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United States Government Accountability Office
Washington, DC 20548

June 29, 2012

Congressional Committees

Subject: *Navy Training: Observations on the Navy's Use of Live and Simulated Training*

The Department of Defense uses live training, simulators, and other virtual training devices to prepare its forces to conduct military operations. Virtual training can help the services mitigate obstacles to training, such as the high cost of conducting live training or range access issues, while allowing military personnel to replicate many of the interactions and procedures they may encounter on the battlefield. In an effort to achieve greater efficiency, maximize training opportunities, and potentially reduce training costs, each military service is in various stages of developing concepts and training programs that mix live and synthetic training (which is how the Navy typically refers to training that relies significantly on simulators or virtual training devices).¹ The Navy, in particular, believes that effective training requires an efficient balance of live and synthetic approaches.

H.R. Rep. No. 112-78 (2011), which accompanied a bill for the National Defense Authorization Act for Fiscal Year 2012, directed GAO to review the status of the military services' training programs and report the results to the House and Senate Armed Services committees. It also stated that in reporting on each of the services, we may take a phased approach in undertaking our review and reporting to the Senate and House Armed Services committees.² This Navy review is the first engagement in our phased approach, and an Air Force review is also underway. For this review, we assessed (1) the principles the Navy considers in determining whether to use live or synthetic training to meet its training requirements, (2) how the Navy's mix

¹ For the purposes of this report, "simulators" will be used to describe specific devices that mimic actual equipment, such as a flight simulator, while "synthetic training" will refer to any training that takes place in a virtual environment.

² H.R. Rep. No. 112-78 (2011), which accompanied H.R. 1540, a bill for the National Defense Authorization Act for Fiscal Year 2012.

of live and synthetic training has changed over time, and (3) how the Navy prioritizes its synthetic training investments.

To address our objectives, we interviewed officials and reviewed and analyzed data from Navy headquarters and Navy commands, including the Office of the Chief of Naval Operations, as well as the U.S. Fleet Forces and Pacific Fleet Commands; commanders from the aviation, submarine and surface platform communities; resource sponsors for these platform communities; and the Naval Reserve Command. We reviewed Navy and command policy guidance, including the Fleet Training Simulator Strategy³ which provides detailed objectives for investments in simulators and synthetic training. We also reviewed the Fleet Synthetic Training Program Instruction⁴ and the Fleet Training Continuum Instruction⁵ which provides guidance on how to successfully execute fleet training. We reviewed Navy's Aviation Simulator Master Plan, which included information on planned investments in aviation simulators.

We conducted this performance audit from August 2011 to June 2012, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence provides a reasonable basis for our findings and conclusions based on our audit objectives.

Summary

To determine whether to use live or synthetic training to meet its training requirements, the Navy relies on guiding principles outlined in its Overarching Fleet Training Simulator Strategy. These principles are intended to provide flexibility in determining the appropriate solution for a specific training requirement or gap, while maintaining readiness levels and capitalizing on technical advances in modeling and simulation. In applying these principles, Navy decision makers

³ *Overarching Fleet Training Simulator Strategy in support of Synthetic Training in Program Objective Memorandum 2013 and beyond* (Jan. 25, 2011).

⁴ Commander, U.S. Fleet Forces Command and Commander, U.S. Pacific Fleet Instruction 3500.3, *Fleet Synthetic Training Program* (Mar. 31, 2011).

⁵ Commander, U.S. Fleet Forces Command and Commander, U.S. Pacific Fleet Instruction 3501.3C, *Fleet Training Continuum Instruction* (Mar. 31, 2011).

consider the circumstances surrounding each individual requirement. For example, the Navy may choose to use synthetic training where regular live training is not feasible due to operational, cost, or safety concerns, such as training for ballistic missile defense.

Over the last decade, the Navy has increased its emphasis on the use of synthetic training. For example, between 2003 and 2011, the Navy has taken certain steps, such as establishing organizations to focus on synthetic training and issuing a concept of operations. The Navy's platform communities currently use different mixes of live and synthetic training. For example, the submarine community conducts all of its pre-deployment training in shore-based simulators. Navy surface ships have the capability to conduct just over half of their training synthetically, but the mix of actual training varies by ship-type and by mission area. Navy makes significant use of simulation for new pilot training and pilot practice once personnel are assigned to operational units, but Naval aviation makes limited use of synthetic training for graded events⁶ due to concerns about simulation realism and safety. According to Naval Reserve Command officials, there are no significant differences between the anticipated tasks that active and reserve component forces conduct when using simulators.

The Navy's Overarching Fleet Training Simulator Strategy also provides 12 investment priorities for synthetic training. For example, aviation, littoral combat ship, and future platform simulator procurement takes precedence over legacy platform simulator investments. The Navy applies these priorities to guide decisions on simulator procurement and upgrades at both the platform and fleet levels. At the platform level, the aviation community has an investment strategy, contained in its naval aviation simulator master plan; the surface community is working on a master plan, which is expected to be complete by the end of the year; and the priority in the submarine community is ensuring that upgrades to the actual submarines are made to the corresponding simulators. At the fleet level, a fleet training integration panel prioritizes investments across the platforms and fleets and provides a forum where the priorities of each platform community compete against each other. For additional details on our results, see enclosure I.

⁶ Graded training events are those that are reported through the Navy's readiness reporting system.

Agency Comments

In commenting on a draft of this report, the Department of Defense concurred with our report and observations. The Department's comments are reprinted in their entirety in enclosure II.

We are sending copies of this report to the Secretary of Defense, the Secretary of the Navy, and to the appropriate congressional committees. The report also is available at no charge on the GAO website at <http://www.gao.gov>. Should you or your staff have any questions on the matters discussed in this report, please contact me at (202) 512-9619 or pickups@gao.gov. Contact points for our offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who contributed to this report are listed in enclosure III.

A handwritten signature in black ink that reads "Sharon L. Pickup". The signature is written in a cursive, flowing style.

Sharon L. Pickup
Director
Defense Capabilities and Management

Enclosures – 3

List of Committees

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Chairman
The Honorable John McCain
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Howard P. McKeon
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

Navy Training: Observations on the Navy's Use of Live and Simulated Training

Briefing for the Senate and House Armed Services Committees

Background

- The Navy uses a combination of live and synthetic¹ training to prepare its forces to conduct military operations.
 - Live Training: Navy personnel and units conduct live training using actual platforms (ship, submarine, aircraft) **at sea or on a live training range.**
 - Synthetic Training: Navy personnel and units conduct synthetic training **in a virtual or simulated environment.** This training often involves the use of simulators, computer software that is embedded in a weapon system, or hardware and networks which can be used to conduct training while ships are pierside or underway.

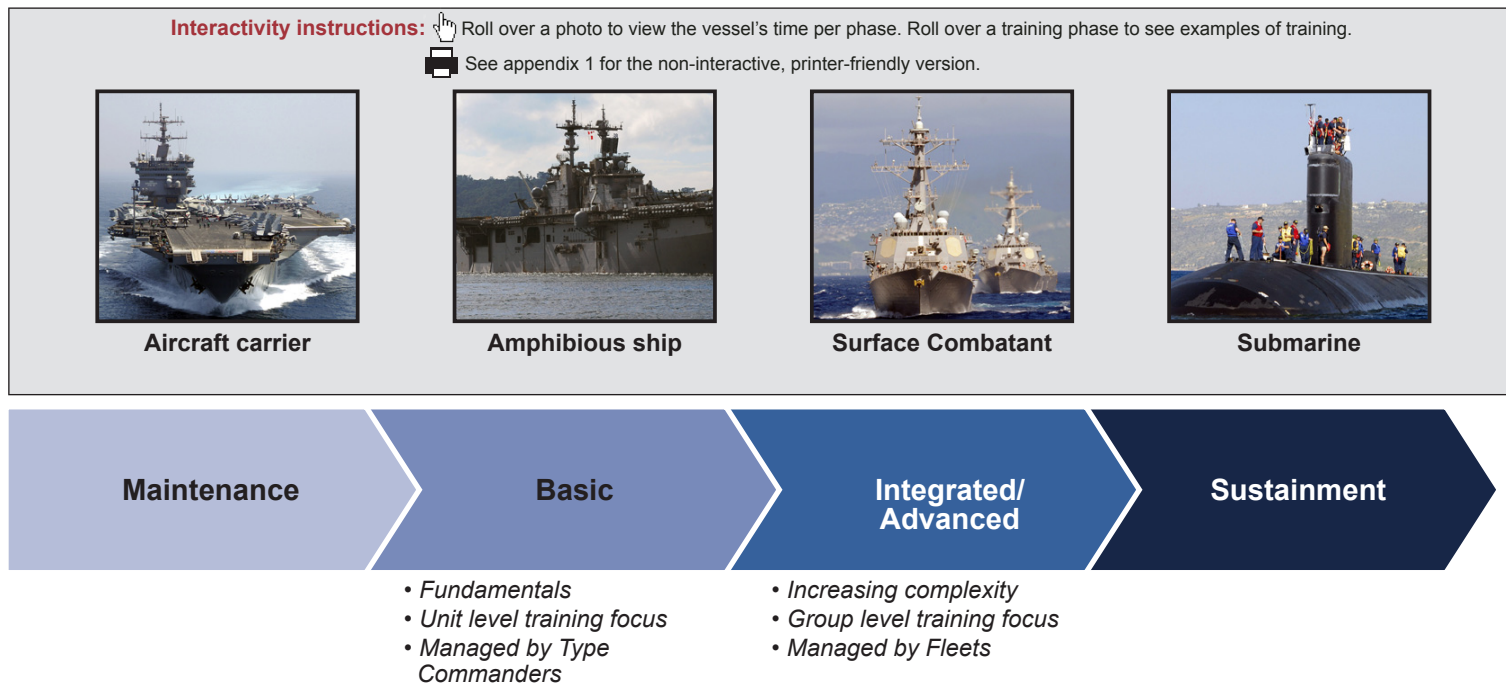
¹ The Navy uses the term “synthetic” rather than “simulated”.

Background (cont'd)

- The Navy has a phased plan (called the Fleet Response Training Plan) that identifies the types of training needed to prepare its forces to deploy for military requirements. Most live and synthetic training occurs within the basic and integrated phases, but some training occurs in all phases.
 - Basic Phase: By the end of this phase, units are expected to exhibit unit level proficiency (e.g., effectively employ weapons and equipment). Type Commanders for each of the Navy's **platform communities** (surface, submarine, and aviation) schedule, plan, and execute unit-level synthetic training events.
 - Integrated/Advanced Phase: During this phase, unit warfare skills are combined so units form a cohesive strike group. The Navy's two **fleet commands** – US Fleet Forces Command and the US Pacific Fleet – train and equip forces during the integrated/advanced phase.

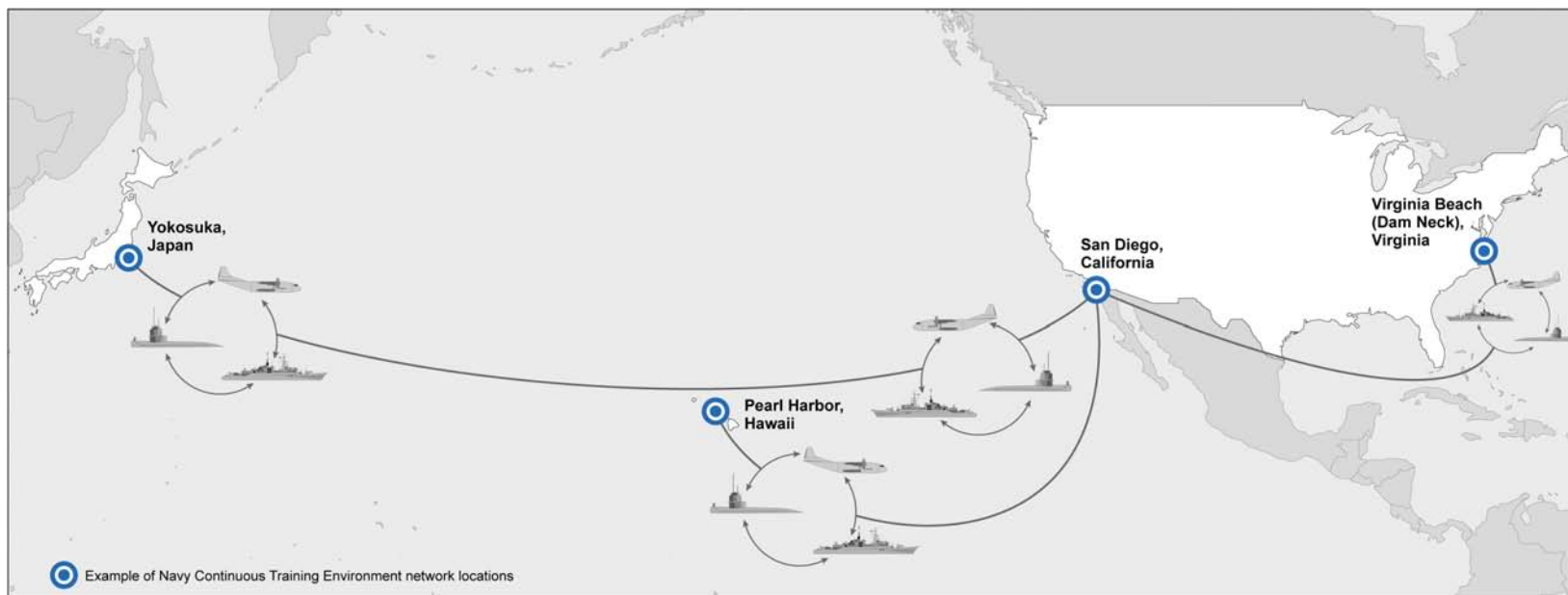
Background (cont'd)

Notional Fleet Response Training Plan Timeline



Background (cont'd)

- The Navy has developed a network called the Navy Continuous Training Environment to distribute synthetic training to its ships, submarine simulators, and aircraft simulators.
- While connected to the network, units that are separated by hundreds of miles or more can train as though they were operating in close proximity to one another.



Source: GAO analysis of Navy data.

Background (cont'd)

- H.R. Rep. No. 112-78 (2011), which accompanied a bill for the National Defense Authorization Act for Fiscal Year 2012, directed GAO to review the status of the military services' training programs and report the results to the House and Senate Armed Services committees.
- This review covers the Navy. We are reporting separately on the Air Force, Army, and Marine Corps.

Objectives

- 1) What principles does the Navy consider in determining whether to use live or synthetic training to meet its training requirements?
- 2) How has the Navy's mix of live and synthetic training changed over time?
- 3) How does the Navy prioritize its synthetic training investments?

Obj 1: Determining the Training Mix

- To determine whether to use live or synthetic training to meet its training requirements, the Navy uses the *Overarching Fleet Training Simulator Strategy*, which includes ***guiding principles***.
- These ***guiding principles*** are intended to provide flexibility in determining the appropriate solution for a specific training requirement or gap, while maintaining readiness levels and capitalizing on technical advances in modeling and simulation.

Obj 1: Determining the Training Mix (cont'd)

Guiding Principles (1 of 2)

- 1) Effective training requires an efficient balance of live and synthetic approaches.
 - 2) Simulator decisions are complex and require thoughtful and thorough analysis.
 - 3) Train in port and validate at sea, or train on the ground and validate in the air, or train at home base and validate in the field.
 - 4) Training simulators should be used to replace live training to the maximum extent possible where training effectiveness and operational readiness are not compromised.
 - 5) Some live training events cannot or should not be replaced by a simulator.
 - 6) If a skill or talent **can be** developed or refined, or if a proficiency **can be** effectively and efficiently maintained in a simulator, then these skills/talents/proficiencies **should be** developed/refined/maintained in a simulator.
-



Obj 1: Determining the Training Mix (cont'd)

Guiding Principles (2 of 2)

- 7) If a qualification or certification can realistically and economically be accomplished in a simulator, do it in a simulator.
- 8) Simulator training objectives must be directly linked with specific Navy Mission Essential Tasks or individual personnel qualification standard requirements.
- 9) Simulators that are intended to interface with other simulators during Fleet Synthetic Training² events must be compatible with the Navy Continuous Training Environment network.
- 10) Simulators that could conceivably be used for multi-platform or cross-platform mission area training should be designed with integration as a primary goal.
- 11) Simulators should provide the appropriate level of fidelity required to effectively and economically train to the specified task(s).
- 12) Simulator procurement needs to stay aligned with Fleet-wide technical innovation to deliver timely, cost effective solutions.

² Fleet Synthetic Training is an event for multiple platforms of various types (air, surface, submarine) or individual units with training audiences connected at different locations through the network, which could be local or worldwide.

Obj 1: Determining the Training Mix (cont'd)

Examples of Applying Guiding Principles (1 of 2)

- The Navy's ***guiding principles*** provide decision makers with a measure of flexibility that allows them to customize simulator decisions based on the individual circumstances surrounding each training requirement. The following are examples of how the Navy applies its guiding principles:
 - Guiding principle 6 states that if a skill or talent can be developed in a simulator, then it should be developed in a simulator. Based on that principle, Navy decision makers have chosen to use synthetic training in areas where regular live training is not feasible due to operational, cost, or safety concerns, such as training for ballistic missile defense.
 - Guiding principle 5 states that some live training events cannot or should not be replaced by a simulator. In 2008, the Navy found that lowering the number of live flying hours below 10 per month resulted in increased risk of accidents while flying. Therefore, Navy decision makers choose live training when the use of synthetic training would cause pilot live flying hours to fall below 10 hours per month.

Obj 1: Determining the Training Mix (cont'd)

Examples of Applying Guiding Principles (2 of 2)

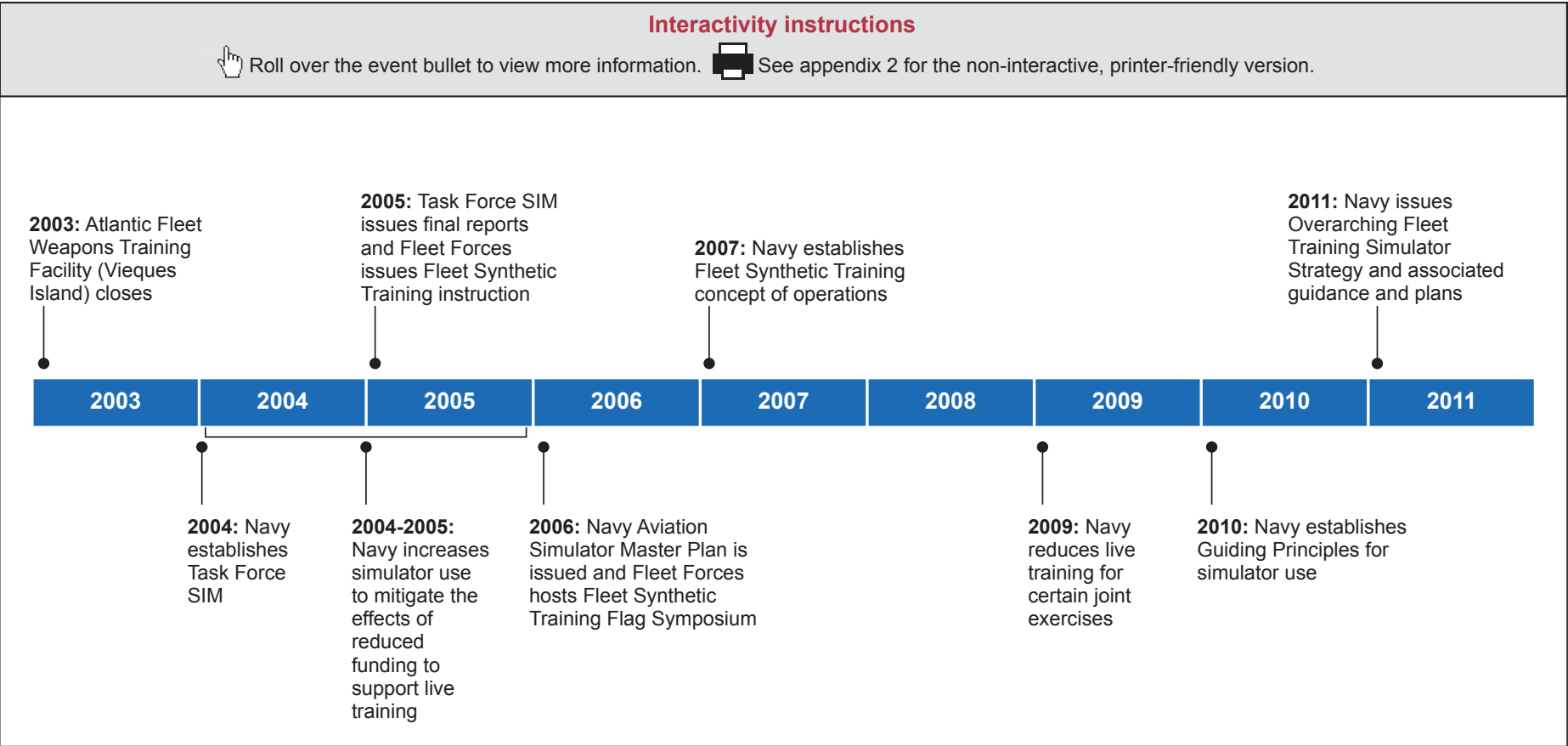
- Guiding principle 1 states that effective training requires an efficient balance of live and synthetic approaches. Based on the principle of efficient balance, the incremental costs associated with a live training event (e.g., fuel, ammunition) must be compared to the incremental costs associated with conducting the event synthetically (e.g., simulators, technical support). Although synthetic training is generally less expensive than live training, decision makers may opt to conduct live training in some cases because the incremental cost of conducting that live training is very low. For example, because a ship's crew typically conducts multiple live training events while underway, moving a single live event to synthetic training would not reduce underway time or fuel costs and it could add to simulator costs, thus making it more expensive to conduct the event synthetically.

Obj 2: Changes in the Training Mix

- The Navy has increased its emphasis on and use of synthetic training over the last decade, as shown on the following slide.
- Currently, the use of synthetic training varies within and among the platform communities because of differences in their training needs.

Obj 2: Changes in the Training Mix (cont'd)

Timeline of Key Milestones



Source: GAO analysis of Navy data.



Obj 2: Changes in the Training Mix (cont'd)

- The Navy's **platform communities** (i.e., surface, submarine, and aviation) use different mixes of live and synthetic training.
 - **Submarine forces:** Submarines use shore-based simulators for all of their pre-deployment training. Some submarines have two rotating crews,³ which led the Navy to procure simulators to synthetically train the at-home crew because live training was not possible. These simulators were then used to train the entire submarine community. This level of synthetic training is possible because the hardware and software in the simulators is the same as that in the actual submarines.
 - **Surface forces:** Surface ships have the capability to conduct just over half of their training synthetically, but the mix of actual training varies by ship type and mission area. For example, some of the oldest ships do not have the type of computer infrastructure needed to support extensive synthetic training and require special technical assistance during Fleet Synthetic Training events. Conversely, simulators for one of the newest ships, the Littoral Combat Ship, are intended to provide crews with full certification prior to deployment, much like submarine crews.

³ To maximize the presence of these submarines, one crew is always at sea, while the other is at home.

Obj 2: Changes in the Training Mix (cont'd)

- **Aviation forces:** Naval aviation currently relies more heavily on live training due to concerns about simulation realism and safety. Fleet Forces Command and Naval aviation command officials noted that Navy makes significant use of simulation for new pilot training and pilot practice, once personnel are assigned to operational units. They also noted, though, that pilots currently do not complete a significant portion of their graded⁴ training events in a synthetic environment. The use of synthetic training in the aviation community varies significantly depending on airframe and mission area. For example:
 - At present, synthetic training accounts for:
 - 18 percent of all F/A-18E/F (fighter) training.
 - Over 50 percent of all P-3 (surveillance aircraft) electronic warfare training.
- Although the aviation community expects synthetic training to increase in the future, it expects live training to remain a majority of total training for key airframes through 2020.

⁴ Graded training events are those that are reported through the Navy's readiness reporting system.



Obj 2: Changes in the Training Mix (cont'd)

- According to Naval Reserve Command officials, there are no significant differences between the anticipated tasks that active and reserve component forces conduct when using simulators. According to these officials:
 - Reservists have access to simulators either in classroom training environments or when they are training with their active component counterparts.
 - The preferred and most common training for a reservist is side-by-side with active component personnel.

Obj 3: Prioritizing Synthetic Training Investments

- The Navy's *Overarching Fleet Training Simulator Strategy* also provides ***investment priorities*** for synthetic training.
- The Strategy states that it is imperative that all training simulator and synthetic training system investments be made in a cost-conscious manner with careful consideration for how those investments will contribute to platform or integrated readiness. In particular, it states that the Fleet must invest in areas that will close the most critical training capability gaps and improve warfighting readiness while providing the highest return on those investments.

Obj 3: Prioritizing Synthetic Training Investments (cont'd)

Investment Priorities (1 of 2)

- 1) Training simulators and synthetic training systems that have the greatest potential to improve mission performance.
 - 2) Investments focus on operator/team training more than staff level training (i.e. training that improves a specific skill as opposed to training in decision-making).
 - 3) Investments that enable cross-platform and multi-platform synthetic training that improve collective warfare area proficiency and readiness.
 - 4) Navy Continuous Training Environment network reliability and sustainability upgrades.
 - 5) Aviation, Littoral Combat Ship, and future platform simulator procurement takes precedence over legacy platform simulator investments.
 - 6) Integration of simulators for current platforms.
 - 7) Investments that procure new or upgraded simulators with greater fidelity.
-

Obj 3: Prioritizing Synthetic Training Investments (cont'd)

Investment Priorities (2 of 2)

- 8) Fleet Training Integration Panel approved warfare area training priorities.
- 9) Training simulators and synthetic training systems that fill gaps in existing live training.
- 10) Investments that provide common data (compiled from historical, worldwide environmental data) for use during cross-platform integrated training, which realistically replicates conditions that affect sensor/communications/weapon system performance.
- 11) Investments that provide a common synthetic training architecture using common security protocols and databases that integrate and can be easily updated as simulators are upgraded.
- 12) Training simulators and synthetic training systems that have the greatest potential to generate savings over live training.

Obj 3: Prioritizing Synthetic Training Investments (cont'd)

- The Navy applies these investment priorities to guide decisions on simulator procurement and upgrades. These decisions are made at both the platform (i.e., surface, submarine, and aviation) and fleet levels (i.e., Fleet Forces Command and Pacific Fleet).
 - At the platform level:
 - Naval aviation has a master plan investment strategy for simulator upgrades to key airframes.
 - The surface community is working on a master plan for synthetic training, which is expected to be complete by the end of the year.
 - The submarine community's training is fully synthetic; its priority is ensuring that upgrades to the actual submarines are also made in the corresponding simulators.
 - The surface and submarine communities also use stakeholder committees to help make simulator procurement and upgrade decisions.
 - At the fleet level, a fleet training integration panel prioritizes investments across the platforms and the fleets.

Obj 3: Prioritizing Synthetic Training Investments (cont'd)

- Although the aviation community has, to date, made limited use of synthetic training for graded events, it has seen opportunities for potential savings and has developed an investment plan to prioritize simulator investments, with the intent of reducing live training costs and achieving better overall training through development and use of high-fidelity simulation.
- The Navy Aviation Simulator Master Plan lays out anticipated simulator upgrades for key existing airframes that are expected to remain in service through 2030. The aviation community identified which simulator upgrades could reduce the most flight-hours and provide the best return on investment. They concluded that an investment of roughly \$500 million over 7 years starting in fiscal year 2012 could lead to a return of \$119 million per year beginning in fiscal year 2020.
- The Navy plans to apply a similar analysis to all new-production systems, including the P-8A, E-2D, and Navy F-35C.

Obj 3: Prioritizing Synthetic Training Investments (cont'd)

- By airframe, Navy's expectations are that the use of synthetic training, as a percentage of unit training, will be as follows:

Synthetic training as a percentage of total training

Aircraft Platforms	Current state	In 2020
F/A-18E/F	18	32
EA-18G	20	34
MH-60R	39	48
MH-60S	41	49

Obj 3: Prioritizing Synthetic Training Investments (cont'd)

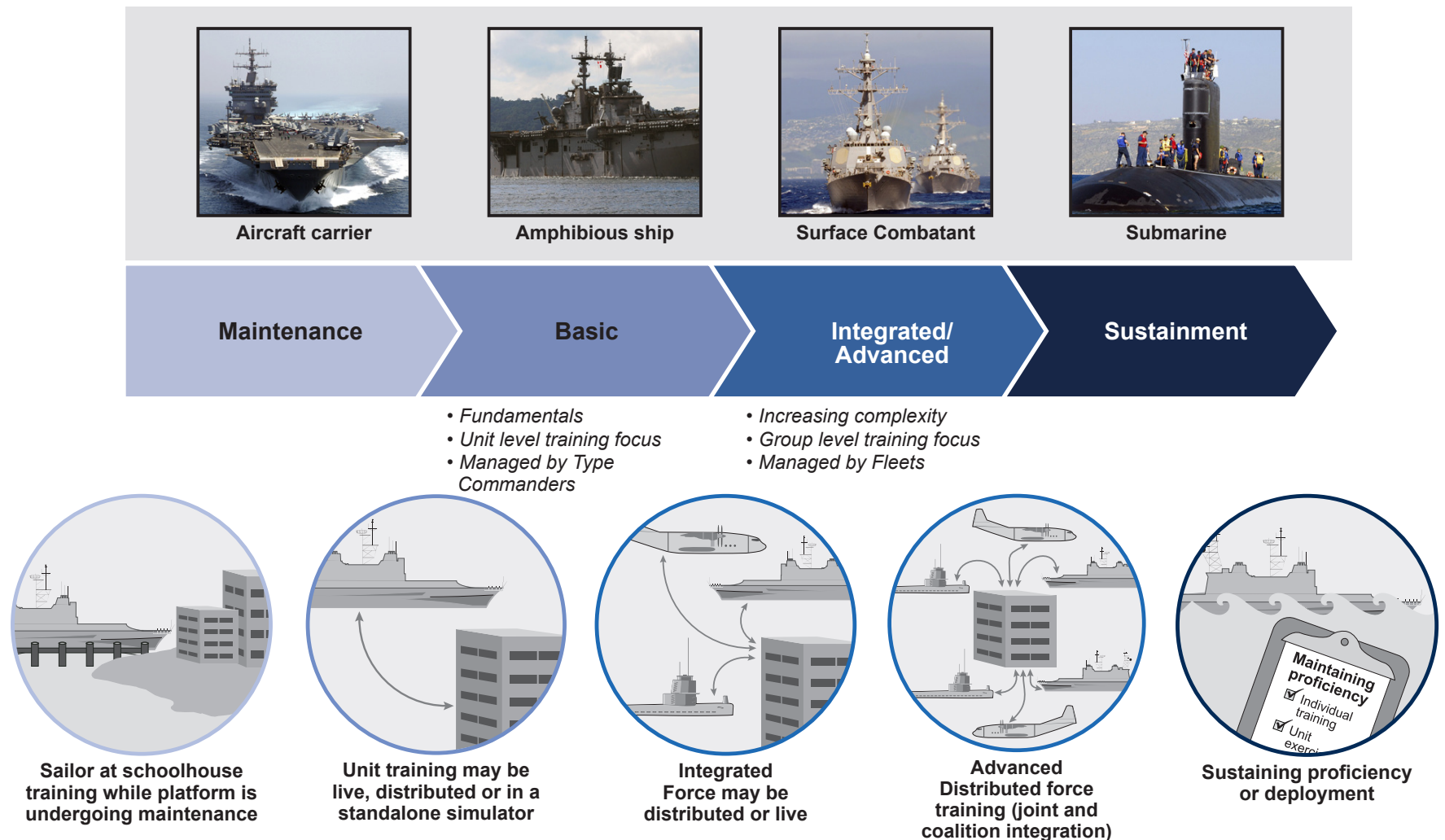
- The surface and submarine communities use platform committees to involve relevant stakeholders in investment decisions.
 - The Surface Warfare Training Committee is responsible for completing and implementing the surface training master plan and assessing training systems and devices for inclusion into the plan. The committee also produces analyses and cost estimates to help guide simulator decisions.
 - The submarine community manages its simulator upgrades to ensure that they align with upgrades to the actual submarines and weapon systems. They also use the Undersea Warfare Training Committee to prioritize training requirements. A member of the committee told us that its analyses are focused on mission essentiality, cost, and delivery mechanisms.

Obj 3: Prioritizing Synthetic Training Investments (cont'd)

- At the fleet level, the Fleet Training Integration Panel, co-chaired by the Atlantic and Pacific fleets, provides a forum where the priorities of the platform communities compete against each other.
- The panel receives inputs from many organizations, including the platform communities, resource sponsors, and contracting offices, among others, and is intended to ensure an integrated training effort as well as establish accountability for fleet training. It also identifies corrective action plans that require additional resources.
- The panel has predominantly focused on platform area synthetic training in accordance with the Fleet Strategy, and less on multi-platform integration.
 - According to the Strategy's guiding principles, simulators that could be used for multi-platform or cross-platform mission area training should be designed with integration as a primary goal. The Fleet commands have thus drafted "roadmaps" to identify cross-community synthetic training integration capabilities needed to enable warfare area training.

Appendix 1: Notional Fleet Response Training Plan Timeline

Notional Fleet Response Training Plan Timeline



Appendix 1: Notional Fleet Response Training Plan Timeline



Aircraft carrier



Source: GAO analysis of Navy data.

Appendix 1: Notional Fleet Response Training Plan Timeline



Amphibious ship



Source: GAO analysis of Navy data.

Appendix 1: Notional Fleet Response Training Plan Timeline



Surface combatant

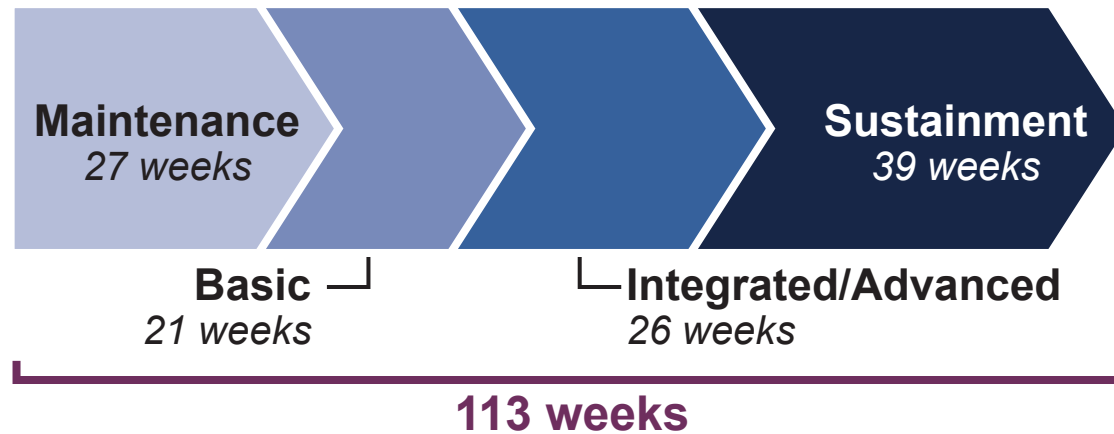


*The Integrated/Advanced training phase includes an average of 14 weeks for Carrier Strike Group escorts and 12 weeks for independent deployers

Appendix 1: Notional Fleet Response Training Plan Timeline



Submarine



Appendix 2: Timeline of Key Milestones

Year	Event
2003	Atlantic Fleet Weapons Training Facility (Vieques Island) closes The closure of the Vieques live training range left the Navy with a gap in its training capabilities. This closure was announced in 2001.
2004	Navy establishes Task Force SIM The Chief of Naval Operations established Task Force SIM (simulation) to provide guidance and a framework for the use of modeling and simulation in the Navy. The task force focused on strike group training and multi-platform, mission-linked tactical flight training, among other things.
2004-2005	Navy increases simulator use to mitigate the effects of reduced funding to support live training Navy begins to increase simulator use to mitigate reduction in flying hours and steaming days and loss of availability of the Vieques range.
2005	Task Force SIM issues final reports and Fleet Forces issues Fleet Synthetic Training Instruction In April and May 2005, Task Force SIM reported on its efforts to promote fleet readiness and joint interoperability by providing a strategic framework and guidance for Navy-wide use of modeling and simulation to support training, acquisition, experimentation, and analysis conducted in synthetic and live environments. In its report, the task force identified initial savings strategies. In November 2005, U.S. Fleet Forces issued the Fleet Synthetic Training Instruction to provide specific responsibilities and procedures for surface ships, submarines, and air squadron personnel regarding Fleet Synthetic Training events.
2006	Navy Aviation Simulator Master Plan is issued and Fleet Forces hosts Fleet Synthetic Training Flag Symposium In April 2006, the Navy Aviation Simulator Master Plan was issued as a strategy to upgrade simulator-based training. In May 2006, Fleet Forces hosted the Fleet Synthetic Training Flag Symposium to articulate a requirement for synthetic training and chart the course for the Navy's Synthetic Training program.
2007	Navy establishes Fleet Synthetic Training concept of operations In April 2007, the Navy issued the Fleet Synthetic Training concept of operations for the Navy Continuous Training Environment. In this concept, the Navy noted that, due to cost, environmental, and political concerns, live range availability was more limited than it had been in the past. The Navy believed that fleet synthetic training could mitigate the impacts of this by substituting, where appropriate, synthetic training for some live training requirements.
2009	Navy reduces live training for certain joint exercises The Navy reduced live underway training for certain joint task force exercises from 3 weeks to 2 weeks per event.
2010	Navy establishes Guiding Principles for simulator use The Chief of Naval Operations approved the guiding principles for simulator use, which established fleet-wide policy.
2011	Navy issues Overarching Fleet Training Simulator Strategy and associated guidance and plans In January 2011, the Navy Fleet commanders issued the Overarching Fleet Training Simulator Strategy, which included the guiding principles established in 2010 as well as investment priorities. Following this, the Navy updated the Fleet Synthetic Training Program Instruction and issued the Fleet Training Continuum Instruction. The Commander, Naval Air Forces also updated the 2006 Aviation Simulator Master Plan with guidance for specific synthetic training investments.

Enclosure II: Comments from the Department of Defense



PERSONNEL AND
READINESS

OFFICE OF THE UNDER SECRETARY OF DEFENSE
4000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-4000

Ms. Sharon L. Pickup
Director, Defense Capabilities and Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

JUN 19 2012

Dear Ms. Pickup,

This is the Department of Defense (DoD) response to the GAO Draft Report, GAO-12-725, "NAVY TRAINING: Observations on the Navy's Use of Live and Simulated Training, dated June 1, 2012 (GAO Code 351646)."

Thank you for opportunity to comment on your Draft Report. The Department agrees with the report and observations. The Navy has a comprehensive program providing the affordable mix of live and synthetic training, as appropriate to each platform community. The Navy program has been analyzed and established in accordance with Navy wide criteria and priorities documented in broad plans and guidelines. Their efforts are commendable.

Sincerely,

A handwritten signature in black ink, appearing to read "Laura J. Junior", is written over the typed name.

Laura J. Junior
Deputy Assistant Secretary of Defense
Readiness

Enclosure III: GAO Contact and Staff Acknowledgments

GAO Contact

Sharon Pickup, (202) 512- 9619 or pickups@gao.gov.

Staff Acknowledgments

In addition to the contact named above, key contributors to this report included Michael Ferren, Assistant Director; Clarine Allen; Grace Coleman; James Lackey; Amie Steele; Maria Storts; and Nicole Willems.

(351646)

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