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O&M Cost Modeling for the Department of Defense

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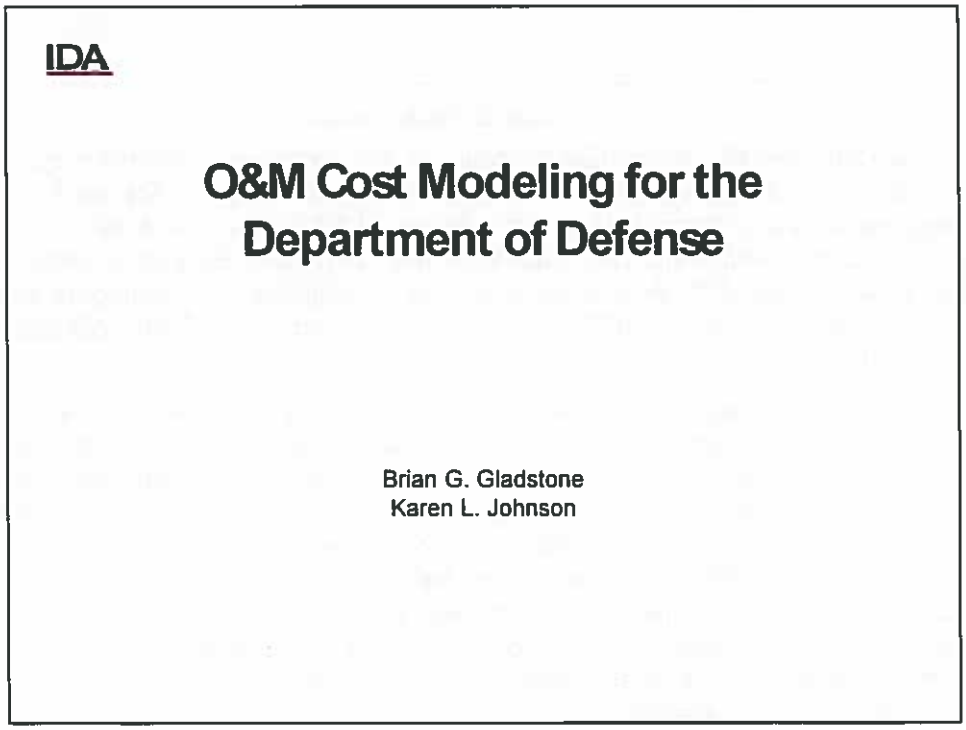
Abstract

The Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics asked the Institute for Defense Analyses to evaluate and update their Operation and Maintenance (O&M) cost model. This document presents the projections of O&M expenditures from revised O&M models for the Department of Defense and the Services, updated for the fiscal year 2015 President's Budget (PB15). This report shows differences between model projections and PB15 requests for O&M for three of four Services as well as for the Department at large.

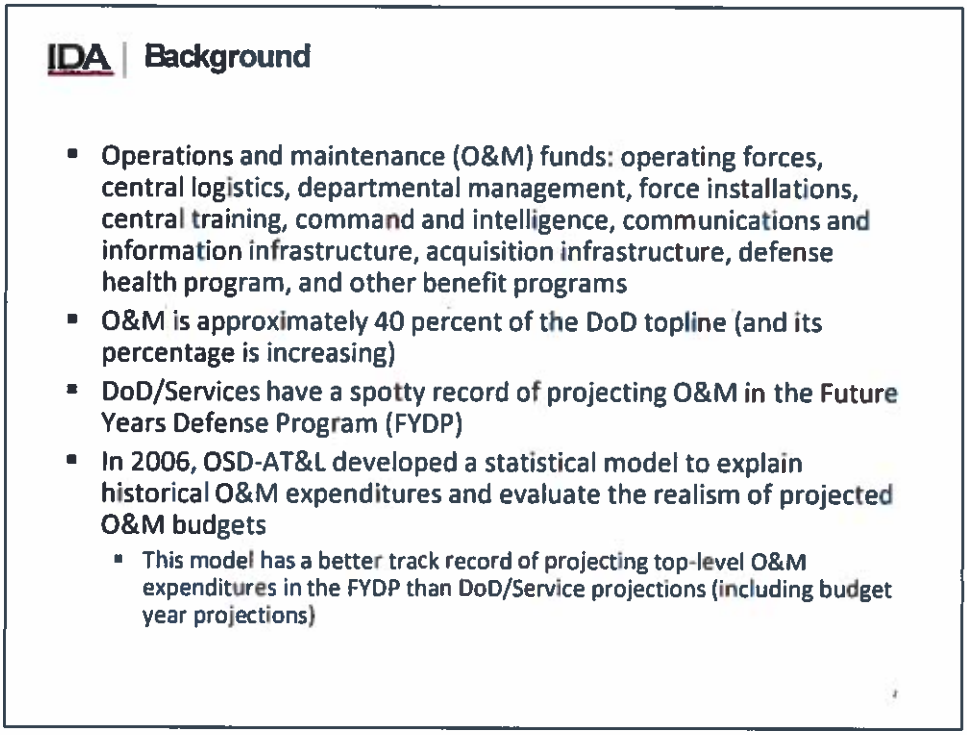
O&M Cost Modeling for the Department of Defense



Slide 1. Presentation Cover Slide

This document is an annotated version of a briefing prepared by the Institute for Defense Analyses (IDA) for the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (OUSD[AT&L]). The briefing was delivered to the sponsor, the OUSD(AT&L) office in Acquisition Resources and Analysis (ARA), on May 6, 2014. It presents Operation and Maintenance (O&M) cost estimates for the Department of Defense (DoD) and the Services as well as a cost model to evaluate future O&M costs.

Background



Slide 2. Background

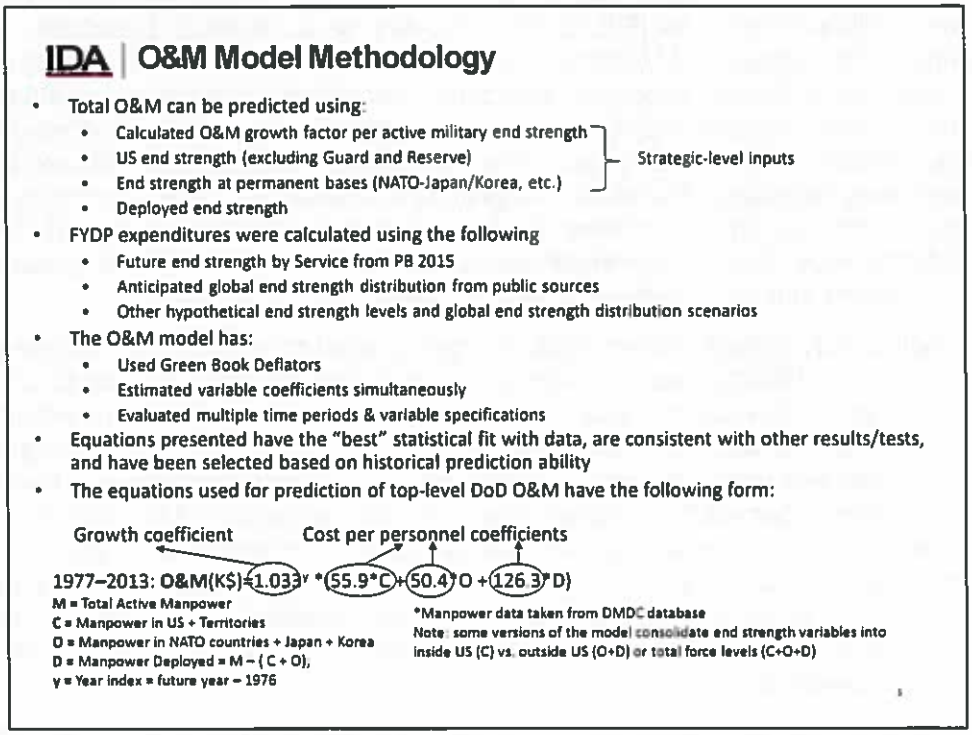
The OUSD(AT&L) asked IDA to evaluate and update a model for projecting future O&M expenditures and develop an automated O&M estimating tool for use by AT&L staff. O&M expenditures are of particular interest to the OUSD(AT&L) because they are a large and growing component of the DoD topline. In the President's Budget for fiscal year 2015 (PB15), O&M expenditures are the single largest funding title, accounting for 45% of the total DoD budget in Fiscal Year (FY) 2014. This is up from 40% of the DoD topline throughout much of the 2000s.

O&M funding supports a wide variety of day-to-day activities, such as individual and military unit training, equipment maintenance, base operations and facilities sustainment, personnel acquisition and management, and certain administrative and Service-wide activities. Despite the size and importance of the O&M account, expenditures were consistently greater than cost projections during the past two decades of Future Years Defense Program (FYDP) submissions. This behavior results in risk to military readiness, continuity of core DoD activities, and investment programs (i.e., procurement and research, development, test, and evaluation [RDT&E]), since all of these accounts have been historical "bill-payers" for O&M shortfalls when DoD budgets are decreasing and supplemental funding is scarce.

Recently, O&M shortfalls have been corrected in supplemental budget requests. During Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), and its successor Operation New Dawn (OND), supplemental funding for Overseas Contingency Operations (OCO) has funded a significant percentage of total O&M expenditures. As these contingency operations come to a close, and military personnel return to the United States, the availability of OCO or other supplemental funding is uncertain. Additionally, recent fiscal pressures on the DoD topline, and the federal government, constrain budgetary flexibility. These current conditions necessitate accurate DoD base budget O&M cost estimates to ensure military readiness, continuity of core DoD activities, and minimal disruptions to investment programs.

In 2006, the OUSD(AT&L) developed O&M cost models that use military end strength and global posture (as proxies for operations tempo [OPTEMPO]) to estimate Service and DoD O&M costs. Historically, this model's FYDP O&M estimates were more accurate than Service and DoD FYDP cost projections in predicting O&M expenditures over the FYDP.

O&M Model Methodology



Slide 3. O&M Model Methodology

The O&M model described on Slide 3, as well as its AT&L predecessors, estimates O&M expenditures based upon two types of variables: an O&M per person growth factor and the end strength/global posture of the active duty military. Both end strength and global posture variables serve as OPTEMPO proxies since they respond to the demands on the military in a similar manner. For most Service O&M cost estimates, and the top-level DoD O&M estimate, these variables statistically explain more than 90% of the historical variability in O&M expenditures since the 1970s (shown later).

The O&M per active duty military end strength growth factor is the first component of the O&M model. Surprisingly, the long-run average macroscopic DoD growth factor has

been relatively stable at about 3.5% per year per active duty end strength, when global posture is also considered (see regression results on Slide 5). Substantial annual historical O&M cost changes are mathematically explained by this real-growth factor; however, the underlying causes of this growth are complex. Example components of this cost growth factor may include changes in (1) military technology (old versus new); (2) military benefits; (3) military readiness; (4) DoD business practices; (5) external markets; (6) accounting and budgeting practices; (7) the cost or amount of equipment per active duty military end strength; and (8) changing military practices (i.e., conversion to an all-volunteer force, use of contractors in lieu of military personnel [e.g., contractor logistics support], etc.). Perceived real O&M growth per active duty military end strength can also be the result of errors in proscribed inflation indexes.

In addition, this growth can arise from both "beneficial" and "detrimental" changes to military operations, investments, personnel, and more. For example, manpower reductions resulting from a more efficient military (perhaps due to more complex and expensive equipment) can cause the O&M rate (O&M cost/military end strength) to increase because military manpower (end strength) is shrinking in the denominator of this factor, and the cost of the more complex equipment (which usually has greater O&M costs) is increasing in the numerator. However, this O&M cost growth may be offset by total cost savings elsewhere (such as in Military Personnel [MILPERS]), and may be considered "beneficial" to the Department. Conversely, O&M cost growth due to maintenance costs for aging facilities and equipment, new and more expensive equipment (that does not have an impact on end strength), or other reasons may be considered "detrimental" by some. This report does not evaluate benefits or harms that accrue from increasing or decreasing O&M expenditures per man. Nor does it evaluate the relative magnitudes of beneficial versus detrimental O&M cost changes; it does not indicate whether the level of past, present, or future O&M funding was optimal for the DoD. Further investigations could examine these underlying causes and impacts in depth, but such analysis is beyond the scope of this paper.

Active duty military end strength and global posture variables are the second component of the O&M model. End strength, global posture, and OPTEMPO are all logically likely to change as a result of major military conflicts and tensions and are expected to be O&M cost drivers. In fact, the timing of actual O&M increases and decreases during 1962–2014 correlates well with wartime and peacetime, respectively (not shown). Each of these variables is also expected to cause an enterprise-wide effect on O&M costs. Although top-level measurements of end strength and global posture correlate with major military conflicts, aggregate OPTEMPO is significantly more difficult to measure at macroscopic levels over time. In addition, end strength and global posture are strategic input variables to the DoD's plans that are recorded, tracked, and predicted. They are measurable at any time and are not subjective.

Although the general concept of estimating O&M with end strength and global posture variables remains from 2006, the composition of the variables has evolved. Previous versions of the O&M model estimate O&M using a growth factor and one of the following:

- End strength in the United States and end strength abroad
- 3–5 geographical regions (United States, Europe, Asia, Middle East, Other)
- By geographic combatant command

This paper's version of the model uses three force distribution and end strength variables: (1) active duty military end strength in the United States, (2) active duty military end strength in permanent overseas bases (which include North Atlantic Treaty

Organization [NATO] countries, Japan, and Korea), and (3) other active duty end strength deployed outside of the United States or permanent overseas bases.

These force global distribution variables are selected because OPTEMPO, which is responsible for a large portion of O&M costs/person, should be different, on average, for each category. For instance, the enterprise-wide O&M cost per person of troops stationed in the United States and overseas bases should be less than for deployed forces because OPTEMPO is lower, and logistics and supporting infrastructure (headquarters, bases, etc.) are defined and less demanding. It is unknown whether U.S. O&M cost per person is greater than permanent overseas base O&M cost per person, because the impact of host-nation support is not clear. Each of these hypotheses is generally supported by model estimates of O&M per-person cost coefficients (shown on Slide 3). It should be noted that the U.S. O&M cost per person and the permanent overseas bases O&M cost per person coefficients are not statistically different from one another (their 95% confidence intervals overlap and their coefficients are similar).

Historical actual data for force global posture is available from Defense Manpower Data Center (DMDC) to develop the O&M models. Because DMDC does not provide global posture forecasts over the FYDP, force global posture estimates during 2015–2019 used in this paper are derived from publicly available sources, including statements by DoD officials, budget or planning documentation, and accounts in the news media. The O&M cost model uses these data sources to produce logical estimates of future O&M costs. In addition, hypothetical end strength and force distribution scenarios during 2015–2019 are model inputs, used to perform "what if" O&M cost estimates. For instance, the lowest number of military deployments in recent times occurred in 1997. Using the end strength and global posture from 1997 as a model input to each year of the FYDP predicts a possible lower bound O&M cost estimate, and assumes that DoD behaviors, active military end strength, and worldwide distribution are similar to 1997 in the future.

The O&M models selected for this briefing are displayed on Slide 5 through Slide 7). Numerous versions of the O&M models were evaluated in this work. We selected models that had logical coefficients and promising descriptive statistics, and appeared to make robust forecasts over time.

The first model characteristic we evaluate is the length and duration of the O&M cost modeling time period. A cost modeling methodology is developed by systematically running multiple regressions using data from different historical time periods, comprising varying numbers of years. The 1977–2013 time period is selected because it is the era of the all-volunteer force, requires fewer data adjustments and standardizations than earlier time periods, and is robust in its forecasts.

Different force distribution variables are also evaluated, including:

- "United States" and "abroad" (two variables)
- "Deployed" and "non-deployed" (two variables)
- "Ashore" and "afloat" (two variables)
- Total DoD end strength (one variable)

It should be stressed that the O&M models described do not predict an optimal level of DoD or Service O&M funding. These O&M models forecast the Services' and DoD's likely O&M spending based on the relationship of historical O&M costs to historical global posture, active duty military head count, and O&M growth/person. These historical time periods include times of O&M funding abundance and times of suboptimal O&M funding practices (e.g., the hollow force era after Vietnam and the "procurement holiday" era after the Cold

War). In addition, these O&M models do not consider factors such as readiness and other variables that may change (e.g., Active Duty to Guard and Reserve ratios, changing readiness levels, new equipment, or concepts of operations). Thus, judgment that considers "real time" knowledge of the DoD's future plans must be used when interpreting, using, or modifying O&M estimates.

These O&M cost models are useful as starting points to evaluate official or proposed FYDP base-budgets or wartime O&M projections under various force structure and global posture scenarios. If there are significant differences between the O&M projections derived from these cost models and the DoD's or the Services' estimates, it is useful to question assumptions to gain an understanding of why the future O&M/person relationships are expected to be different from the historical O&M/person relationships.

This paper evaluates whether future DoD or Service O&M cost projections, given a specified level of active duty military end strength and global posture (as a proxy for OPTEMPO), are consistent with expectations based on history.

Baseline DoD Future End Strength Distribution

IDA | Baseline DoD Future End Strength Distribution

- End strength total from PB 15
- Force distribution from public sources

	Derived End Strength for FY 13-19						
	Personnel Distribution						
	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19
United States	1,084,881	1,057,392	1,043,941	1,017,441	993,241	973,541	963,741
NATO, Japan, Korea	146,917	144,502	142,087	142,087	142,087	142,087	142,087
Deployed	150,547	121,406	121,172	121,172	121,172	121,172	121,172
Total	1,382,345	1,323,301	1,307,200	1,280,700	1,256,500	1,236,800	1,227,000

- Changes in end strength levels from PB 2015:
  - Army: reduction from 532,043 to 420,000 through 2019
  - Navy: reduction from 323,951 to 315,718 through 2019
  - Marine Corps: reduction from 195,657 to 174,000 through 2019
  - Air Force: reduction from 330,694 to 303,852 through 2019
- Alternative scenario shifts "deployed" end strength in excess of the minimum historical deployment level (which occurred in 1997) to the U.S. for all future years

Slide 4. Baseline DoD Future End Strength Distribution

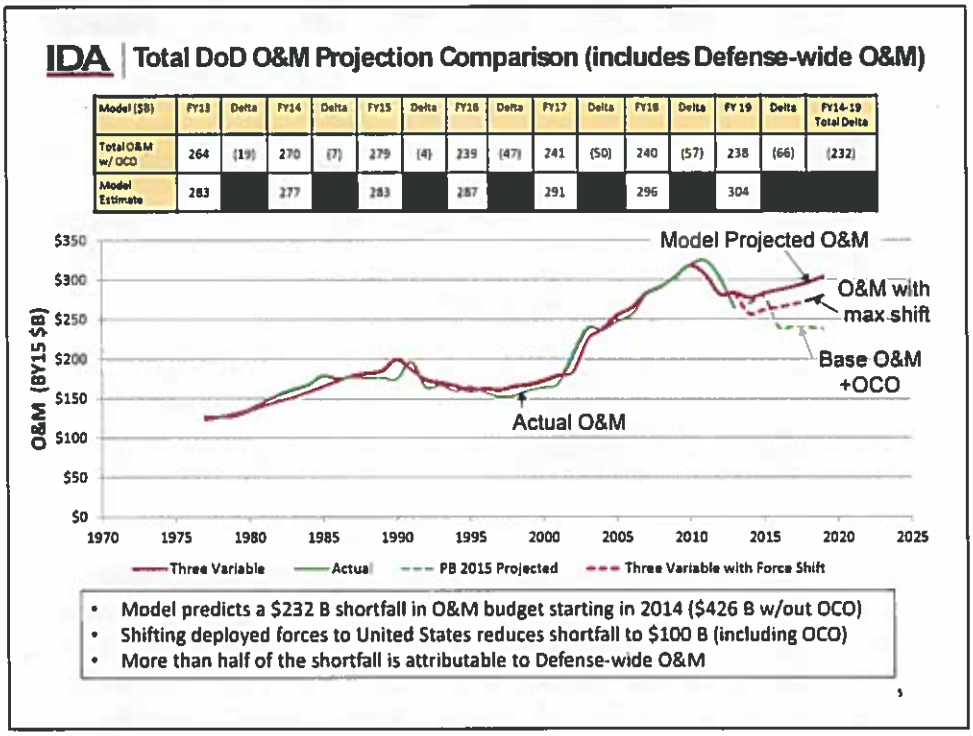
Slide 4 shows DoD FY 2013–FY 2019 end strength and global posture estimates that are used to project O&M during the FYDP in this paper. Adjustments are made to DMDC total end strength data because they are not consistent with total military end strength reported in PB15. Specifically, DMDC's 2013 percentage of total end strength in the "United States," "Permanent Overseas Bases," and "Deployed" categories are applied to the historical 2013 total military end strength reported in PB15. Because DMDC has not yet reported global posture information for 2014, the ratios from 2013 were applied to the 2014 total end strength reported in PB15. The number of troops in the "United States," "Permanent Overseas Bases," and "Deployed" categories are then adjusted based on expectations reported in publicly available sources. End strength reductions projected in

PB15 and the return of forces from Afghanistan to the United States constitute most of the change to future end strength projections. These same end strength and global posture adjustments are applied to each of the four Services (data not shown). The expected Service end strength changes reported in PB15 are also shown on this slide.

As described previously, forecasts of O&M costs throughout the FYDP are also generated using 1997 end strength and global posture (~35,000 troops deployed) actuals. This develops "lower bound" O&M cost forecasts that are consistent with recent historical relationships between O&M, end strength, and global posture (and thus OPTEMPO).

The automated O&M model enables analysts to develop models and perform their own "what if" analyses by choosing regression eras and providing end strength/global posture forecasts.

Total DoD O&M Projection Comparison



Slide 5. Total DoD O&M Projection Comparison (Includes Defense-Wide O&M)

Slide 5 shows actual top-level DoD O&M (solid green line) costs from 1977 through 2013 in billions of BY 2015 dollars, along with the model's cost estimate (solid red line). DoD PB15 (dashed green line) and model forecasts (again displayed as a solid red line) are shown for the FYDP ending in 2019. FYDP estimates are based on expected global posture from adjusted DMDC data (described previously) and PB15 total end strength.

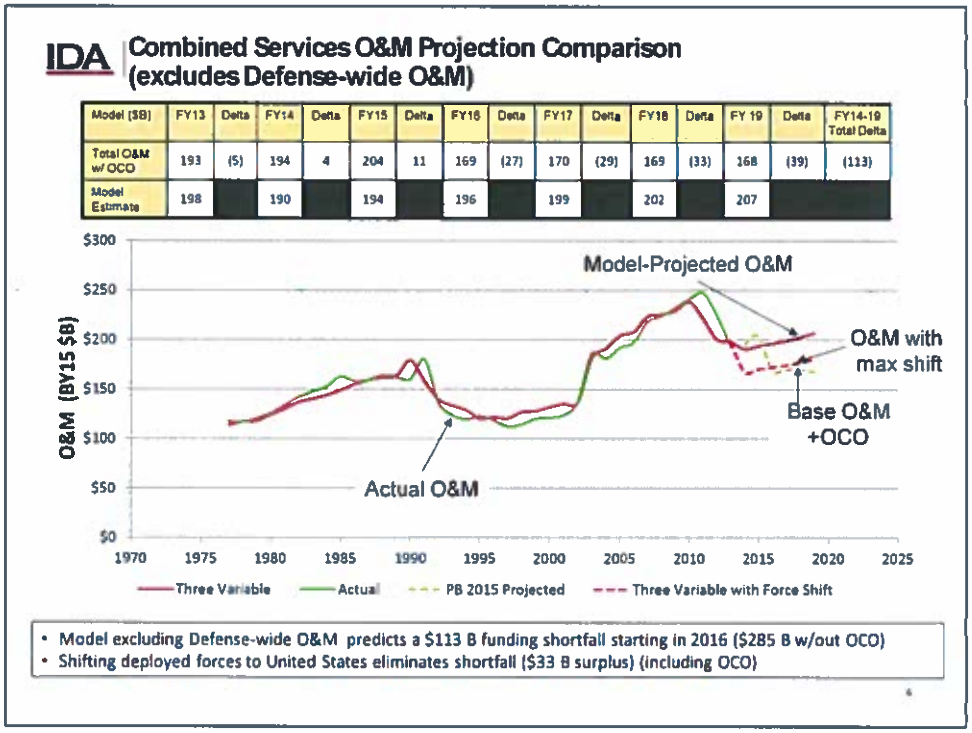
The "lower bound" O&M cost forecast (dotted red line), which is consistent with recent historical relationships between O&M, end strength, and global posture in 1997 (which had the minimum number of deployments in recent times), is also shown.

Actual DoD O&M cost and modeled O&M cost during 1977–2013 are similar; however, both the baseline O&M cost model and the "lower bound" O&M cost model are higher than PB15 O&M requests (including OCO) in the FYDP. The O&M model forecasts that O&M will cost $232 billion more than PB15 requests (with expected OCO) over the

FYDP; excluding the DoD's expected OCO increases this difference to $426 billion. The lower-bound estimate is $100 billion more than DoD's PB15 request (including OCO).

On Slide 5, much of the difference in O&M estimates during the FYDP is attributable to Defense-wide O&M, which is difficult to model using end strength and global posture variables. Slide 6 depicts a model that removes Defense-wide O&M and re-estimates O&M expenditures from 1977 through the FYDP.

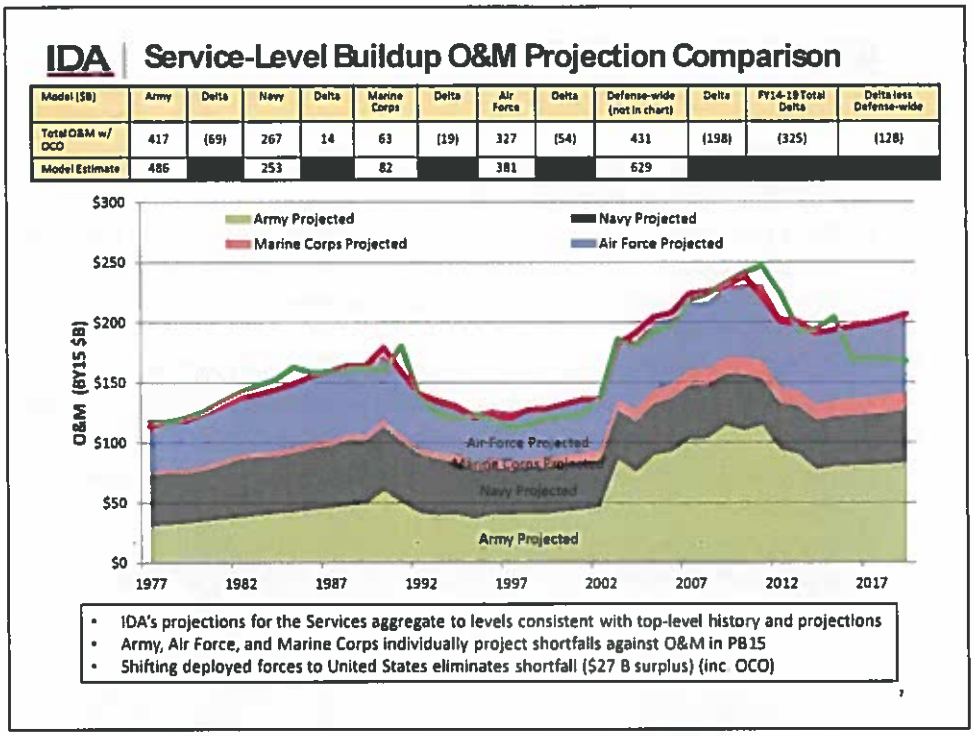
Combined Services O&M Projection Comparison



Slide 6. Combined Services O&M Projection Comparison

Slide 6 shows that historical actuals and model-calculated O&M (both excluding Defense-wide O&M) track reasonably well. In the FYDP, model forecasts of Service-only O&M are $113 billion larger than Service-only O&M in PB15 (with requested OCO added). This increases to $285 billion if OCO is removed from expected Service-only O&M. In the alternative scenario, deployments fall to a minimum historical level, and the model projects O&M costs $33 billion lower than those contained in PB15 (with requested OCO). It should be emphasized, however, that the alternative scenario is inconsistent with publicly available information on the DoD's future end strength and global posture.

Service-Level Buildup O&M Projection Comparison



Model ($B)	Army	Delta	Navy	Delta	Marine Corps	Delta	Air Force	Delta	Defense-wide (not in chart)	Delta	FY14-19 Total Delta	Delta less Defense-wide
Total O&M w/ OCO	417	(69)	267	14	63	(19)	327	(54)	431	(198)	(325)	(128)
Model Estimate	486		253		82		381		629			

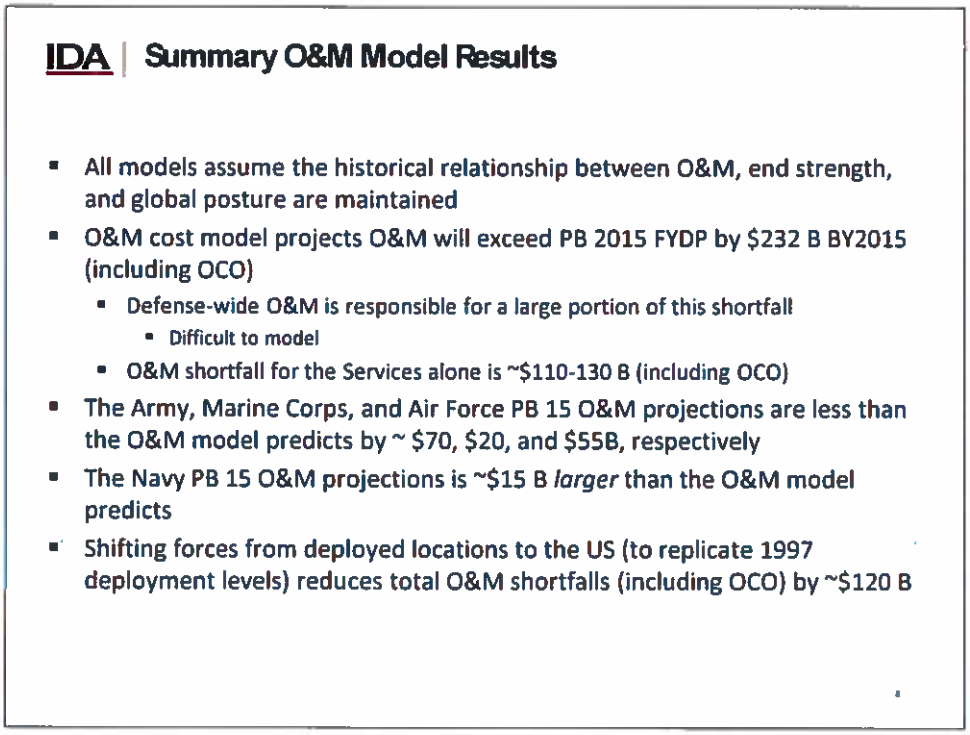
Slide 7. Service-Level Buildup O&M Projection Comparison

Slide 7 depicts O&M model estimates from each individual Service-specific O&M cost model that was generated for this paper (colored areas). These estimates were generated using historical and PB15 projected military end strength data by Service and estimates of each Service's global posture from publicly available sources, cited previously. In addition, the O&M model estimates from the combined Services model (discussed on Slide 6, and excluding Defense-wide) is shown with a red line. The solid green line represents actual combined-service O&M expenditures and requests over the FYDP from PB15.

The sum of O&M cost estimates from individual Service cost models are very close to the projection from the combined Services O&M model for the entire time period evaluated. Both estimating methodologies are larger than PB15 combined Service O&M requests by over $100 billion in the FYDP, and both modeling methodologies project surpluses of ~$30 billion in the "lower bound" scenario. Thus, the models remain consistent.

Slide 7 documents PB15 O&M requests, corresponding O&M cost model projections, and the difference between them. Three of the four Services' (Army, Marine Corps, and Air Force) PB15 O&M requests are lower than the corresponding Service-specific O&M model projections (not shown). Only the Navy PB15 O&M request is larger than the O&M model forecasts, but, in practice, this surplus would be retained by the Navy and not used to offset the shortfalls of the other Services.

Summary O&M Model Results



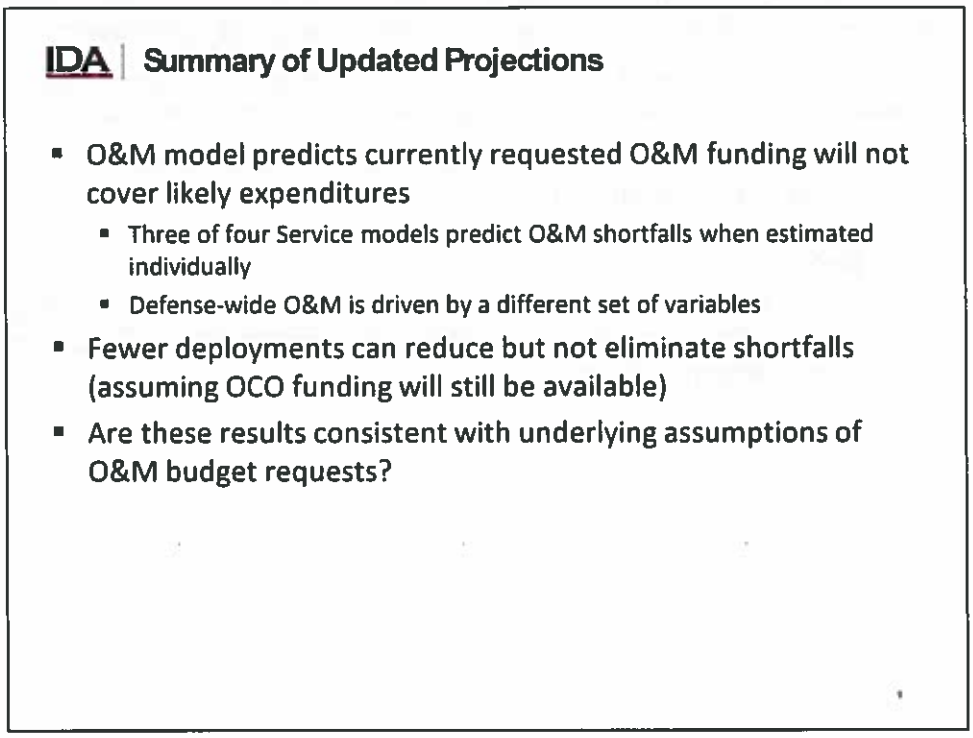
Slide 8. Summary O&M Model Results

Slide 8 summarizes this paper's O&M cost projections using PB15 data. Estimates are generated at the DoD level, the combined Service level, and for the individual Services. Except for the Navy, the O&M forecasts in this paper are significantly higher than those reported during the FYDP in PB15. The top-level DoD O&M model in this paper predicts that the DoD will spend ~$230 billion more on O&M than is in the PB15 FYDP. Much of this difference (~50%) is attributable to Defense-wide O&M, which is difficult to model. Removing Defense-wide O&M from total DoD O&M reduces the projected shortfall over the FYDP by nearly half, to $110–$130 billion.

We also generated O&M cost models for each of the Services individually. The Army, Marine Corps, and Air Force FYDP O&M levels are lower than the O&M model predictions by $70 billion, $20 billion, and $55 billion, respectively. In contrast, the Navy cost model in this paper estimates lower O&M costs than the Navy FYDP O&M level by ~$15 billion. When aggregated (with the Navy overage canceling part of the shortfalls of the other Components), combined individual O&M cost model projections for each of the four Services are consistent with a single cost model that evaluates total DoD O&M, excluding Defense-wide O&M.

What-if analyses demonstrate that bringing most of the deployed troops back to the United States (1997 deployment levels) would decrease the difference in DoD O&M at top level by more than half. Such an aggressive redeployment scenario would also eliminate shortfalls in the combined Services cost model and reduce the shortfalls in the individual Service models. These projections, of course, include projected future OCO under the current PB15 estimates, which may not materialize if overseas military commitments shrink to historically low levels.

Conclusions



Slide 9. Summary of Updated Projections

The O&M models in this paper indicate that requested O&M funding in the FYDP is less than historical relationships would suggest. This is true both at the top level of the DoD and for three of the four individual Services. These trends will likely continue even if the military reduces its deployments quickly. Only at historically minimal levels of deployments, far different from the global posture at the time of this study, do O&M levels requested by the DoD match model-projected O&M costs. We do not have a robust model to make a projection of future O&M expenditures for Defense-wide O&M.

The estimating methodology discussed in this paper could allow the OUSD(AT&L) analysts to evaluate O&M costs using just a few strategic variables. In addition, it enables "what if" analyses with respect to military end strength and global posture. O&M models and their projections can elucidate inconsistent cost-driving assumptions and help to highlight them for discussion and analysis in the budget process.

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Acknowledgments

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