN.



First, we define O&M broadly as all operating and support (O&S) costs, less the personnel costs discussed in previous slides. We do so to include some minor cost elements in the O&S category that are paid for with non-O&M money.

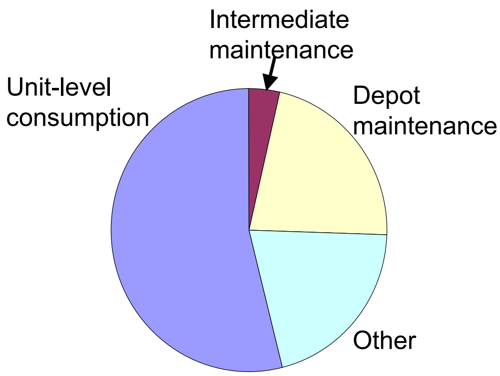
For our analysis, we rely on historical costs from the Navy's VAMOSC database for legacy programs and N-81's estimates for new programs.

Based on the analysis presented earlier, Sea Swap would require fewer ships to keep the same amount of presence. Operating fewer ships lowers O&M cost. However, the remaining ships would be used more heavily. This would result in higher O&M costs for each operating ship. Under Sea Swap, there would be two deployments (at 6 months each) and a 24-month maintenance (and training) period in the ship's cycle. The percentage of time that each hull deploys would thus be 33 percent (12/36). The current Op Tempo assumes 51 underway days per quarter deployed and 24 underway days per quarter non-deployed. For each Sea-Swap cycle, this would translate to 294 underway days (6 months x 17 underway days/month + 24 months x 8 underway days/month) or 118 days per year (VAMOSC provides annual data).

We assume that transit fuel and crew transportation/TAD offsets each other in costs, based on the SurfPac findings from the Higgins experience. SurfPac found that the funds for OPTAR and the Systems and Equipment Material Assessment Team (SEMAT) were relatively minor.

O&M Costs for DDG–51 Class

Total $14.2M per year

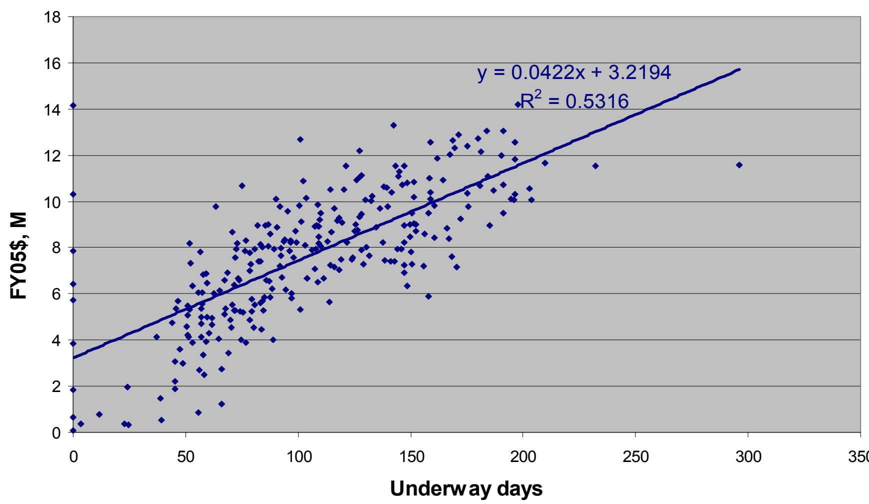


- Unit-level consumption includes costs of fuel, materials for operations, maintenance, and support consumed at the unit level, depot-level reparables, training munitions, transportation, and TAD pay
- Other includes contractor support, sustaining support, and indirect support

Here we show the average annual O&M costs for all the DDG–51 class of ships in the VAMOSC database by the major cost category. The total cost is $14.2 million per year. Unit-level consumption accounts for more than half of the total costs. Unit-level consumption includes the costs of fuel, materials for operations, maintenance, and support consumed at the unit level, depot-level reparables, training munitions, transportation (including cost of unit personnel travel for training, administrative, or other purposes, such as crew rotations and deployments), temporary additional duty/temporary duty (TAD/TDY) pay, and other unit-level consumption costs, such as purchased services.

In addition to unit-level consumption and intermediate and depot maintenance, O&M includes costs for contractor support, sustaining support, and indirect support.

DDG Unit-Level Consumption Increases with Underway Days



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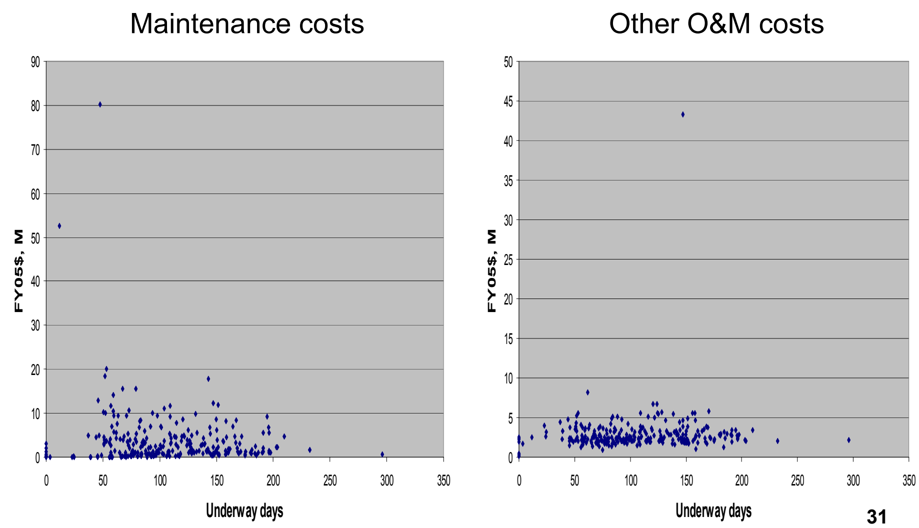
Because the number of underway days would vary depending on the crew option, we examined how the costs of each O&M category would vary with the number of underway days. Here we show that there is a clear relationship between unit-level consumption and underway days for the DDGs. We use this information to adjust the average annual unit-level consumption costs under Sea Swap where the number of underway days would increase.

Other O&M Costs Do Not Vary with Underway Days



Whereas the relationship between unit-level consumption and the number of underway days for the DDGs was clear, that is not the case for the other O&M cost categories. Here we show the relationships between the sum of intermediate and depot-maintenance costs and underway days and between other O&M costs and underway days. Although it is not shown here, we also examined the relationship by each individual category (just the depot maintenance, for example) and found no significant relationship.

For these O&M categories, we used the historical average annual costs to estimate costs under both crewing options.

Example: DDG O&M Costs

Option	Total DDG hulls	Annual DDG O&M costs ($ M)	Difference from programmed
Programmed	62 (7 FDNF)	$883	NA
8:6:2	34 (7 FDNF)	$503	-$380

- VAMOSC shows that average annual O&M cost for a DDG is $14.2 million
- Higher hull usage (14 additional underway days per 12-month period) under Sea Swap would add $0.6 million
- Sea Swap would require 28 fewer hulls to achieve the same presence => yearly O&M savings of $380 million

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Here we demonstrate how Sea Swap would affect the O&M costs of DDGs under different crewing options.

First, we base the O&M costs of the traditional option on the historical average costs from VAMOSC ($14.2 million annual cost per ship). Then, using the relationship illustrated in the previous slide and the accompanying regression result, we adjusted the O&M costs under Sea Swap to account for the higher hull usage: 14 additional underway days per 12-month period would add about $0.6 million per year.

We estimate the overall impact of Sea Swap on O&M to be an annual savings of $380 million, which is due mainly to operating 28 fewer hulls to achieve the same presence.

Example: LCS O&M Costs

Option	Total LCS hulls	Annual LCS O&M costs ($ M)	Difference from programmed
Programmed	56 (10 FDNF)	$414	NA
No Sea Swap	106 (10 FDNF)	$753	$340

- LCS O&M costs (for hull and the modules) are still being estimated
- Assume they are about half the DDG costs (based on relative acquisition costs)—$7.1 million per year
- Assume higher hull usage under Sea Swap would add $0.3 million
- Sea Swap would require 50 fewer hulls to achieve the same presence => yearly O&M cost avoidance of $340 million
- LCS service life is 30 years => $10 billion cost avoidance in O&M

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We follow the same procedure to assess the impact of Sea Swap on a sunrise program (LCS). Because LCSs have not yet been deployed, we have no historical O&M cost data. Those costs (for hull and the modules) are still being estimated. We assumed that they would be about half the DDG costs (based on rough relative acquisition costs), or $7.1 million per year. We also assumed that the relationship of cost to underway day for LCS would be similar to that for the DDG. Under those assumptions, the higher hull usage under Sea Swap would add $0.3 million per year.

We estimate the overall impact of the LCS Sea Swap on O&M to be an annual cost avoidance of $340 million, which is due mainly to operating 50 fewer hulls to achieve the same presence.

Sea Swap and Maintenance

- Would Sea Swap affect the maintenance cost per ship?
- USS *Higgins* experienced lower depot-level maintenance cost per day than the “control” ships
- Historical VAMOSC data suggests that higher usage does not affect maintenance costs of surface combatants
- Intuitively, continuous high usage would result in an adverse maintenance effect

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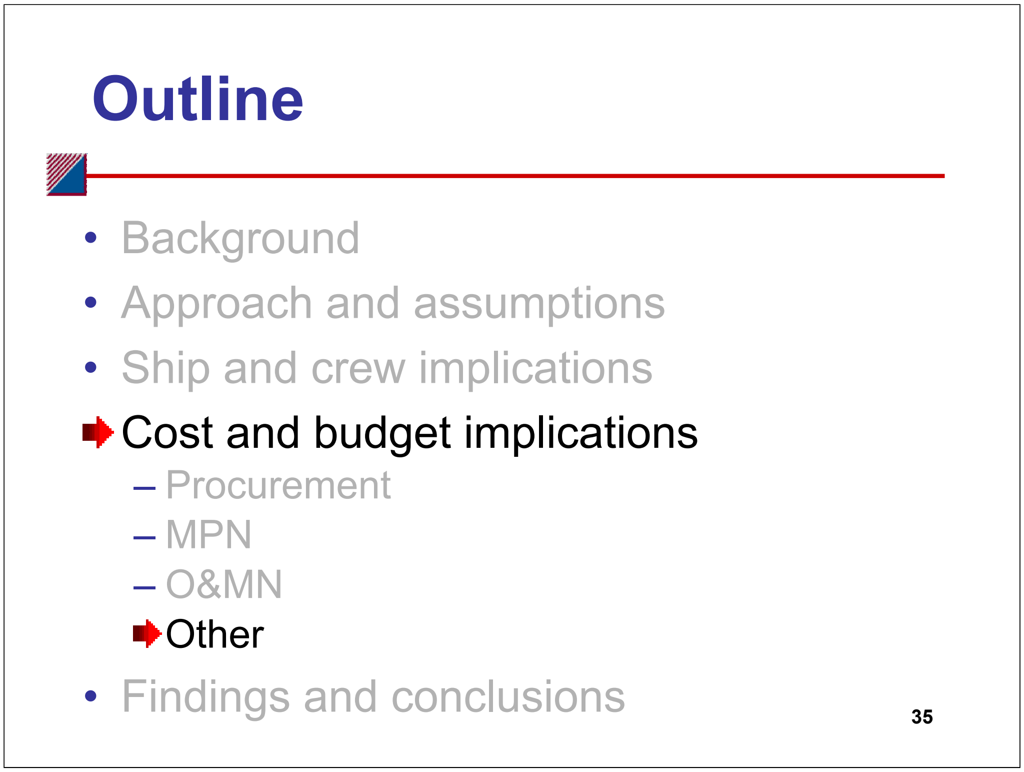
SurfPac found that USS *Higgins* (the Sea-Swapped DDG) experienced lower depot-level maintenance cost per day than the “control” ships[3] and concluded that there was no significant operational impact from the Sea-Swap experience. Earlier, we showed that the historical VAMOSC data did not reveal any relationship between usage and maintenance costs. However, both of these findings are counter-intuitive: Shouldn’t higher usage result in some adverse maintenance effects, either higher maintenance cost or poorer ship condition? We were not able to test this as a part of this study, but it would be an interesting and worthwhile project.

3. The control includes other DDG-51 class ships deployed under the traditional crewing: USS Milius (deployed November 2002–June 2003), USS Okane (deployed January 2003–July 2003), and USS Decatur (deployed August 2003–March 2004).



In this section, we discuss the impact of Sea Swap on other budget categories, such as RDT&E and MILCON.

Other Considerations

- Other possible Sea Swap issues:
  - Crew are no longer tied to ships => this is a large change to SWO culture
  - No ship ownership => this could affect maintenance
- Sea Swap should have little if any direct impact on RDT&E
- Infrastructure will need to be enlarged to accommodate crews with no ships

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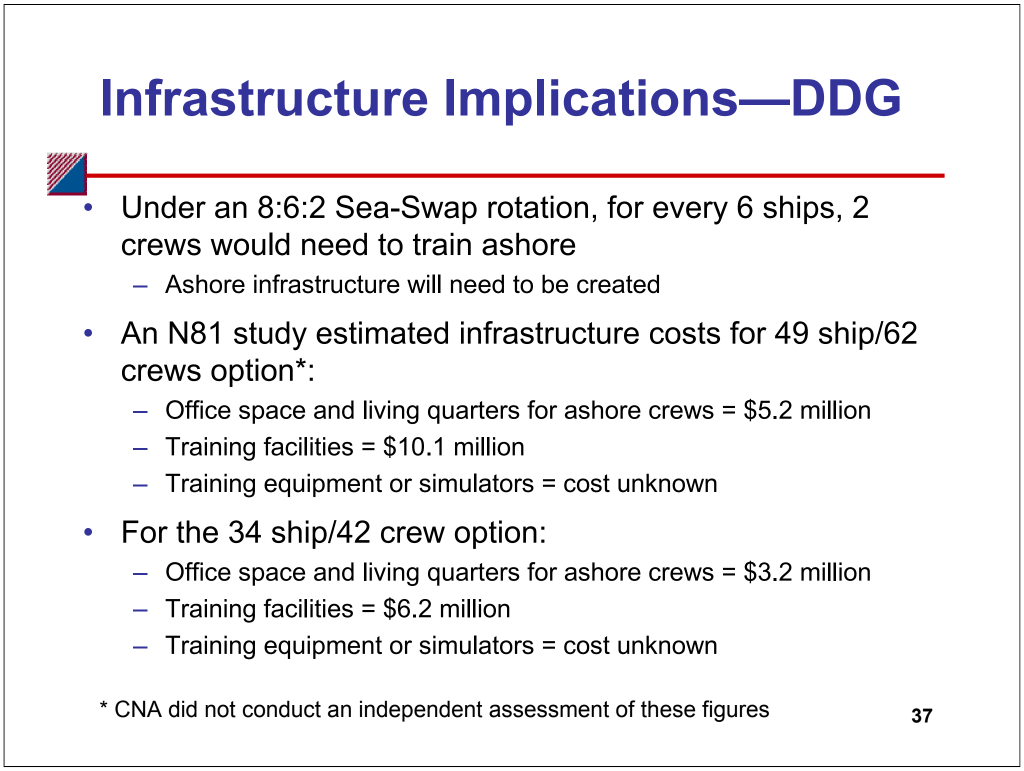
In practice, the Navy has done Sea Swaps many times including swapping an entire airwing during the Korean war. However, for the surface community, doing Sea Swap on a continual basis represents a major shift in operations. Just how this will affect every aspect of Navy operations is still largely unknown. Some officers in the surface community have voiced concerns over the fact that a crew would no longer be tied to a specific hull. This lack of ownership might affect ship morale (crews currently identify themselves by their ship names) as well as maintenance. However, given the paucity of information concerning the implications of these possibilities, we can only comment on it.

We can state with a great deal of certainty that RDT&E accounts should not be directly affected by Sea Swap although there might be some incidental or indirect implications. One could, for example, imagine a scenario in which Sea Swap leads to more maintenance which, in turn, inspires the Navy to fund an effort to develop less fragile systems.

Finally, Sea Swap will mean that some crews will need to spend more time training ashore because they will have no ship. N81 has already done some analysis on the infrastructure implications. We report their findings on the next slide.



Under the 8:6:2 Sea Swap rotation, for every two ships deployed, there will be two crews at the beginning of their training pipeline with no ship to train on. As such, the ashore infrastructure will need to be improved to accommodate these crews.

N81's Sea Swap study showed that the infrastructure will have to be enlarged in two areas. First, new office spaces will have to be created for some of the crew members. They estimated that the total bill to add the needed office space in Norfolk and San Diego to support Sea Swap would be roughly $5.2 million. In addition, new training facilities would also need to be built at both bases. The total bill for this infrastructure improvement at both bases would be roughly $10.1 million, not including any costs of training equipment or simulators. Both of these estimates are based upon having 62 crews and 49 ships.

The cost would probably be lower for the 34 ship/42 crew Sea Swap option. In this case, there are only 8 crews with no ship versus 13. As a crude estimate, we took $8/13^{\text{ths}}$ of N81's estimates as the necessary funding for infrastructure. Our estimates indicate that infrastructure costs for the DDG under this force structure will be roughly $3.2 million for office space and living quarters and another $6.2 million for training facilities.

Infrastructure Implications—LCS

- LCS CONOPS are still being reviewed
  - Ashore infrastructure will need to be created
  - It is not clear how large this infrastructure will be
- There will be 16 crews with no hull
  - Office space and living quarters for ashore crews = $1.3 million
  - Training facilities = $2.5 million
  - Training equipment or simulators = cost unknown

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The concept of operations for LCS is still under review. The current plan is to adopt Sea Swap as the rotational regime, but it is unclear how the seaframe crew will be trained versus the crews attached to a specific module. Given so many unknowns, the best we were able to do was to take N81's infrastructure estimates for the DDGs and adjust them for the LCS crew size (about one-third of a DDG) and for the fact that there will be 16 versus 13 crews with no hull to train on. Our crude estimates indicate that infrastructure costs for the LCS under the program of record will be roughly $1.3 million for office space and living quarters and another $2.5 million for training facilities. In addition, there will be costs of training equipment or simulators—we did not estimate these costs.

Outline

- Background
- Approach and assumptions
- Ship and crew implications
- Cost and budget implications
  - Procurement
  - MPN
  - O&MN
  - Other
- Findings and conclusions

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We wrap up with our findings and conclusions.

Findings and Conclusions

- We examined the cost implications of Sea Swap using an example each of both sunset and sunrise programs, assuming that forward presence is requirements-driven and hence fixed
  - Analyzed how each of the major appropriations would be affected by Sea Swap
  - Provided the framework for assessing the costs of different rotational crewing options
  - Developed rough order-of-magnitude estimates
- There would be significant cost savings or cost avoidance from Sea Swap implementation—we identified types of costs and savings and illustrated their magnitudes

FY05$, millions	DDG-51		LCS	
	"One-time"	Annual	"One-time"	Annual
SCN / OPN	-1,400		-14,000	
MPN		-305		-177
O&M		-380		-340
RDT&E	0		0	
Infrastructure req't	9 +		4 +	
Infrastructure O&M		0.5 +		0.2 +

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In this study, we examined the cost implications of Sea Swap. We identified the types of costs and savings associated with Sea Swap and illustrated their magnitudes using an example each of both a sunset and a sunrise program.

We found that there would be significant cost savings or avoidance from implementing Sea Swap for both sunset and sunrise programs: a one-time savings of about $1.4 billion and about $700 million annual savings for a sunset program (DDG–51), and a one-time cost avoidance of roughly $14 billion and $500 million annual cost avoidance for a sunrise program (LCS).

In developing our estimates, we assumed that forward presence was requirements-driven and hence fixed. Had we allowed the amount of forward presence to vary, the results would also have varied. We provided the framework for analysis in this report such that one could examine the cost impacts of different levels of presence.

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