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Data Analysis for a Navy Education Strategy

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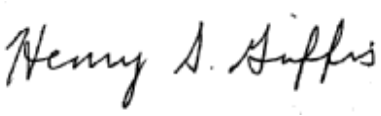

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Contents

Executive summary

This report details data analysis done in support of developing an education strategy for unrestricted line (URL) officers in the Navy. The Navy is a technical institution. Some believe that Navy officers need a background in technical studies (engineering, science, and math) to be proficient in their communities. Within a Navy officer's career, however, there is a shift in job requirements. As officers become more senior, jobs require less tactical proficiency and more decision-making and critical thinking skills. We analyzed a variety of data to investigate the need for technical backgrounds for URL officers, as well as the graduate education that can provide the critical thinking skills needed for later in the career.

Areas of analysis

The belief that success in the Navy requires a technical undergraduate education has been accompanied by a belief that officers have been less technical in recent years—as measured by whether an officer has an undergraduate major in engineering, science, or math. We classify URL accessions according to whether they had a technical degree, as well as by community, gender, and source of entry. We look at the quality spread between technical and nontechnical majors, using the order of merit (OOM) ranking from the United States Naval Academy (USNA). We also summarize literature analyzing the value of a technical undergraduate education in terms of performance and retention.

The Navy wants its officers to get graduate education because it can enhance critical thinking as well as provide specific expertise. We looked at when in their careers Navy officers earn graduate degrees, where they receive them, and whether they are resident or nonresident degrees. Again, we summarize literature regarding the value of graduate education in terms of performance and retention.

The Navy is a closed labor market, and officers typically come in with only a Bachelor's degree, so the Navy must provide any graduate education it wishes its officers to have. However, URL officers already have career paths that are filled with sea tours, shore billets, and other training requirements. We analyze the career paths of URL officers to see where graduate education might fit.

The Navy has specific requirements for graduate education in certain fields, such as financial management. Billets are coded as requiring a graduate-level knowledge of specific fields, and officers receive similar codes on receiving graduate degrees. We analyze the inventory of billets with graduate education requirements alongside the inventory of educated officers, as well as the match of officers to billets.

Findings

We find that the level of technical degrees for URL accessions has been relatively stable over time, despite beliefs in the Navy that it has been declining. Only the submarine community has seen a small decline. Gender is not an issue since male and female accessions have nearly the same percentages of technical degrees. The percentage of technical accessions in the top third of the USNA class has also been steady, and there is no difference by gender. Recently, the percentage of accessions in the top third has fallen for the submarine community. Previous research has shown that having a technical degree does not significantly increase retention. In addition, there were no significant differences in performance, as measured by success in dropping laser-guided bombs (LGBs) or in winning ship awards.

We analyzed the when, where, and how of URL officer graduate education and found the following:

- Officers predominantly earn degrees as lieutenants and lieutenant commanders.
- Since 1981, almost 40 percent of officers earned their degrees at the Naval Postgraduate School (NPS), and over 10 percent received degrees from the Naval War College (NWC).

- The number of URL officers going to NPS has dropped of late, though overall URL endstrength has also declined.
- More officers received degrees through in-resident than non-resident education in 2005, though the numbers are much closer than they have been in the past.

In our review of past research on graduate education, we did not find that it improved performance, again as measured by dropping LGBs successfully or winning ship awards. The literature did show, however, that officers with graduate degrees are more likely to promote and tend to stay longer than officers without graduate degrees.

We use the career paths of submarine and surface warfare officers (SWOs) to create an average career path, using those who made it to at least the rank of commander. In comparing our career paths with the expected paths obtained from community managers, we find that there is some room in both communities for officers to obtain graduate education at the first shore tour. Aviators do not have the same opportunity for graduate education at this point because they are mainly still in flying billets, typically as instructors. A lot of the discussion of fitting graduate education into a career path concerns a 20-year career, but the career path of a *successful* officer is longer. Average career lengths for officers promoted to commander, and not beyond, is 21.5 years. For officers promoted beyond commander, careers average 27.6 years. These longer careers should be considered when thinking about return on investment of graduate education.

Our career path analysis shows that officers have opportunities to get graduate degrees early in their careers, but we believe the use of specific skills will not occur until later in their careers. There seems to be an abundance of officers with the necessary skills, as set out in the billet requirements. The match of officer skills to billet requirements is very low, however, even when considering only a match on the major area of specialty. The Resource Management & Analysis (3XXX) subspecialty group has over 7 times the number of officers with graduate subspecialty codes as there are billets requiring them, but only 29 percent of these billets are filled with an appropriately skilled officer. The system does not seem to be working properly, and specific expertise is not being fully used.

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Introduction

The Navy is trying to produce an overall education strategy that will guide the training and education of officers in the future. Reference [1] provides support in developing this strategy, including discussions with community leaders and educational institutions, and analysis of some of the major issues relevant to the provision of education in the Navy. This paper describes the data analyses that inform [1].

The Navy is often considered a very technical service and there is a belief that Navy officers must be technically trained to succeed. This training is believed to be important at the junior officer level, when officers are working in functional jobs. We first look at the current state of undergraduate officer education and the benefit to the Navy of officers with technical undergraduate majors.

As officers become more senior, there is a change in focus from operational tours requiring technical proficiency to staff tours requiring decision-making and complex problem-solving. Critical thinking skills, communication skills, and knowledge of both the Navy and the other services become more important at senior levels. Graduate education is thought to enhance critical thinking and communication skills; in the Navy, it is often combined with joint education. The second section focuses on the data regarding graduate education in the Navy, specifically for unrestricted line (URL) officers.

To create a feasible education strategy, the Navy has to figure out *how* to provide education to officers and *when* in their careers to provide it. Officer career paths are already filled with sea duty, shore billets, and other training requirements. The third section provides data on the career paths of URL officers in three different communities: submarine warfare, surface warfare, and aviation. The analysis of the career path assists in showing where in the career an officer might have time to receive resident graduate education.

In addition to the general need for critical thinking, the Navy has requirements for graduate education specifically targeted to a skill or functional area, such as financial management. The timing of graduate education in the career path cannot be determined without thinking about when officers utilize this specific expertise. The demand for this level of skill is coded into the billets using subspecialty codes. The fourth section of the paper focuses on this demand, as well as the inventory of officers who can fill these positions. The section also looks at how well the Navy matches qualified officers to the jobs requiring their specific skills.

The paper concludes with a summary of our findings.

Undergraduate education

There is a belief in the Navy that a technical undergraduate education is critical to success as a Navy officer—especially as a submarine officer. This need for technical expertise is starting to cause difficulty in accessing qualified submarine officers because it is believed that the percentage of officers taking technical degrees has fallen in recent years. To investigate, we look at the proportion of technical and nontechnical accessions into the URL community over time. We compare officers with technical and nontechnical backgrounds to see if the data are consistent with the view that technical expertise, meaning an undergraduate technical major, is necessary to succeed.

The United States Naval Academy categorizes undergraduate majors using three tiers:

- Tier I—Engineering & Weapons
- Tier II—Mathematics & Science
- Tier III—Humanities & Social Sciences.[1]

We define *technical* undergraduate degrees as having majors in either the engineering or math/science tiers (Tier I/II).[2] Tier III degrees are considered nontechnical degrees. We use the undergraduate major code in the Officer Master File (OMF) to determine whether the person was "tech" or not.[3]

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1. The definition of the tiers is slightly different for Naval Reserve Officers Training Corps (NROTC) and Officer Candidate School (OCS) accessions. We use the USNA categorization since most of our data focus on these accessions.
2. We have heard from some in the Navy that only a Tier I major is technical, but we use the more widely used definition of Tiers I *and* II.
3. See the appendix for a full list of undergraduate codes in the OMF and their associated tier.

We analyzed data from the OMF to look at the tech / nontech breakdown of officers' undergraduate education for the last 20 years. We look at trends in the mix of technical / nontechnical degrees by URL community, source of entry, and gender. USNA also provided data on graduates and their degrees, and we use these data to further analyze the issues.

Overall trend in URL technical degrees

Following [1], we focus on URL officers, the largest share of accessions in the Navy. URL officers also pose the most challenges to developing an education strategy.[4] Figure 1 shows the percentage of accessions into the URL community with a technical degree from 1988 through 2006. Throughout most of the 1990s, there was a decline in the proportion of URL accessions with a technical major. In more recent years, there has been a correction of this decline, and the level of technical degrees in 2006 was about the same as the level in 1988.

The URL includes the submarine community, as well as the pilots, the naval flight officers (NFOs), and the surface warfare officers (SWOs). Though we focus on these four large communities, the URL also includes Special Warfare and Special Operations officers. Figure 2 shows the percentage of accessions holding technical degrees, by URL community. We can see that accessing pilots have increasingly held technical degrees, while NFOs and SWOs have remained at nearly the same level as they were 20 years ago. Submarine accessions have had the largest drop in percentage with a technical undergraduate degree, with a rather steady decline after 1996. However, this community still has by far the largest percentage of technical degree holders.

4. See the appendix for a display of all Navy accessions and a breakdown by Navy community.

Figure 1. Percentage of URL accessions with technical degrees

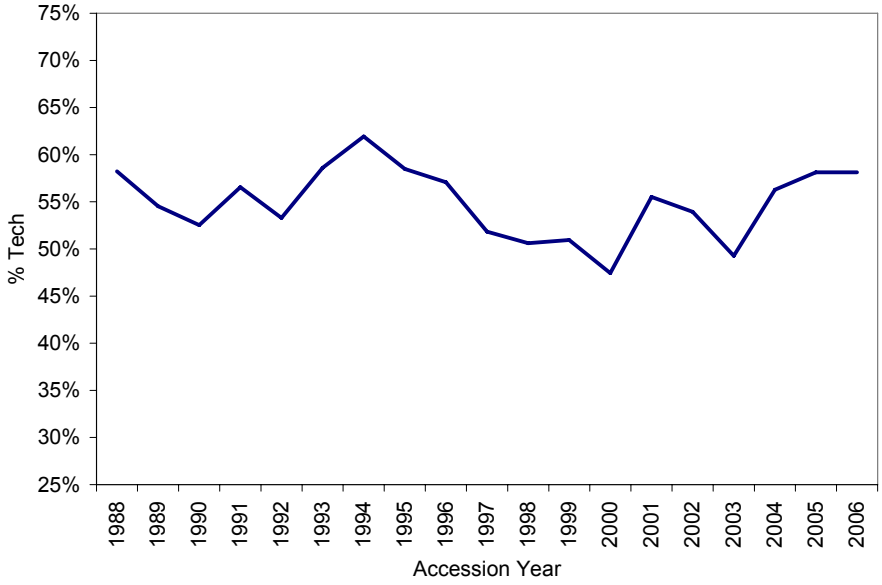
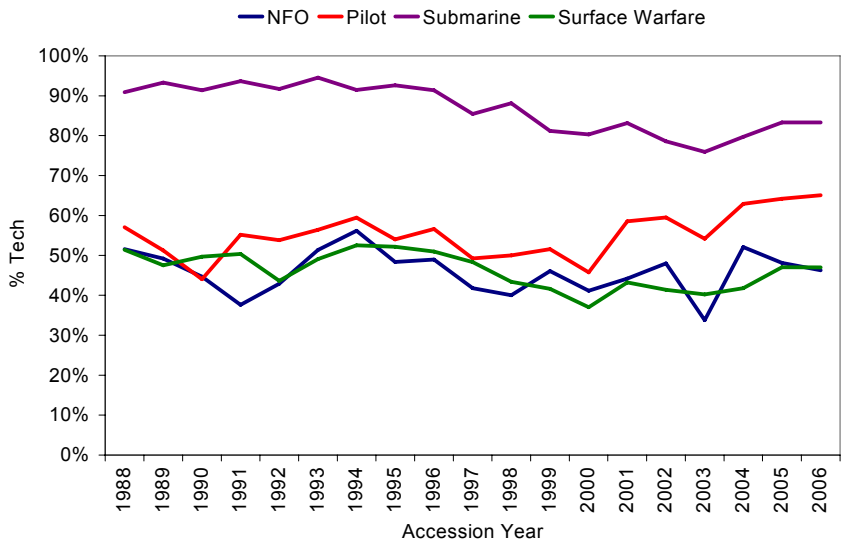


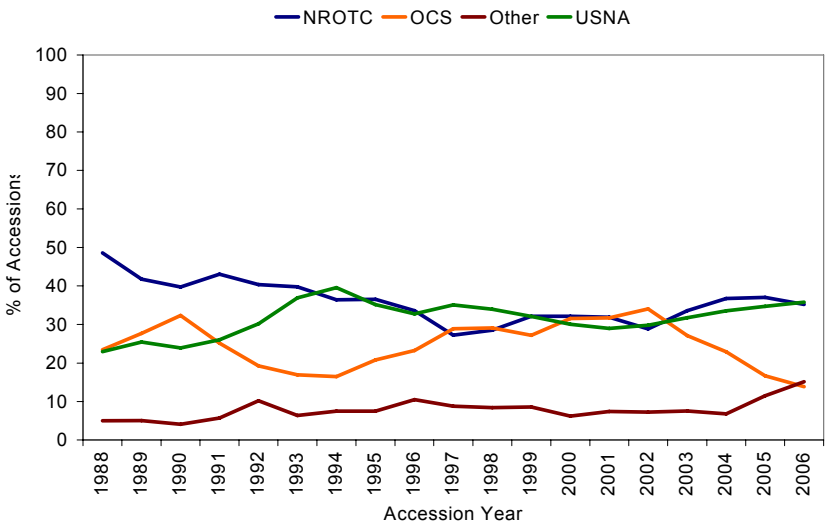
Figure 2. Percentage of URL communities with technical degrees



Source

Figure 3 displays the percentage of officers entering the URL community through USNA, NROTC, OCS, and other sources.[5] USNA and NROTC typically account for the largest percentage of accessions into the URL. Historically, the Navy has used OCS as a valve to control accession levels, putting more candidates through OCS when accessions need to increase, and putting fewer through when accessions need to decrease. In recent years, this valve has been turned off, and accessions from OCS have declined rapidly.

Figure 3. Percentage of URL accessions coming from different sources of entry

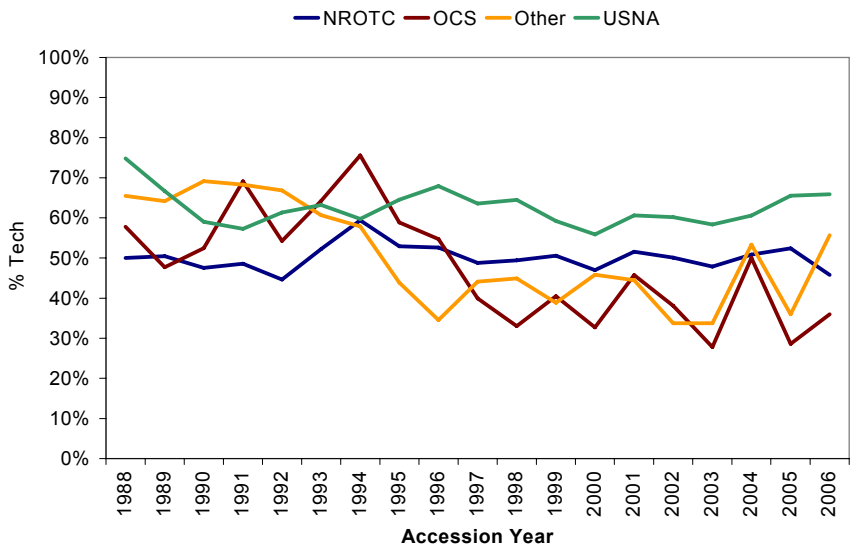


The source of entry is a factor in the technical/nontechnical debate because each program has a different focus and some have more control over the number of technical degrees they output. USNA has a technical focus and a very strong technical core curriculum, but it has

5. Other sources include direct appointments and enlisted to officer programs.

seen a slight drop in technical degrees over the last 20 years, as figure 4 shows. NROTC has less control over the degree that an officer chooses, as well as the core curriculum that the university requires, though it does include some Navy-centric classes above and beyond the university's core courses and can require specific courses as part of an NROTC core curriculum. As figure 4 shows, NROTC has been relatively stable in terms of percentage of accessions with technical degrees and is currently near the 20-year average. OCS and Other accessions have had more variation in percent technical, but a large number of data on graduate majors are missing from these sources, especially for recent years. However, though rates of technical degrees have been somewhat stable, the USNA graduates have historically had higher rates of technical degrees than NROTC, OCS, and other sources of entry into the Navy.

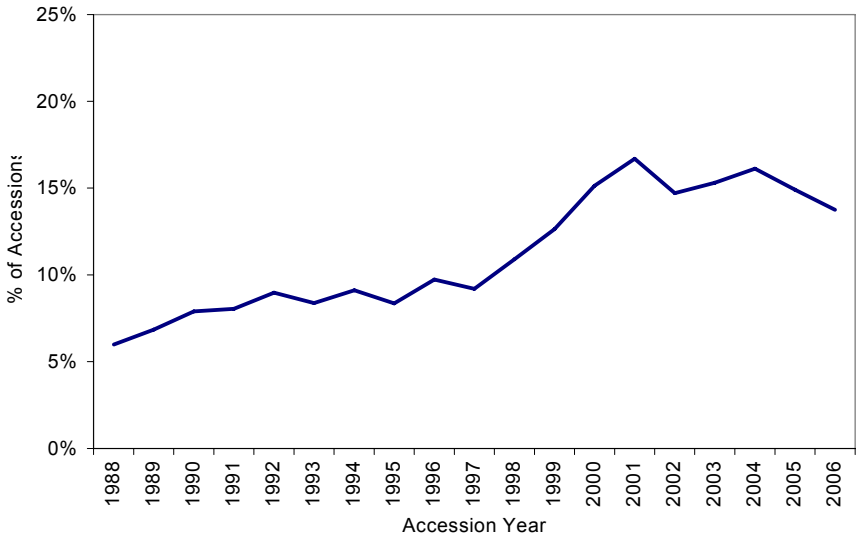
Figure 4. Percentage of URL accessions with technical degrees by commissioning source



Gender

Although gender is not directly linked to education, some believe that the increase in female accessions is a cause of the decline in technical degrees in the Navy. We have already shown that there has not been a general decline in technical degrees, and we will now show that the link between gender and technical degrees is not as many believe it to be. In addition, given that only men can be submarine officers, it is possible that trends in the gender distribution of officers may have affected the pool of eligible submarine officers. Figure 5 shows the percentage of URL accessions by gender, and figure 6 shows the technical degrees by gender for URL accessions.

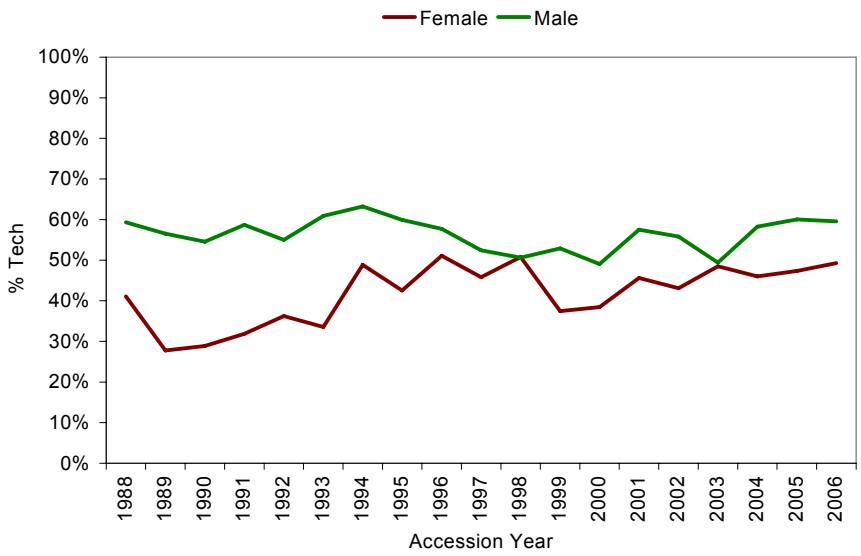
Figure 5. Female accessions into the Navy's URL communities



Female accessions into the URL community have increased over time, from only about 5 percent in 1988 to about 14 percent in 2006. These female accessions have also been increasingly technical, in terms of their undergraduate degrees, while men entering the URL have been stable in the level of technical degrees. Men had almost exactly the same percentage of technical degrees in 2006 as in 1988. In recent years, the gap in technical degrees between men and

women has shrunk significantly. This seems to dispel any prior belief that women are generally less technical than men or that the increase in female officers has caused a decrease in the overall technical level of the Navy.

Figure 6. Percentage of URL accessions with technical degrees, by gender



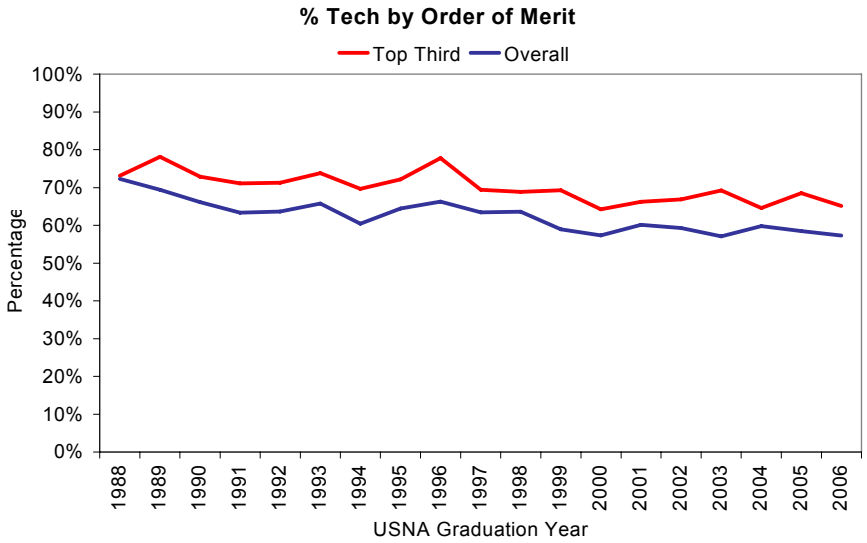
A measure of quality for USNA graduates

The idea that the Navy needs a specific percentage of accessions with technical degrees is hard to prove or disprove with data alone. But the question of tech/nontech does not necessarily get at the full issue. There are quality and performance issues that the technical degree itself, while perhaps a proxy, does not answer. USNA keeps Order of Merit (OOM) data on each graduating class, with graduates ranked from top to bottom in numerical order based on a weighted average of academic performance as well as physical education and military performance. We use the OOM data to break graduating classes into thirds, and we look at the distribution of technical degrees, community choices, and gender in the top third of each graduating class from 1988 through 2006.

Overall technical degrees in top third of graduating class

As shown in figures 3 and 4, USNA is responsible for a sizable portion of the URL community's accessions and is typically more technical than other sources of entry. Figure 7 shows the percentage of USNA graduates with technical degrees, both overall and for the top third of the class. The top third has had a higher proportion of technical degrees since 1988, so it appears that the higher quality students are disproportionately taking technical majors.

Figure 7. Percentage of top third and overall graduating class with technical major

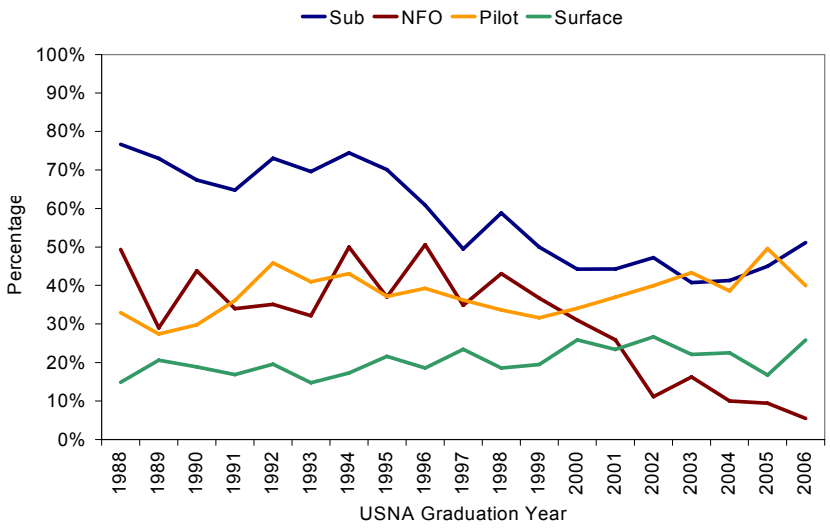


Community choice

We also looked at the choice of community for graduates in the top third of their class. In figure 8, we focus on four URL communities: submariners, pilots, NFOs, and SWOs. Only about 20 percent of graduates going into the surface warfare community have come from the top third of the class, and this has been relatively stable over time. The other communities have seen significant changes over time. Pilots and NFOs have moved in opposite directions since 2000, with pilots

increasing the share coming from the top third, while fewer of the NFOs have come from the top third of the class.[6] Similarly, submarine officers coming from USNA have seen a sharp decline in the proportion graduating in the top third of their class. This proportion was as high as 77 percent in 1988 and fell to 51 percent in 2006.

Figure 8. Percentage of URL community accessions from top third

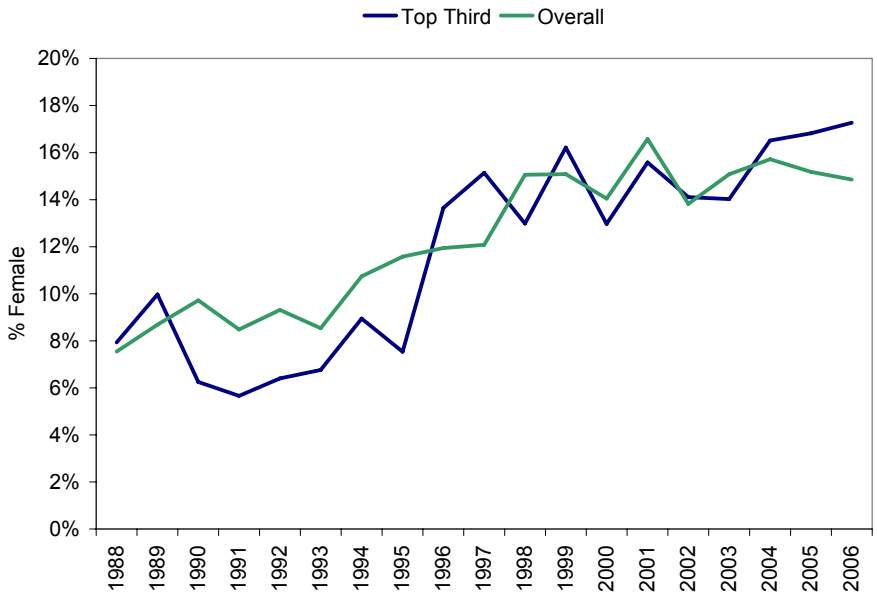


Gender

The proportion of women in the top third was typically right in line with the overall proportion of women in the USNA, meaning that the quality of women at the academy is the same as the quality of men. Figure 9 shows the percentage of USNA graduates who are women, as well as the percentage of the top third who are women.

6. It is possible that the availability of laser eye surgery to correct vision has allowed more officers to be eligible to be pilots and has altered the mix of officers entering the pilot and NFO communities.

Figure 9. Percentage of USNA graduates, overall and from top OOM third, who are female



Value of technical education

While it is relatively easy to quantify the number and percentage of technical degrees in the Navy, assessing the value of a technical education is not so simple. Previous work has looked at this topic, and we present a summary of the results here. The previous literature has primarily focused on the effects of a technical degree on promotion and retention.

Reference [2] asks whether engineers make better naval officers and uses data from USNA graduates to test this. Both academic major at USNA and GPA are included in the analyses of whether an officer is found to be "superior" in the fitness report as a division head and whether the officer stays 6 months after the initial service obligation. In analyzing these measures for surface and submarine officers, both major and GPA are found to be not statistically related to either performance or retention.

Reference [3] analyzes numerous naval officer characteristics for their impact on promotion to various ranks and command screens.

College major is included in four categories: Engineering, Science, Business, and Other. This paper finds very little evidence that the undergraduate major affects promotion and career advancement for all URL communities. Conversely, GPA was found to be significant in many cases.

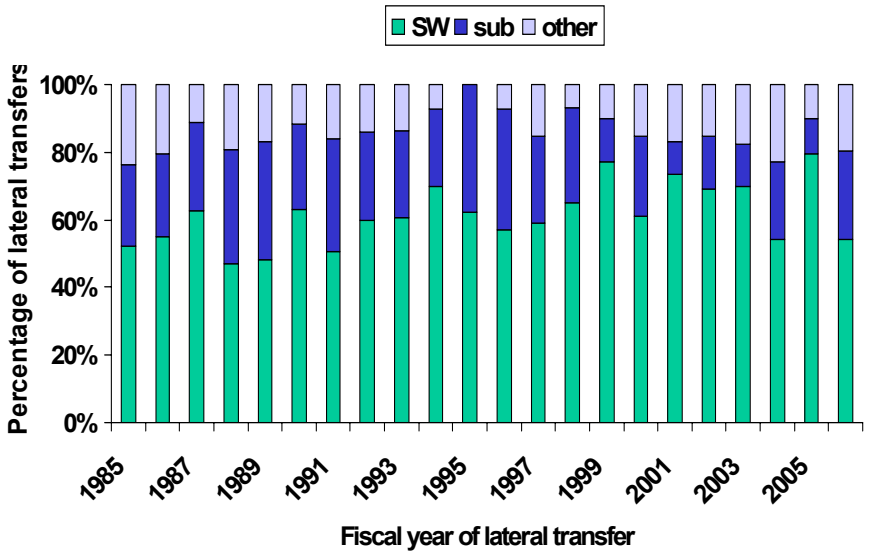
The effects of undergraduate education on retention were touched on in [4] as well. In an analysis of NFO attrition from undergraduate flight training, education major was included and divided into six categories: Engineering, Aviation Tech/Management, Math/Science, Business, Social Sciences/Other, and Missing. Controlling for other factors, such as college GPA, source of entry, demographics, and NFO test scores, [4] finds that social science majors have higher attrition rates from training, though the finding was true only for the earlier phases of training.

As part of our research on the education strategy, we analyzed performance data on bombing success and awards for ships to see if technical undergraduate degrees had an impact [5]. In the first part of the analysis, aviators who dropped laser-guided bombs (LGBs) in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) were compared on several levels, including technical undergraduate degrees. Where sample sizes allowed analysis, there were no significant differences in the bombing accuracy of technical and nontechnical majors, holding other factors constant. As a second part of the analysis, ship performance awards were used as a measure of performance, and crews who had won the award (the Battle Effectiveness Award for ships and crews and the Battle Efficiency Award for submarines—known as the "Battle E" awards) were compared with those who did not win in a given year. The findings did not show any consistent impact of having a higher percentage of technical officers on board a submarine or ship in terms of winning the performance awards. Furthermore, there was no evidence that Battle E award winners were manned by a higher percentage of Lieutenant Commanders and Commanders with a technical undergraduate degree.

Whether or not technical undergraduate education of URL officers has value to the Navy in terms of retention and performance, there is still value in providing qualified officers to the RL communities. As

presented in [6], the engineering duty officer (EDO) community in the RL is made up predominantly of lateral transfers from the URL, particularly the surface warfare and submarine communities. As figure 10 shows, lateral transfers from the URL community regularly make up more than 80 percent of the EDO community. There is also specific guidance stating that officers eligible to lateral transfer to EDO have technical degrees, stating that "undergraduate degrees should be in engineering or the physical sciences with evidence of academic excellence" [7].

Figure 10. Percentage of lateral transfers to EDO (146x) by originating community [6]



Graduate education

Navy operational commanders have indicated that, although the officers assigned to their staffs require critical thinking and communication skills (among other things) to perform well, they are coming in with insufficient skills to perform the duties of the job. Officers coming to these staff positions are the front-runners in the Navy, having successfully completed their operational tours. The operational tours, where these officers most likely excelled, do not seem to be providing the critical thinking and communication skills necessary. Graduate education is one means by which officers might be able to obtain the critical thinking and communication skills necessary to succeed as staff officers.

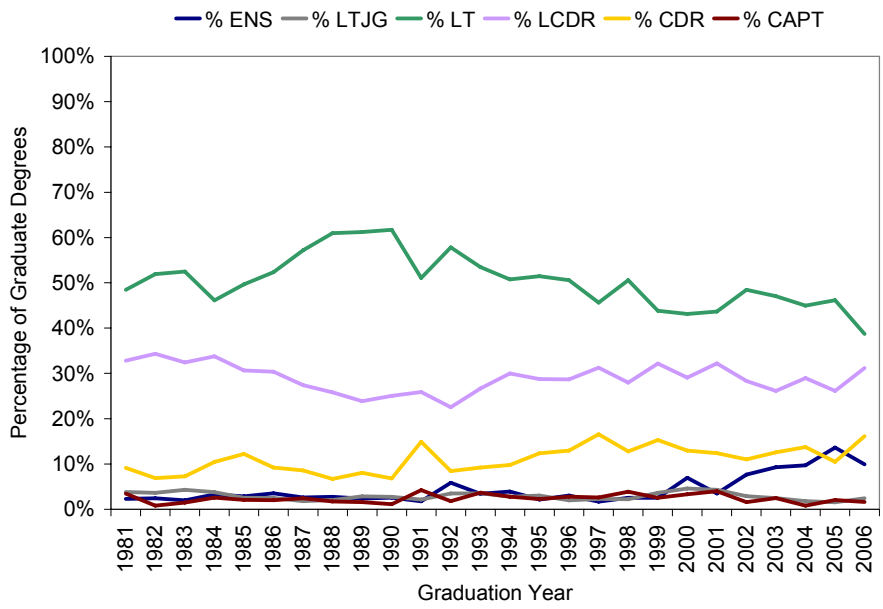
This section focuses on the data analyses on graduate education. We tried to answer the questions of when, where, and how graduate education is delivered to a Navy officer. When in the career does an officer get graduate education? Where do Navy officers get their graduate degree—primarily the Navy Postgraduate School? How do they receive their degrees—mostly through resident, in-classroom learning or through distance learning or other non-resident programs? We also look at the relationship between having a graduate degree and performance and retention.

To answer these questions, we use individual-level data from the OMF for all officers who obtained graduate degrees in the Navy since 1980. We follow them through their careers by looking at each duty station where they were assigned. We match graduate degrees to the previous duty station at the time of degree attainment. Even though these data include all Navy officers, we will again focus on the URL community.

When do officers get graduate education?

Figure 11 shows the breakdown by rank for the share of graduate degrees obtained by URL officers in the 1981–2005 period.

Figure 11. Grade when graduate degree obtained



Lieutenants and lieutenant commanders account for the largest proportion of those obtaining graduate degrees each year, combining to account for 70 to 80 percent of degrees.

Where do officers get graduate degrees?

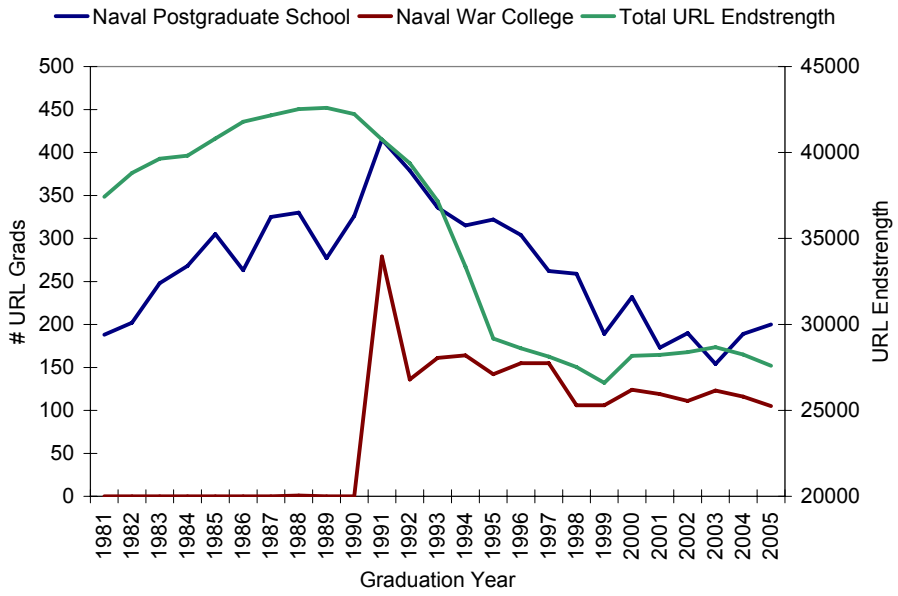
It is not surprising that the schools with the highest numbers of Navy officers receiving graduate degrees were the Naval Postgraduate School (NPS) in Monterey, CA, and the Naval War College (NWC) in Newport, RI. Over the course of our data, almost 50 percent of URL officers received their graduate degrees from one of these two schools, and NWC did not get accredited for graduate degrees until 1991. Table 1 displays the top ten institutions for URL officer graduate work, along with the percentage of degrees obtained there from 1981 to 2005. Besides NPS and NWC, the schools that offer the most graduate opportunity to Navy officers are located near arge Navy contingents—such as Salve Regina University in Newport, RI, and Old Dominion University in Norfolk, VA—or offer online or distance education courses.

Table 1. Top ten institutions providing URL officers graduate degrees

Institution	Percentage of all degrees
Naval Postgraduate School	38.5
Naval War College	11.2
Troy University	3.5
Salve Regina University	2.7
University of Southern California	2.7
Webster University	2.6
George Washington University	2.2
National University	1.9
Old Dominion University	1.8
Central Michigan University	1.7

In recent years, URL graduates from NPS have declined (figure 12); however, total URL endstrength was also declining in that time. NWC graduates have stayed relatively steady after accreditation in 1991.

Figure 12. URL graduates from NPS and NWC, 1981–2005



How is the degree obtained?

Time is in short supply for an officer to get a resident graduate education, as we will discuss further, but several locations offer this opportunity, and the Navy makes use of them. In calculating the percentage of officers who get resident versus nonresident education, we count only those assigned to a location for the specific purpose of obtaining a degree. For example, an officer assigned to NWC who gets a degree from there is considered resident, but an officer who obtains a graduate degree from Salve Regina in Newport while stationed there is considered nonresident. This analysis excludes officers who complete their education while assigned to colleges as NROTC instructors.

Figure 13 shows the breakdown of resident and nonresident degrees for URL officers. Nonresident degrees have been very steady over the entire period, despite large changes in overall URL endstrength. The decline in resident education follows the decline in endstrength, as shown before in figure 12. Most of the resident graduate education in the Navy is done at either NPS or NWC. In 2005, 70 percent of resident graduate degrees came from NPS or NWC.

Figure 13. Resident and non-resident URL graduates, 1981–2005

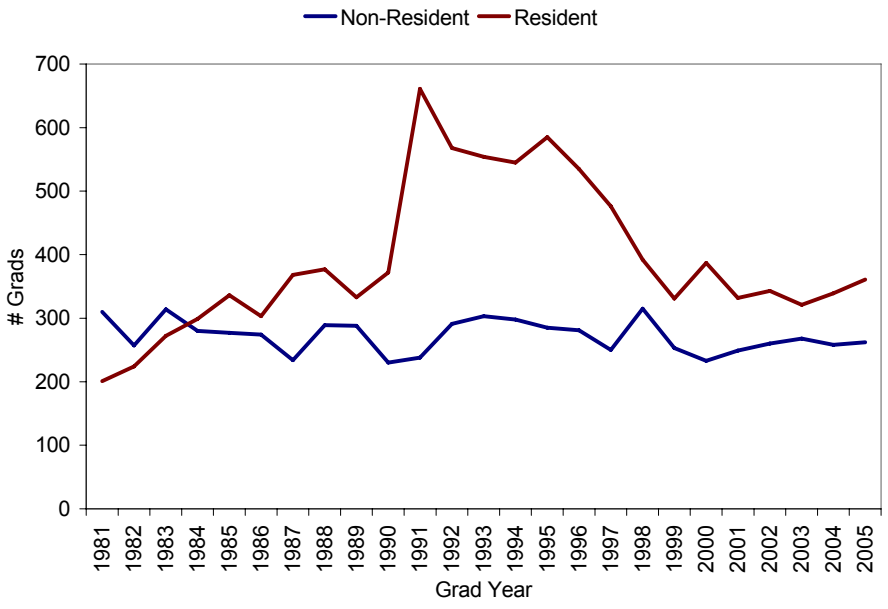
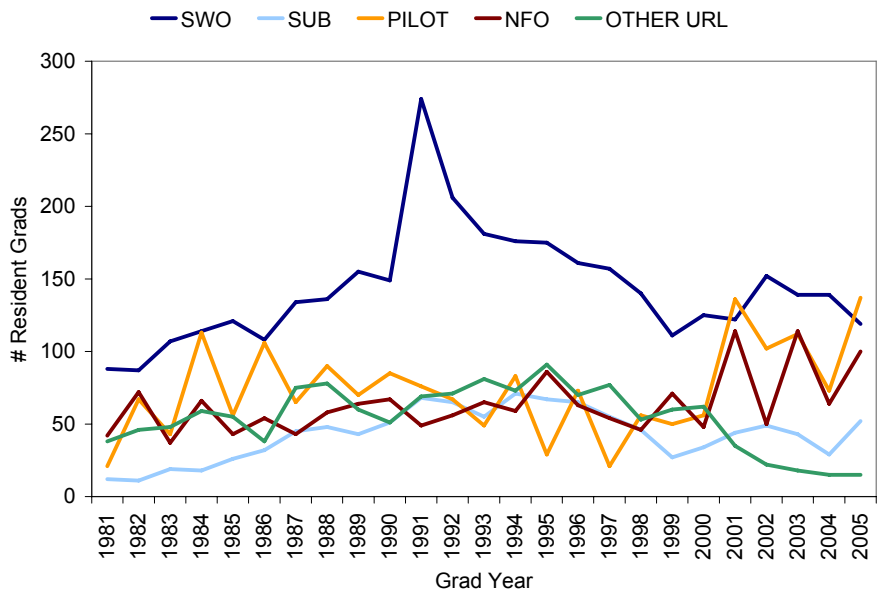


Figure 14 displays the resident URL graduates by community. There are definitely differences between communities in terms of who gets a resident degree, with SWOs sending the largest numbers to resident education over the years. Submarine officers, however, are consistently on the lower end of the spectrum.

Figure 14. URL resident graduate degrees by community, 1981–2005

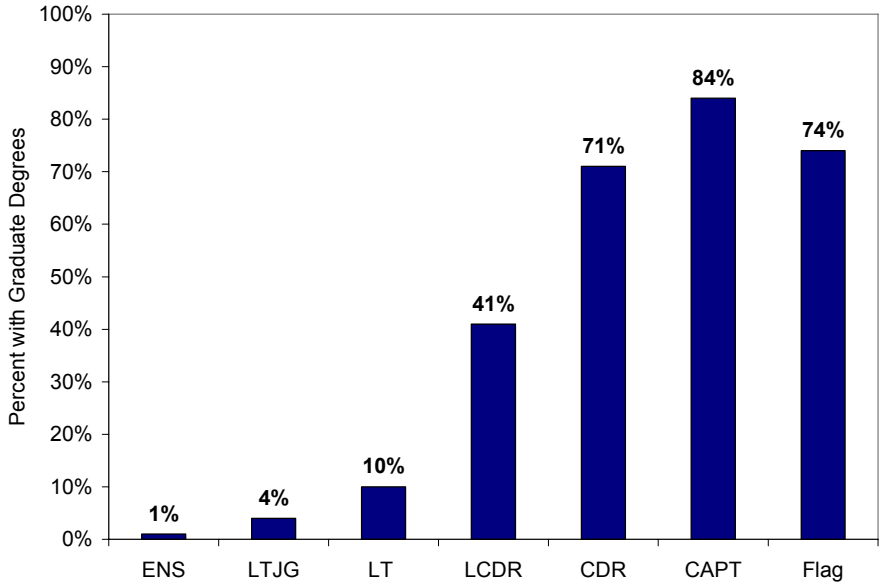


Do officers with graduate degrees do better?

If the Navy believes that critical thinking skills are needed to perform well, it follows that officers with graduate degrees (and possibly enhanced critical thinking skills) would get promoted at faster rates than those without degrees. Likening a graduate education to an increase in productivity, [8] compares promotion rates for officers with and without graduate degrees as part of the marginal benefit of graduate education. Officers with graduate degrees are significantly more likely to promote to all ranks from O-4 to O-6 but are not more likely to promote to flag officer, controlling for other factors.

In 2006, the trend was still such that a much larger proportion of officers in the higher ranks held graduate degrees. Since officers typically receive graduate education as either a lieutenant or lieutenant commander, this is somewhat obvious for the lower ranks. However, the prevalence of graduate degrees at ranks above lieutenant commander imply that officers with graduate degrees both stay in the Navy and get promoted to higher ranks (figure 15).

Figure 15. Percentage of URL officers with graduate degrees by rank, 2006



Reference [9] uses the same data as [8] and notes that those officers with graduate education also tend to stay longer than those without.[7] While it is believed that graduate education enhances critical thinking and assists officers in their staff positions, we also look at the effect of a graduate degree on performance of operational tours. The graduate education of a commanding officer of a ship was included in the analysis of the ship awards in [5]. The Battle E award winners were

7. There is typically an additional service requirement for officers who receive graduate education that the Navy provides.

compared with other ships on the basis of the percentage of officers with graduate degrees, and there was no evidence that having a higher percentage correlated with winning the award. Having a higher percentage of lieutenant commanders and commanders with graduate degrees on a ship also was not correlated with winning the performance award. Consequently, it doesn't appear that a graduate degree adds or detracts from operational performance.

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Career path analysis

The Navy wants to provide in-resident graduate education to its most successful officers. The timing of the education is important, too, because specific skills gained in graduate education may atrophy if not used over time. As [1] describes, URL officer career paths are already crammed, trying to fit in operational training, operational tours, joint education and experience, and shore tours, as well as graduate education. The different communities have different career paths and face different challenges in terms of providing graduate education to their best and brightest officers.

To investigate the timing of graduate education within a career path, we looked back at the career paths of successful officers (commanders and captains) in the Navy today and attempted to create the average career path of the successful officer for each community. We focus on the submarine and surface warfare communities, and discuss previous work concerning the aviation community. We categorize tours by sea tour, shore tour, or student tour, and we group consecutive tours of the same type into one.

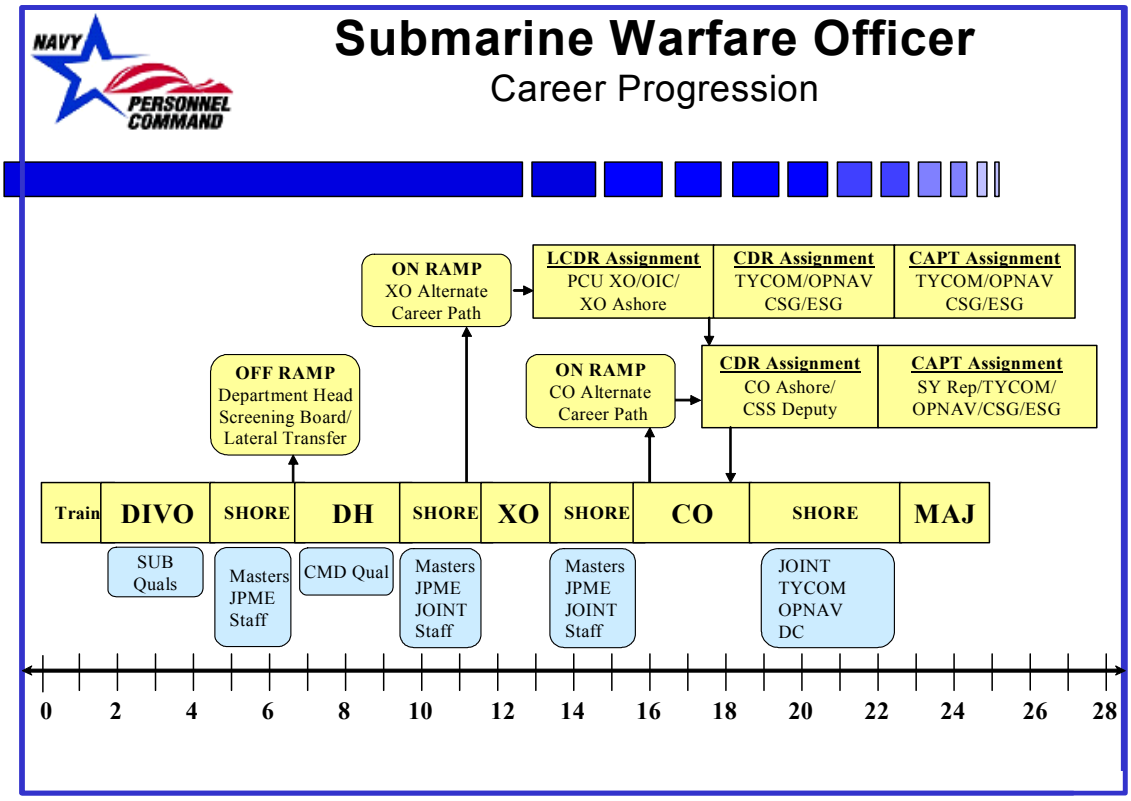
In addition, we look at the length of officer careers for those officers reaching the rank of commander. A lot of discussion surrounds fitting all of the career requirements into a 20-year career. We examine whether this is the appropriate timeline for successful URL officers.

Submarine officer career path

We looked at the 2006 OMF and at the careers of all submarine officers who were active commanders (O-5) at the time of the snapshot. We then reconstructed the typical career path of a successful submarine officer. It turns out that there is a fairly stable career path; most officers take the same path to success. The career starts out with a year and a half of training, followed by a 3-year sea tour. There were also a number of officers who did not go directly to training after accession

and were held up on a shore tour for an average of 6 months. From there, they went to the training and then to the 3-year sea tour, and their careers mimic those of officers who went directly into training at accession. After the first sea tour, two paths diverged. One group of officers went into an approximately 28-month shore tour, while the other went to a student billet for 20 months—most likely for graduate education, typically at the Naval Postgraduate School. Both groups then went to 6-month training and to another sea tour of 36 to 40 months (department head (DH) tour), followed by a shore tour of about 28 months. After this shore tour, most officers returned to sea for about 2 years (executive officer (XO) tour). This tour was followed by another 28-month shore tour, and then 8 or 9 months in a student billet. The next tour was another sea tour (commanding officer (CO) tour) of about 2 years.

Figure 16. Career progression of a submarine officer [10]

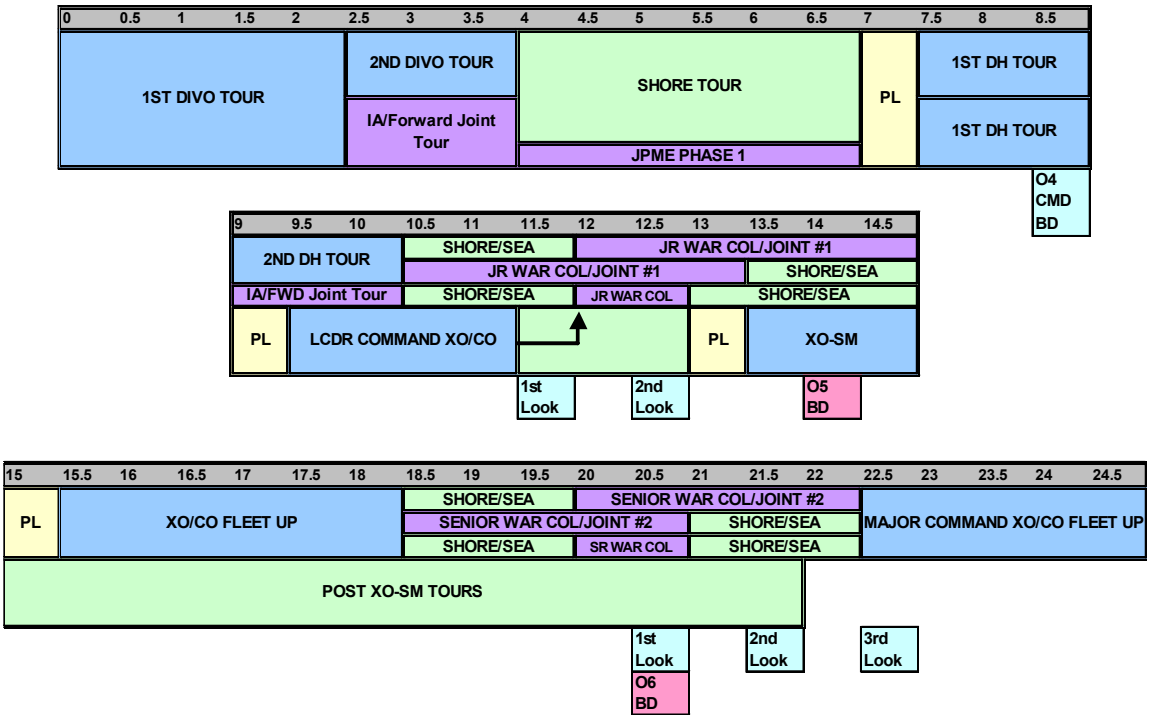


We did not look at specific billets in our analysis of the career path, but it seems to follow the expected career path of the submarine community manager (figure 16). The first shore tour is the first chance for a Master's degree, and we see that several current O-5s went to a student tour for 18 or more months at that point. The shore tour between XO and CO also had several officers going to a student billet, presumably to get Joint Professional Military Education.

Surface warfare officer career path

We performed a similar analysis on SWO commanders from the 2006 data, but we did not find a similarly neat career path. There seem to be many paths to success in the SWO career (see figure 17).

Figure 17. Career progression of a SWO [11]



Of the 955 officers whose careers we tracked, 709 started in a student billet for an average of 9 months, while 172 started on a shore tour for

about 9 months, and 79 went straight to a 2-year sea tour. Most of those starting out as students went next into a sea tour of 3 to 4 years and then either to a shore tour for 2 years or to a student tour for 20 months. This second student tour is when we believe most SWOs were sent to the Naval Postgraduate School to obtain a graduate education. The paths continue to branch out in multiple directions. Following those who went to a 20-month student tour, the majority followed that with a 3-year sea tour (DH tour) and then either a 14-month student tour or a 28-month shore tour.

It is difficult to compare our results with the current expected career path for SWOs since it has changed in recent years. Given that we are looking back 15 years or so at the careers of officers who are now O-5s, we cannot directly compare that with the expected path for new accessions into the SW community. Figure 17 presents the current SWO path, and we can see the differences from the start. There is no longer an initial training tour; instead, SWOs go directly to a sea tour.

Aviator career path

Previous CNA work constructed the career path of a typical aviation officer. Reference [12] included career progression as part of the analysis into officer success during OIF/OEF (figure 18). The paper looked at successful officers and retraced their career paths.

The aviator career path seems very rigid, with little room for graduate education until later in the career. As we previously showed, both submarine officers and SWOs have opportunities for graduate education in their third or fourth tour. The work also noted that the constructed career path differed from the notional guidance in that the initial training/Fleet Replacement Squadron (FRS) tour was longer by up to 2 years, shortening any additional time out for other opportunities. About half of aviators followed the notional timeline closely, while the other half followed the timeline depicted in figure 18.

In [13], alternative career paths for aviators were investigated, and the current inventory of aviators was analyzed to create a career path out of where officers were at the current point in their career when the snapshot was taken. This career path closely resembles that of [12] (figure 19).

Figure 18. Career progression of an aviation officer [12]

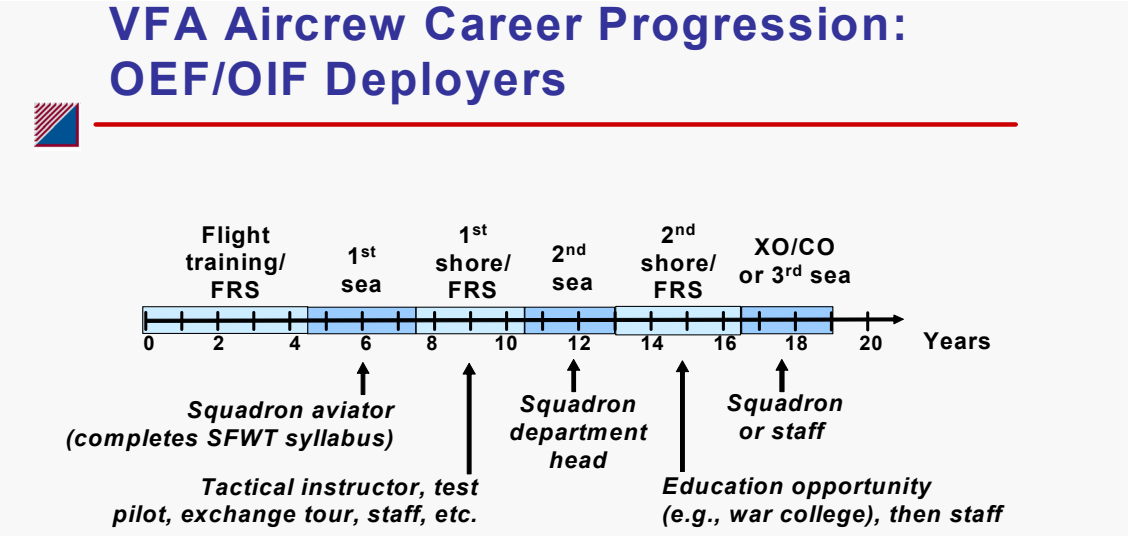
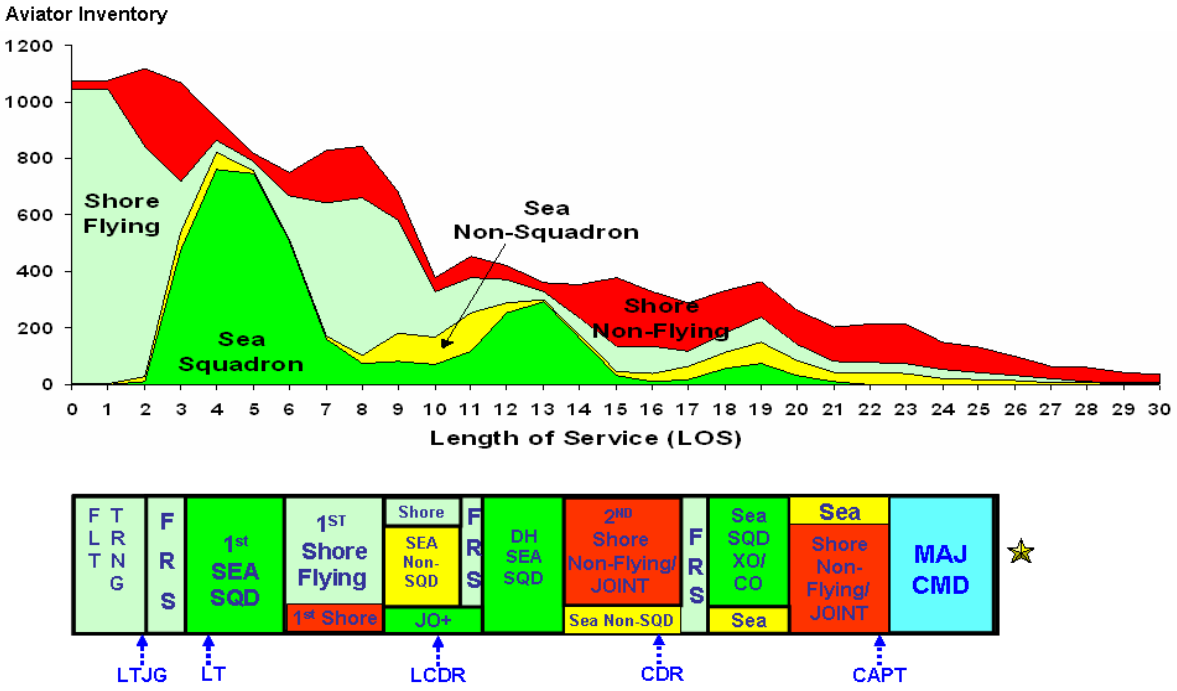


Figure 19. Career progression of an aviation officer [13]



Career lengths

In addition to the work on specific community career paths, we considered the overall length of an officer's career. While a large number of officers retire at the 20-year point, successful career officers who are promoted to O-5 and above typically have longer careers—but how much longer?

We studied officers who achieve the rank of O-5 from 1980 to 1995 and analyzed the continuation rates of those officers to 20 years of service and beyond. Most O-5s in our data were promoted at 14 or 15 years of service, and we separate those commanders who were promoted to captain and above, and those who were not.

Figure 20 shows the average survival rates for officers promoted to O-5 between 1980 and 1995 who were not promoted beyond the rank of commander.[8] As the figure shows, about a third of officers promoted to commander retired at 20 years of service (YOS), but, on average, about 20 percent of commanders make it to at least the 24th year of service. Over the time period analyzed, we calculated an average career length of 21.5 years of service for an officer promoted to commander and not promoted beyond.

Figure 21 shows a similar survival curve for those officers promoted to O-5 from 1980 to 1995 who were promoted beyond.[9] Given that most of these officers were promoted to O-6 around 21 YOS, we show the survival beyond 23 YOS. As the figure shows, most officers promoted beyond the rank of commander continue to at least 26 YOS, with over 26 percent making it to 30 YOS. Clearly, the 20-year career is not the limit for these officers, as we calculated an expected career length of 27.6 YOS over the time period analyzed.

8. Yearly continuation rates for O-5s are given in table 8 of the appendix.

9. Yearly continuation rates for O-6s are given in table 9 of the appendix.

Figure 20. Survival past 17 years of service

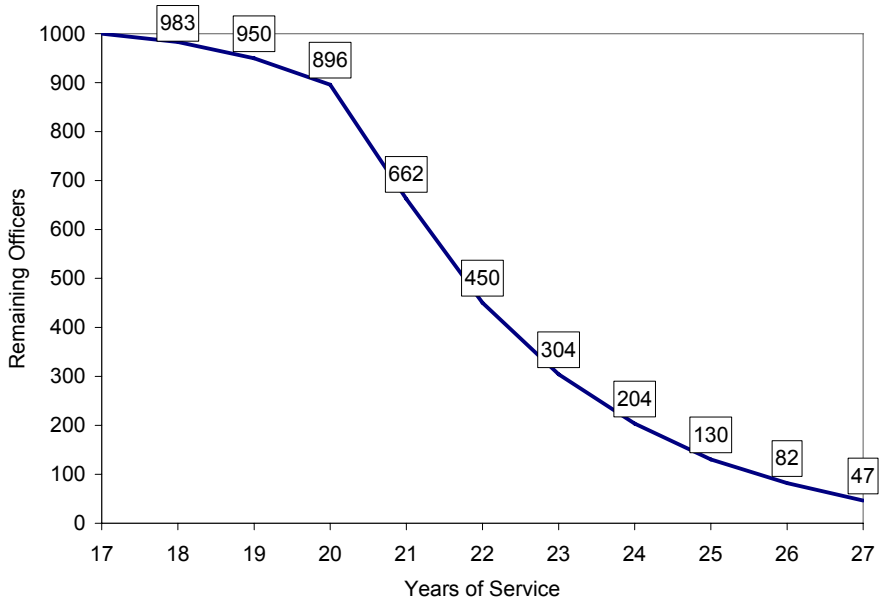
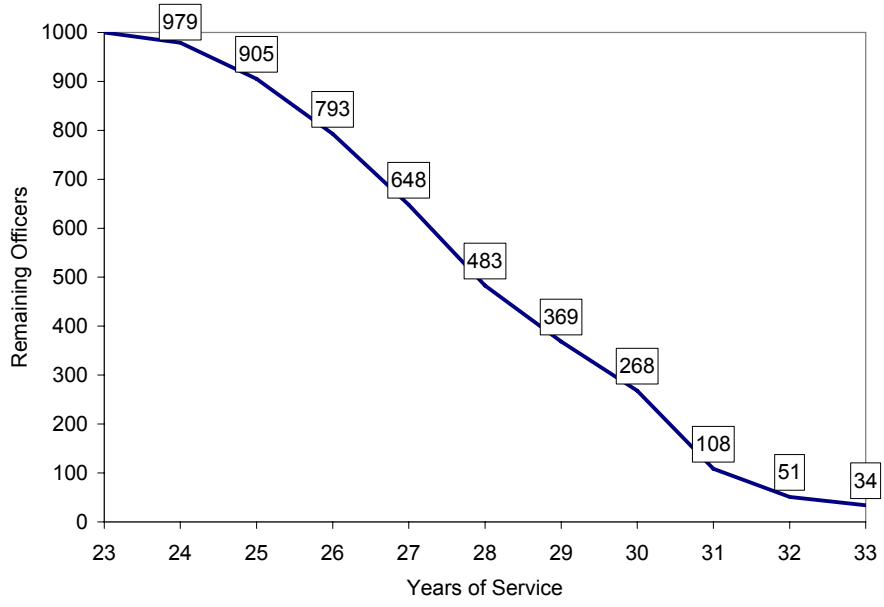


Figure 21. Survival past 23 years of service



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Skill utilization

As discussed earlier, there is some opportunity for URL officers to obtain graduate degrees early in their career. The opportunity for utilizing the specific expertise they gain, however, does not come until later in the career. We looked at the Navy's requirements for specific expertise at the graduate level and the inventory of officers with graduate education. We examined the overall graduate education requirements for the Navy, as well as those for billets at sea. We analyzed the current (2006) billets coded for higher education and looked at the officers currently filling those billets and the level of matching of inventory to requirements.

During the analysis of the coded billets, we were told about some inconsistencies with the billet codes and the validation of billet requirements. In this research memorandum, however, we present the data as they appear on the billet and personnel files.

Graduate requirements

Billets with special requirements are labeled with a five-character code known as a subspecialty code. The first four digits represent the discipline, and the fifth letter code represents the level of expertise necessary. We focus on the graduate education requirement, which is found in the coding of billets with P-, Q-, C-, and D-codes.[10] Because C- and D-codes are relatively rare, we mainly discuss the P- and Q-codes. The disciplines, indicated by the numeric code, are grouped into six categories for URL officers: National Security Studies (2xxx), Resource Management & Analysis (3xxx), Applied Disciplines (4xxx), Engineering (5xxx), Operations, (6xxx), and Any Discipline (0000). Table 2 shows the breakdown of graduate requirements by community and discipline for 2006 billets.

10. A P-code represents a requirement for a Master's level of education, and a Q-code requires a Master's level of education and professional experience. A C-code requires a Ph.D. level of education, and a D-code requires a Ph.D. level of education and professional experience.

Table 2. 2006 graduate degree requirements for URL officers

	Discipline						
Type of officer	National Security Studies	Resource Mgmt. & Analysis	Applied Disciplines	Engi-neering	Oper-ations	Any Discipline	Total
Any URL officer[a]	143	138	40	68	116	268	773
Surface warfare	35	79	14	178	161	2	469
Submariner	17	13	6	753	22	2	813
Special warfare	102	6		3	3		114
Aviator	24	36	5	227	55	2	349
Total	321	272	65	1,229	357	274	2,518

a. This category encompasses the 1000, 1020, and 1050 billets. These billets may be filled by URL officers from any community. We also include 1100 billets in this category, which are URL officers with fleet support specialty.

There were 2,518 URL officer billets coded for graduate education in 2006. This accounts for 10 percent of all URL billets in 2006. Of the billets requiring graduate education, 2,134 were P-codes, 381 were Q-codes, 1 was a C-code, and 2 were D-codes. The most prevalent billet subspecialty codes are shown in table 3.

Table 3. Top ten URL billet subspecialty codes—2006

Code	Description	Number of billets
5203P	Plant Propulsion Systems	548
0000P	Any Discipline	274
5203Q	Plant Propulsion Systems	147
2000P	National Security Studies—General	142
6301P	Undersea Warfare	119
5700P	Combat Systems	90
5403P	Test Pilot	89
3211P	Operations Research and Analysis—Analysis & Assessment	81
5000P	General Engineering & Technology	56
2500P	Special Operations/Low-Intensity Conflict	48

Graduate supply

Officers also have subspecialty codes based on their education and experience; officers can have multiple subspecialty codes at the same time, whereas billets have only one. We next examine the supply of graduate subspecialty codes in the 2006 OMF. Table 4 presents the number of officers qualified to fill the most prevalent specialty billets. An officer is qualified for a billet if he/she holds a subspecialty code in the same discipline, with at least the requisite amount of education. An officer with a Q-code in a specified discipline is qualified to fill a P-coded billet in that discipline, but the reverse is not true.

Table 4. Officers with most prevalent billet subspecialty codes—2006[a]

Code	Description	Number of billets	Number of qualified officers[b]
5203P	Plant Propulsion Systems	548	1,872
5203Q	Plant Propulsion Systems	147	650
2000P	National Security Studies—General	142	2,231
6301P	Undersea Warfare	119	89
5700P	Combat Systems	90	116
5403P	Test Pilot	89	293
3211P	Operations Research and Analysis Analysis & Assessment	81	176
5000P	General Engineering & Technology	56	219
2500P	Special Operations/Low-Intensity Conflict	48	43

a. 0000P is used only for billets. These billets can be filled by any officer with a P-code or higher level of education.
b. Qualified officers include all with a subspecialty code matching the first four digits, with at least the appropriate level of education (e.g., the 1,872 officers qualified to fill 5203P billets includes the 650 officers who are qualified to fill 5203Q billets).

As you can see from table 4, there are some specific billet codes where the Navy does not have an adequate supply of qualified officers to fill all of the billets. If we expand the definition of qualified to include officers with the appropriate education level and a specialty in the same major area, the numbers improve somewhat. Table 5 shows a comparison of the 2006 billets and officers by major area.

Table 5. Billets and officers by major area—2006

Code	Description	Number of billets	Number of officers[a]
2	National Security Studies	321	2,562
3	Resource Management & Analysis	272	2,035
4	Applied Disciplines	65	262
5	Engineering & Technology	1,229	3,121
6	Operations	357	763

a. Officers can hold subspecialty codes in more than one major area, as well as multiple codes in the same major area. These numbers represent the total of all codes held.

This comparison of officers and billets, however, assumes that all officers with appropriate subspecialty codes are filling billets that require their specialties. We next look at the matching of skills to requirements.

Matching skills to requirements

We have just shown the inventory of officers with specific expertise and compared them with the billet requirements. We will now look at how well the Navy uses these specific skills in terms of appropriately matching qualified officers to billets requiring their expertise.

We looked at the 2006 billets and the officers that were filling them in a September 2006 snapshot. Of the 2,518 billets with graduate requirements in 2006, 280 (11 percent) were not filled when we took our snapshot. We look at the remaining 2,238 billets and how well their requirements were matched.

In 431 observations, the officer in the billet had a subspecialty code that exactly matched the primary subspecialty of the billet. As mentioned before, officers may have subspecialty codes that are not exact matches but still fulfill the requirement (as in a 5403Q-coded officer filling a 5403P billet). In general, having the same numeric code at least means you are a specialist in that field at some level. In 2006, 893 of the officers filling graduate-requirement URL billets had a subspecialty code that matched the first four digits of the billet's primary subspecialty code.

We also considered the level of matching for only the first digit of the subspecialty, focusing on officers with a graduate-level subspecialty code (see table 6). When matching on only the major area of the subspecialty, officers filling the billets in 2006 matched 49 percent of the time. Looking at the individual major areas, however, National Security Studies (subspecialty codes starting with 2) and Operations (subspecialty codes starting with 6) both have significantly lower match rates for their billets.

Table 6. Match of billet subspecialty by major area—2006[a]

Subspecialty group	Number of billets	Fill	Number matched	Percent matched (of filled)	Inventory
2	321	284	116	41%	2,562
3	272	231	68	29%	2,035
4	65	49	18	37%	262
5	1,229	1,104	723	65%	3,121
6	357	306	45	15%	763
Total	**2,244**	**1,974**	**970**	**49%**	**8,743**

a. This table excludes the 0000P billets since officers do not hold subspecialty codes with this designation.

There were also 274 billets that simply required a graduate education in any discipline (the 0000P-coded billets). In our data for 2006, 264 of these billets were filled, and 123 of the filled billets had officers with a graduate-level subspecialty code.

Though it appears that the Navy is providing enough officers with graduate education and providing it in appropriate specialties, there are still issues with the use of the graduate education. It is possible that the career paths of officers make it difficult to use their specific skills. We next look at career paths for URL officers—specifically, submariners and SWOs.

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Summary

As the Navy tries to create an education strategy for its officer corps, it needs to understand where it currently stands in terms of educating officers.

Although the submarine community has seen a slight drop in technical undergraduate majors accessing into the Navy, there is no overall decline. The submarine community has also seen a drop in quality in terms of accessions from the Naval Academy, and the community is trying to reverse this trend. In general, it appears that the Navy is still doing very well at accessing technically skilled officers. The technical undergraduate degree is a simple measure, but its value is hard to define. Officers accessing with a technical undergraduate degree have slightly better retention and pipeline training success, but studies have been unable to show a higher proficiency in operations.

The Navy provides graduate education to a significant number of officers each year—mainly lieutenants and lieutenant commanders. The Naval Postgraduate School and the Naval War College provide most of the resident graduate education in the Navy. Graduate education appears to aid in retention and promotion, though its effects on proficiency have been harder to measure.

One issue that needs to be addressed in terms of an overall education strategy is where in the career of an officer the graduate education can be provided. We analyzed the career paths of successful submarine, surface warfare, and aviation officers to see where in the career a graduate education might be obtained. For submarine officers and SWOs, there appears to be some room in the first shore tour to go to a resident graduate education program, though for aviators there doesn't seem to be any time early in the career. In addition, we found that the 20-year career that is often discussed is not necessarily appropriate for "successful" officers who will be promoted to commander and beyond. We calculated an expected career length of 21.5 YOS for

officers promoted to commander and not promoted beyond, and an expected career length of 27.6 YOS for officers promoted beyond commander.

The question of when an officer gets a graduate education is tied to when the officer needs to utilize the education. There is an overall need for enhanced critical thinking in all jobs, but some graduate education provides specific expertise that the Navy requires for specific billets. Though the Navy seems to do a good job of providing graduate education, it has had difficulty in matching skilled officers to jobs that require their specific skills. In analyzing the match between subspecialty codes on billets and officers, only 63 percent matched on the overall major area of the specialty in 2006, and far fewer matched on the exact specialty. Even in billets where any discipline would suffice, the match of education level in 2006 was relatively low, at only 47 percent.

Appendix: Additional data

This appendix presents additional data and background information used in the analysis to support the education strategy.

Undergraduate majors and tiers

As previously discussed, the undergraduate majors are grouped into three tiers, with the first two making up the definition of a *technical* major. Table 7 lists the undergraduate major codes in the OMF along with their description and their tier.

Table 7. List of undergraduate majors and tiers, by code

Code	Major	Tier
00	None reported/Liberal Arts	III
01	Agriculture, General	III
02	Animal Science	III
03	Dairy Science	III
04	Horticulture	III
05	Soil Science	III
06	Forestry	III
07	Range Science	III
08	Agricultural Sciences, n.e.c.	III
09	Natural Science	III
10	Biological Science	III
11	Botany	III
12	Bacteriology	III
13	Microbiology	III
14	Physiology	III
15	Zoology	III
16	Entomology	III
17	Parasitology	III
18	Virology	III
19	Biological Science, n.e.c.	III

Table 7. List of undergraduate majors and tiers, by code (continued)

Code	Major	Tier
20	Medicine	III
21	Pharmacy	III
22	Public Health	III
23	Dentistry	III
24	Nursing	III
25	Optometry	III
26	Veterinary Science	III
27	Pharmacology	III
28	Osteopathy	III
29	Nutrition	III
30	Health Sciences	III
31	Anatomy	III
32	Pathology	III
33	Medical Sciences, n.e.c.	III
34	Geology	III
35	Naval Science (other than USNA)	III
36	Operations Research/Systems Analysis	II
37	Meteorology	II
38	Chemistry (other than Biochemistry)	II
39	Biochemistry	II
40	Ceramics Engineering	II
41	Naval Academy (USNA-Annapolis only)	I
42	Metallurgy	II
43	Mathematics	II
44	Physics/Oceanography	II
45	Astronomy	II
46	Physical Sciences, Computer Science	II
47	Civil Engineering	I
48	Agricultural Engineering	I
49	Operational Systems Technology	II
50	Safety Engineering	I
51	Marine Engineering/Naval Architecture	I
52	Nuclear Engineering	I
53	Ordnance Engineering	I
54	Industrial Engineering	I
55	Chemical Engineering	I
56	Electrical Engineering	I
57	Mechanical Engineering	I

Table 7. List of undergraduate majors and tiers, by code (continued)

Code	Major	Tier
58	Textile Engineering	I
59	Electronics Engineering	I
60	Communications Engineering	I
61	Aeronautical Engineering	I
62	Mining Engineering	I
63	Petroleum Engineering	I
64	Metallurgical Engineering	I
65	Architecture	I
66	Engineering, n.e.c.	I
67	International Affairs	III
68	Political Science	III
69	Public Administration	III
70	Industrial Arts	III
71	History	III
72	Industrial Management	III
73	Personnel Administration	III
74	Psychology	III
75	Anthropology	III
76	Archaeology	III
77	Economics	III
78	Accounting	III
79	Geography	III
80	Business Economics	III
81	Business Administration	III
82	Finance	III
83	Retailing	III
84	Physical Education	III
85	Education	III
86	Home Economics	III
87	Systems Engineering	I
88	Law	III
89	Library Science	III
90	Statistics	II
91	Social Welfare Administration	III
92	Social Sciences	III
93	Fine Arts	III
94	English Literature	III
95	Classics	III

Table 7. List of undergraduate majors and tiers, by code (continued)

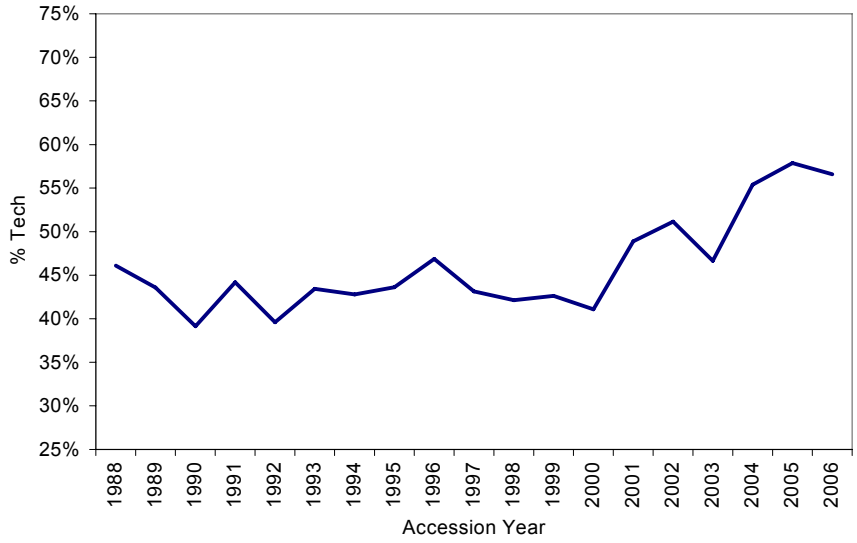
Code	Major	Tier
96	Modern Languages	III
97	Theology	III
98	Philosophy	III
99	Naval Intelligence (Degree Program) (Monterey)	I
0A	Management	III
0B	Radio/Television Broadcasting	III
0C	Communications, General	III
0D	Journalism	III
0E	Film/Radio/Television Production	III
0F	Speech	III
0G	Industrial Design	III
0H	Podiatry/Chiropody	III
0J	Physical Therapy	III
0K	Occupational Therapy	III
0L	Audiology	III
0M	Speech Pathology	III
0N	Physician's Assistant	III
0P	Medical Technology	III
0R	Hospital Administration	III
0S	Health Care	III
0U	Military Studies	III
0V	Aviation Safety	III
0W	Aviation Management	III
0X	Administration	III
1A	Leadership	III
2A	Toxicology	III
3B	Interdisciplinary Studies	III
OT	Sports Science	III

Some issues arise with the coding of "00." As shown above, it is described as "None reported/Liberal arts" and assigned to tier III. However, not all nonreported majors will be nontech, and this confounds the issue somewhat. We excluded those with a "00" code from our data.

Overall trend in technical degrees

Figure 22 presents the proportion of all Navy accessions with a technical undergraduate degree from 1988 to 2006.

Figure 22. Percentage of accessions with technical undergraduate degrees

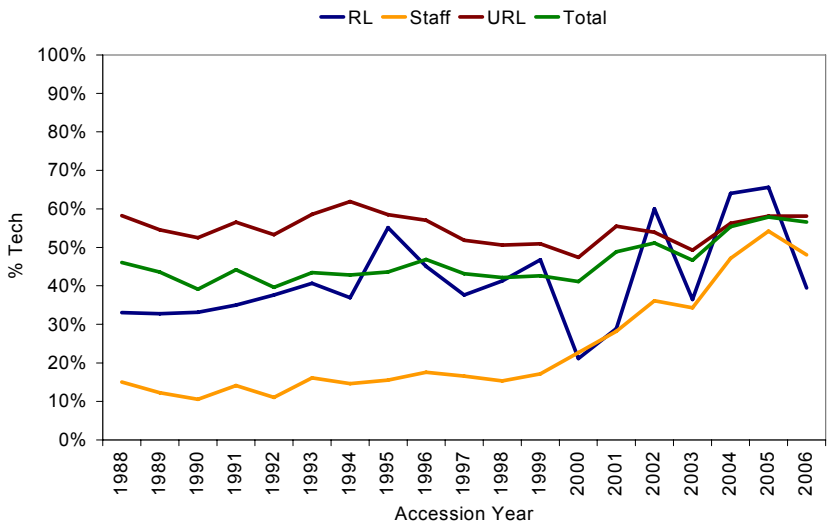


Overall, the level of technical undergraduate degrees has not declined over the period studied; it has actually increased recently.

Community

While overall technical degrees have risen rather sharply, trends for specific communities have not all seen the same increase. Figure 23 displays the percentage of accessions with technical undergraduate degrees by Navy community. The share of URL accessions with a technical degree has been relatively steady since 1988, while Staff corps has steadily increased and Restricted Line (RL) has also trended upward.

Figure 23. Percentage of community groups with technical degrees



Continuation rates for commanders and above

The continuation rates shown in table 8 are the percentage of O-5s who make it to the specified year of service, given that they have made it to the previous year (for example, of the officers who promoted to O-5 in 1980 and subsequently reached 20 years of service, 69.4 percent also made it to 21 years of service).

Table 9 shows a similar summary for those promoted to O-5 from 1980 to 1995 and were subsequently promoted to captain and above. Given that most officers promote to O-6 around 21 years of service, we show the continuation rates beyond 23 years of service.

Table 8. Continuation rates for officers promoted to commander, but not beyond

Promotion FY	18	19	20	21	22	23	24	25	25+
1980	96.3%	96.1%	91.2%	69.4%	76.6%	78.5%	76.1%	75.6%	61.5%
1981	97.8%	98.5%	91.9%	71.8%	69.0%	70.3%	78.3%	75.4%	57.1%
1982	96.6%	98.4%	95.1%	68.3%	64.6%	71.9%	70.9%	44.9%	54.3%
1983	97.7%	97.1%	93.0%	70.6%	71.1%	68.6%	61.0%	56.9%	48.8%
1984	97.5%	97.3%	96.1%	92.5%	78.9%	79.6%	84.8%	75.4%	69.3%
1985	99.7%	99.1%	97.1%	76.1%	72.9%	73.9%	57.6%	43.8%	22.9%
1986	99.7%	99.3%	94.9%	80.4%	74.7%	65.5%	61.8%	33.8%	13.0%
1987	99.1%	97.7%	95.0%	80.2%	77.2%	68.5%	24.8%	20.6%	28.6%
1988	99.4%	98.1%	93.4%	72.3%	57.3%	19.5%	39.1%	88.9%	25.0%
1989	100.0%	99.4%	97.5%	69.3%	54.2%	36.2%	52.4%	63.6%	64.3%
1990	99.1%	95.6%	94.0%	66.2%	44.1%	65.5%	71.8%	73.2%	65.9%
1991	98.2%	93.5%	90.3%	69.3%	64.6%	74.7%	67.0%	74.0%	63.0%
1992	98.8%	94.4%	91.7%	73.6%	65.2%	66.9%	61.8%	61.8%	79.4%
1993	98.2%	92.5%	97.0%	73.4%	65.1%	63.0%	73.6%	62.5%	65.0%
1994	97.4%	93.8%	94.0%	72.0%	65.8%	71.7%	70.3%	67.2%	90.7%
1995	97.9%	95.8%	95.1%	66.7%	75.4%	68.0%	73.1%	74.7%	80.0%

Table 9. Continuation rates of officers promoted to commander and beyond

Promotion FY	24	25	26	27	28	29	30	30+
1980	97.7%	91.8%	92.8%	75.7%	75.0%	78.2%	73.0%	36.9%
1981	98.4%	95.5%	92.4%	77.8%	73.2%	66.7%	63.3%	47.4%
1982	99.4%	95.1%	88.7%	74.5%	65.9%	74.1%	80.0%	48.8%
1983	96.4%	89.1%	87.0%	69.7%	73.0%	81.9%	83.2%	40.5%
1984	97.3%	91.2%	81.1%	77.4%	74.8%	81.5%	77.3%	39.7%
1985	97.9%	93.3%	83.1%	71.9%	83.6%	87.2%	85.3%	50.5%
1986	99.2%	90.5%	77.7%	92.1%	82.3%	80.7%	83.5%	64.8%
1987	97.2%	89.0%	83.2%	87.0%	79.6%	86.8%	81.6%	49.0%
1988	96.8%	87.6%	90.0%	87.6%	84.2%	84.4%	77.0%	41.3%
1989	94.3%	91.7%	87.7%	88.6%	81.7%	78.4%	85.7%	35.6%
1990	96.8%	94.1%	91.6%	84.8%	81.2%	82.3%	81.2%	34.7%
1991	98.6%	91.9%	86.6%	92.9%	83.3%	86.9%	78.8%	37.1%
1992	99.0%	91.7%	87.2%	86.5%	84.4%	78.2%	67.7%	N/A
1993	99.1%	91.8%	93.6%	86.2%	84.0%	75.9%	N/A	N/A
1994	99.1%	97.4%	90.1%	86.0%	74.4%	N/A	N/A	N/A
1995	99.7%	97.9%	87.6%	78.2%	N/A	N/A	N/A	N/A

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