Defense Standardization Program

Case Study

Navy Self-Contained Breathing Apparatus

Market Research Yields Significant Results

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Market Research Yields Significant Benefits

This case study illustrates how the Navy applied market research to achieve significant qualitative and quantitative benefits by using a standard commercial product for self-contained breathing apparatus (SCBA) acquisitions.

Background

For more than 50 years, sailors who were responsible for firefighting and damage control on U.S. Navy vessels have worn a device called an oxygen breathing apparatus (OBA). The breathing apparatus is a critical life-support system that allows firefighting and damage control teams to work in smoke-filled environments or areas containing noxious fumes or gases. Breathing apparatuses are used to rescue sailors from life-threatening environments and allow damage control parties to minimize or prevent damage to the ship.

OBA design and technology date from the 1930s and 1940s. The basic OBA components include a faceplate, breathing tubes, a regulator, harness, and oxygen-generating canister. Users wear the OBA on the chest, with a facemask that resembles gas masks used during World War I. An oxygen-generating canister supplies 30 to 60 minutes of breathable air, depending on the wearer's respiration rate. The canister, which produces oxygen from a chemical reaction similar to the devices used to generate emergency oxygen in commercial aircraft, is not refillable; it must be disposed of after use. Once the canister begins to generate oxygen, it cannot be turned off and restarted.

The technology used in OBAs was leading edge more than 50 years ago. The design for OBAs came from a traditional Navy research and development program. The technical requirements were set forth in military specifications MIL-B-24692A, *Breathing Apparatus, Oxygen Generating, Type A-4 (Metric)*, and MIL-C-17671F, *Canister, Oxygen Breathing Apparatus, for Type A-4*. Those specifications have not been revised since 1993 and 1989, respectively. Only one or two suppliers have produced the OBA for the Navy.

The number of breathing apparatuses in the Navy varies with the number and type of active vessels. The Naval Sea Systems Command (NAVSEA) estimates there are more than 15,000

breathing apparatuses in service. The Navy establishes a minimum allotment for each class of vessel depending on the ship's size and crew and the function it performs. For example, a Nimitz-class aircraft carrier with a shipboard and aircrew contingent of about 5,800 will have a complement of 382 breathing devices. An Arleigh Burke-class guided missile destroyer with a crew of 366 will have a complement of 73. When not in use, breathing apparatuses are housed in storage lockers strategically placed throughout the vessel.

Problems

OBAs present technological, ergonomic, logistical, and expense issues—SCBAs are an improvement in all areas.

While OBAs have continued to perform their intended function adequately since their introduction into the Navy more than 50 years ago, numerous problems and issues have arisen around the technology, ergonomics, logistics support, and cost.

Technology

The OBA was state-of-the-art technology when it was introduced, but over the years the design had remained the same. In the meantime, commercial breathing apparatuses were developed for fire departments, and a competitive environment encouraged the introduction of newer technology. For many commercial applications, SCBAs replaced breathing devices with oxygen-generating canisters. SCBAs use a cylinder of compressed air to supply the wearer with breathable air, similar to the way a skin diver receives air. SCBA cylinders can be recharged in 1 minute or less; OBA canisters must be replaced after use.

OBAs have numerous technological deficiencies:

- No recent safety features such as visual, audible, and vibratory indicators to alert the user of low air supply
- Hose material deteriorates when exposed to ultraviolet light;
- Bacteria can grow in the breathing unit
- Oxygen canisters generate heat as a byproduct, creating the potential for burns and posing a storage and possible fire hazard

- OBAs are not certified by the National Fire Protection Association (NFPA) and the National Institute of Occupational Safety and Health (NIOSH).

OBAs are purchased according to military specification requirements. Without a change to those specifications, there is no opportunity or incentive for a manufacturer to enhance the product with new features and technology.

Ergonomics

Users wear OBAs on the chest; SCBA users wear the air cylinders, mounted on a harness, on the back, which improves weight distribution and affords more arm flexibility, essential in fighting fires. OBAs could hinder users who needed to crawl to avoid heat or smoke.

OBAs are harder to put on, prone to snagging on shipboard objects, and more uncomfortable to wear, especially for female sailors. OBA ergonomics cost the wearer additional fatigue during firefighting tasks.

SCBAs allow easier movement in passageways.

Logistics Support

OBAs required more costly logistics support than SCBAs. The system design requires the Navy to inventory and provide numerous spare oxygen canisters. After the canisters are spent, they require additional handling and processing for environmentally sound disposal. Parts of the OBA, such as hoses, are more prone to damage and failure than modern SCBAs, requiring frequent maintenance and replacement parts. The Navy is responsible for maintaining a logistics infrastructure for the OBAs that includes inventory management of the units, canisters, and spare parts, and distribution to the fleet.

Costs

Because the commercial firefighting market has moved to modern SCBA designs, there are no large commercial production runs available to the Navy. With only one or two manufacturers of the OBAs, prices are dis-

proportionately high for the level of technology provided. The price of oxygen canisters increased sharply in recent years, increasing the cost of live training as well as the cost of replacing canisters consumed in normal use. Acquisition projections had focused on the costs of the devices themselves, but did not fully consider the life-cycle cost implications.

Outcome

NAVSEA recognized the OBA shortcomings and began research and development for a new breathing device during the 1980s; however, this effort was not completed. With the advent of acquisition and military specification reform in the 1990s, it became clear that the traditional way of doing business was changing and that a commercial solution to the Navy's breathing apparatus requirements might offer significant benefits.

Detail of SCBA air cylinder.

Based on Office of the Secretary of Defense guidance, a NAVSEA Integrated Products Team (IPT) was created in September 1996 to plan the next breathing apparatus acquisition. The IPT was a cross-functional industry and government team. Team members were chosen for their expertise and knowledge about the product and acquisition reform initiatives. Team members worked to ensure that the next breathing apparatus acquisition would meet or exceed the requirements of the end users.

The IPT began the acquisition process by conducting market research of all existing commercial SCBAs to determine if commercial SCBAs would meet Navy requirements. NAVSEA tested all the commercial units. The product evaluations focused on safety requirements, reliability, and interchangeability of the systems, which provided the Navy with insight into the commercial technology being used, and provided NAVSEA with good product knowledge useful for planning the upcoming acquisition.

The IPT also investigated creative ways to purchase the SCBAs. The General Services Administration (GSA) was supplying government agencies with commercial SCBAs through a Federal Supply Schedule (FSS). The Navy originally rejected use of the SCBA FSS because

Navy requirements far exceeded the FSS maximum order limitation, and because the FSS did not provide enough flexibility in the technical terms. The Navy also required that the SCBAs and spare parts be available for at least 10 years, which exceeded the FSS 1-year contracts.

Despite the apparent roadblocks to using the FSS, the IPT was undeterred. The team met with the GSA Administrator and explained the impediments to using the FSS for procurements such as the SCBA. GSA was receptive to the Navy requests and initiated a process that resulted in a legislative change that eliminated the maximum order limitation and the requirement to recompete FSS contracts annually. GSA now awards 5-year FSS contracts with the option for an additional 5-year extension. After overcoming initial objections to the use of the GSA Schedule, NAVSEA proceeded with an FSS acquisition.

GSA allowed FSS contracts to be awarded every five years instead of annually in order to streamline the SCBA acquisition process.

Evaluation

The Navy prepared a draft commercial item description (CID) containing Navy requirements and solicited the commercial SCBA vendors. NAVSEA also conducted an industry briefing and went through several rounds of questions and answers with vendors. The Navy gave SCBA vendors an opportunity to demonstrate their commercial units. The demonstration allowed vendors to present their units in the best light. At the same time, the demonstration revealed major drawbacks in some units. For example, one potential vendor had a major component of its SCBA fail during the demonstration. Other vendors offered SCBAs that did not comply with the Navy-required NFPA and NIOSH standards.

NAVSEA also asked the vendors to provide bid samples of the actual units being offered. This allowed the Navy to evaluate various SCBAs by thoroughly examining, operating, and maintaining them using original equipment manufacturer (OEM) maintenance manuals. The operational experience with the bid samples further revealed the true advantages and disadvantages of the units. Evaluators assessed how the units actually performed, as opposed to how they were designed to perform. This evaluation uncovered sharp edges on one device that could cause injury. Other units had features that could snag on ship passage-

ways or were too large to fit into space aboard ship. Identifying these problems would have been difficult without a bid sample and a highly qualified evaluation team.

After a thorough evaluation of the commercial SCBAs, the Navy determined that a commercial unit could meet its requirements as well as provide the latest technology. The Navy also determined it did not need to engage in costly research and development. The increased flexibility in the FSS contracts allowed the Navy to award a 5-year contract, with an option to extend the contract for an additional 5 years. For ordering the SCBAs, the Navy created a blanket purchase agreement (BPA) under the FSS. BPAs allow streamlined, incremental ordering of the units, eliminating the need for maintaining inventories and ensuring that the latest commercial technology will be available in the new units.

Life-cycle costs were an important factor in determining the commercial SCBA vendor.

Life-Cycle Costs

NAVSEA evaluated SCBA vendors by using a best-value approach. Life-cycle costs over a projected 15-year service life were considered, including commercial warranties and cost factors such as purchase price, maintenance, disposal, and warranties. The unit with the lowest price did not have the lowest life-cycle costs. From the winning vendor, the Navy received a 15-year warranty on the regulator and an 8-year warranty on the entire SCBA. After selection of the SCBA vendor, other offerors were debriefed thoroughly on both their technical evaluations and life-cycle costs. The debriefing provided guidance to the other vendors on how to improve their products and be more competitive on future SCBA acquisitions.

Investments and Payoffs

The SCBA program to replace the OBAs is in progress—both OBAs and SCBAs are being purchased. Funding has not been authorized to replace all OBAs; therefore, they will be replaced incrementally. This incremental replacement will lower the risk to the Navy, provide additional opportunities for competition, and allow product improvement on the newest units. Table 1 shows a comparison of the OBA and SCBA purchase prices.

	Basic Unit	1 Box Canisters	1-2 Spare Cylinders	Total
OBA	$1,500	$500	N/A	$2,000
SCBA	$1,600	N/A	$1,000	$2,600

Table 1 ***Comparison of OBA and SCBA Purchase Prices***

Because purchase quantities and prices change, the values, rounded to the nearest $100, are representative for comparison only. The SCBA basic unit, which includes a cylinder, is fully functional; however, Navy practice is to have one or two spare cylinders for every SCBA. This practice allows quick cylinder changes. Empty cylinders can be taken to a compressor for recharging. To replace 15,000 OBAs with SCBAs at $2,600 per unit would cost $39 million. Because the SCBA is a commercial item, the Navy does not need to invest in a research and development effort.

The OBA cannot function without an oxygen canister, so the true cost of the unit must include the cost of the canisters. Because the canisters are used up and must be replaced, the effective cost of an OBA exceeds that of an SCBA. SCBA cylinders are designed to last 15 years.

Table 2 provides an estimate of the annual logistics support costs for OBAs and SCBAs.

	OBA Costs ($)	SCBA Costs ($)		
		SCBA	Compressor	Total SCBA Costs
Periodic maintenance	1,435,500	731,250	589,500	1,320,750
Corrective maintenance	930,000	207,750	438,000	645,750
Oxygen-generating canisters	4,387,500	0	0	0
Canister disposal	2,109,375	0	0	0
Cylinder pressurization tests	0	177,750	0	177,750
Cylinder replacement	0	851,250	0	851,250
Breathable air certification	0	0	215,250	215,250
Purifier cartridges	0	0	689,250	689,250
Total	$8,862,375	—	—	$3,900,000
Net annual savings of $4,962,375 15-year savings of $74,435,625				

Table 2 ***Estimated OBA and SCBA Annual Logistics Support Cost Comparison (based on 15,000 units)***

Source: NAVSEA PEO EXW SEA91.

Periodic maintenance for both OBAs and SCBAs includes labor, parts, and tools for normal maintenance such as cleaning, lubrication, and adjustments necessary to keep the apparatus in good operating condition. The OBAs use older technology and materials and require more maintenance.

Corrective maintenance for both OBAs and SCBAs includes labor, parts, and tools to repair the devices or replace damaged or broken parts. The SCBA warranty for 8 years and regulator for 15 years substantially reduce the number of repairs and replacements the Navy must perform. For most of the SCBA life, the Navy need be concerned only with paying to replace or repair damaged items. Defective parts are covered under the warranty.

SCBA commercial units are not only cost-effective, they provide more safety features and solve hazardous material handling problems.

The SCBAs incur additional costs that the OBAs do not. The air cylinders require periodic pressurization tests and certification, and the compressors used to fill the cylinders require tests to ensure they produce uncontaminated breathing air. Air purifiers for the compressors are an added cost. Although the air cylinders have a 15-year service life under normal conditions, an additional annual cost is incurred to replace some air cylinders because of wear and tear or damage.

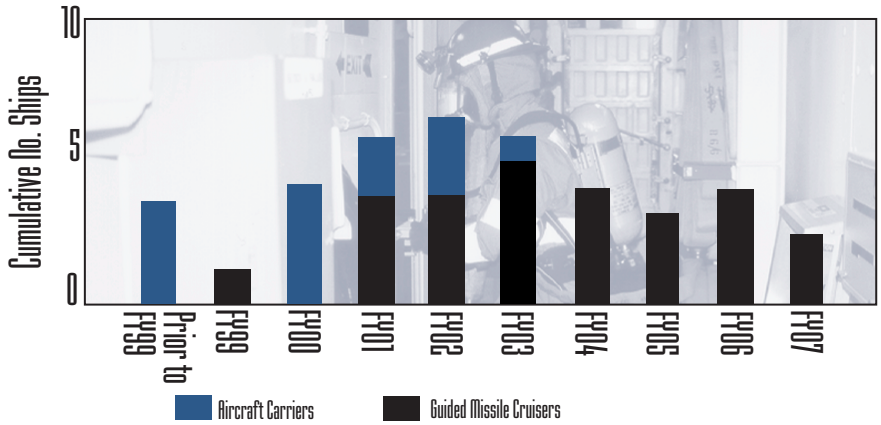
Despite the additional cost factors for SCBAs, the overall logistics cost benefit for SCBAs compared to OBAs is better than 2:1. Over a 15-year period, nearly $75 million in logistics savings will result from the replacement of 15,000 OBAs with SCBAs. Including the estimated $39 million investment cost of purchasing the SCBAs leaves a net estimated savings of nearly $35 million.

Qualitative Benefits

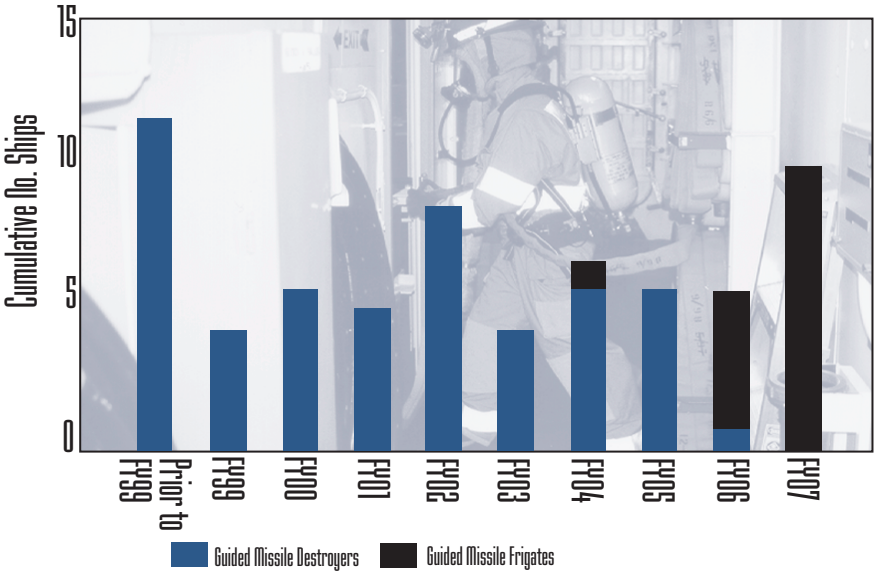
The financial benefits of switching from OBAs to SCBAs are important, but perhaps of even greater importance are qualitative benefits the Navy receives. The commercial units feature a rapid refill capability and state-of-the-art audible and vibratory low air alarms. The commercial units provide improved ergonomics standardization and simpler operation and training. The commercial units solve hazardous material handling and disposal issues that existed with the OBAs. By buying a commercial

product, the Navy also receives the benefit of new technology insertion at no additional development cost. The initial increment of SCBAs purchased for the fleet are being retrofitted to include an additional alarm to meet the latest NFPA requirement.

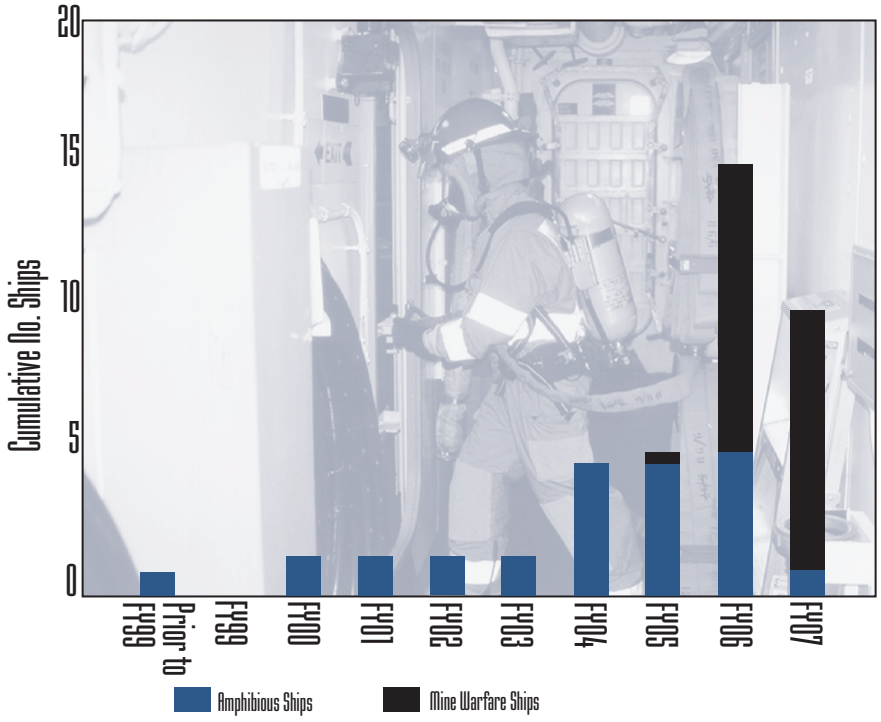
Fleet reports on SCBA performance in shipboard fires has been positive. Shipboard experience indicates that the SCBAs are more comfortable and less fatiguing to wear, have more safety features such as the



Actual and Planned SCBA Outfittings
Aircraft Carriers and Guided Missile Cruisers



Actual and Planned SCBA Outfittings
Guided Missile Destroyers and Frigates



Actual and Planned SCBA Outfittings
Amphibious and Mine Warfare Ships

audible and vibratory alarms, and have cylinders that can be recharged quickly. Perhaps the most important reason for switching to a commercial SCBA is that it gives sailors a greater firefighting capability and therefore an enhanced ability to save lives and equipment.

Status

As of early 2001, the Navy continues its replacement of OBAs with SCBAs. Approximately 6,900 SCBAs have been introduced into the fleet. Funding limitations have affected the quantity and timing of the replacements, but NAVSEA anticipates the eventual replacement of 15,000 OBAs with SCBAs.

The Military Sealift Command and U.S. Coast Guard also have shown interest in purchasing the SCBA. If they decide to do so, they will be permitted to use the Navy BPA to order the SCBAs from the GSA Schedule.

Summary

NAVSEA, through its aggressive and innovative pursuit of a standard, commercial SCBA, obtained a unit with the following characteristics:

- NFPA and NIOSH-approved SCBAs are more comfortable to wear and more reliable, with better performance and lower life-cycle costs
- An 8-year "bumper-to-bumper" warranty on the total system and a 15-year warranty on the regulator
- Air cylinders that can be refilled in less than 1 minute
- Integral, audible, and vibratory low-air alarms.

The Navy negotiated a 60 percent discount off the SCBA manufacturer's list price; cost is less than that of a typical high-end personal computer system.

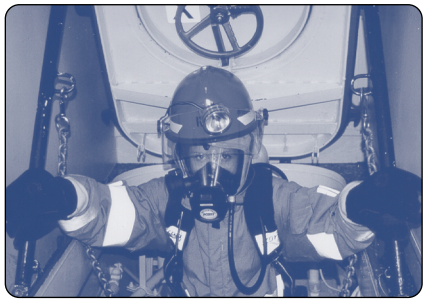
Lessons Learned

Several lessons that underscore the importance of standardization principles emerged during the Navy research and acquisition of SCBAs. These lessons include the value of market research, the advantages of forming an IPT, the benefits of challenging existing processes, the logic of incremental acquisition, the need for debriefing unsuccessful vendors, and the advantage of seeking commercial warranties. Following is a summary of the lessons learned in this case:

- Market research showed that standard, commercially available SCBAs can meet Navy requirements and provide enhanced capabilities while lowering life-cycle costs.
- The IPT process allowed representatives from the fleet to take part in procurement planning from the earliest stages. The IPT process improved the requirements development process and customer satisfaction.
- By aggressively pursuing a commercial SCBA purchase using the GSA Schedule, the SCBA acquisition team not only benefited

from a streamlined SCBA acquisition, but helped bring about fundamental changes in GSA business practices that now allow streamlined purchases of all commodities throughout the federal government. The willingness to take a forward-looking approach and challenge conventional practices and procedures can have profound effects that go beyond a single program.

- Making incremental purchases allows the vendor to add the latest technology to the SCBAs and prevents the Navy from being saddled with many obsolescent units.
- A thorough debriefing of the unsuccessful vendors on both their technical approach and life-cycle costs enhances their ability to improve their products and compete more successfully for the remainder of the Navy SCBA requirements.
- Making the contractor's warranty provisions a source selection evaluation factor can pay substantial dividends. The warranty coverage obtained for the SCBAs will greatly reduce maintenance and replacement costs for the Navy.
- Specifications, military or commercial, that are not updated to keep pace with technology changes can result in purchases of items that are outdated and costly to buy, maintain, and replace. Specifications are designed to set forth the technical requirements so producers may compete on a common basis. However, when specifications become outdated, they may have the unintended effect of limiting competitive opportunities as producers abandon obsolete designs and technology.
- An evaluation of commercial items is essential since not all commercial products are created equal. In giving SCBA vendors an opportunity to demonstrate their commercial products, the Navy discovered major drawbacks in some units.



SCBAs provide the wearer with greater arm flexibility.

Making Systems Work Together

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