# Workforce Assessment of Information Technology Sailors
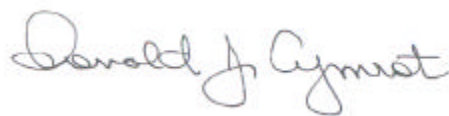
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**CNA**

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# Summary

## Background

Just as the Navy depends on information technology, mission accomplishment depends on the ability to maintain a secure information infrastructure. A necessary component of a secure information infrastructure is a well-trained information technology workforce.

The Director of Naval Training and Education (N79) asked CNA to analyze the information technology workforce—to understand the work performed by this workforce and assess options for enhancing its training and professional development. N79 also asked CNA to assess whether compensation incentives, such as reenlistment bonuses, and advancement exams reflect the work these Sailors perform.

This study served two purposes. First, it was the first application of the SkillsNET method (explained below) to the Navy. Second, it conducted an in-depth analysis of the Navy's active-duty information technology workforce.

We define the information technology workforce as Sailors who facilitate or protect others' use of information and communications systems. It is made up of the following jobs:

- Information Systems Administration (local area network administration, database administration, and help desk)

- Communications (bandwidth and frequency management and message center administration)

- Installation, Maintenance, and Repair (of computer or communications equipment)

- Information Systems Security

- Management and Supervision (officers and senior enlisted).

The current Occupational and Naval Standards have several constraints, such as the fact that frontline personnel conducting the work on a day-to-day basis are not the primary source used to describe the tasks performed.

We implemented the SkillsNET process of SkillObjects™ at four fleet concentration areas, in which different groups of Sailors described and reviewed their tasks. SkillObjects are a registered trademark of The SkillsNET Corporation. The process also involved linking each task to skills and abilities defined by the U.S. Department of Labor, clustering the tasks, and capturing the tools and knowledge for each task cluster. The final step involved a survey in which Sailors rated the mission criticality of each task. We measured mission criticality on the basis of responses to the following factors: consequences of misperformance, task delay tolerance, proportion of the workforce performing, and time on task. We produced an index of mission criticality for each task.

In addition to the SkillsNET process, we conducted a survey of the information technology workforce to understand how the limitations of the current Occupational Standards affect the targeting of the training, reenlistment bonuses, and advancement exams. We matched the survey data to the Enlisted Master File and the Officer Master File, and we obtained detailed cost data for training courses. Participants in our data collection represented nearly the full array of Navy ships and activities, including large and small ships, and a variety of key shore stations, such as the Naval Security Group Activity (NSGA) and the Naval Computer Telecommunication Area Master Station (NCTAMS).

# Findings

## SkillObjects versus Occupational and Naval Standards

The SkillObjects method captured more tasks than the Occupational and Naval Standards. Overall, SkillObjects for the information technology workforce captured about 200 more tasks than the Occupational and Naval Standards; however, the SkillObjects missed only 15 Occupational Standards tasks—mostly for obsolete technologies. The

implications of the Occupational Standards missing critical tasks are significant because the standards are a primary basis for most A-School curricula and advancement exams.

## Training gaps

The information technology A-Schools do not cover many mission-critical tasks. Based on the curriculum developers' review of the task inventories, we found that the information technology A-School fails to cover 79 and 60 percent of the mission-critical tasks in Information Systems Administration and Communications, respectively. Similarly, for the Cryptologic Technician Operations (CTO) A-School, the training gaps in these two areas are 53 percent and 60 percent.

Sixty-two percent of junior Sailors (E-4 and below) reported in our survey that their A-Schools were not useful or only slightly useful. Not a single officer or senior enlisted Sailor responding to our survey recommended leaving the A-School as it is.

Four of the five SkillObjects with the largest training gaps (such as analysis of suspicious network activity) were not captured at all by the Occupational Standards. The fifth one was covered—but only partially.

## Potential for training consolidation

Three information technology ratings have significant overlap in the tasks performed by Sailors. According to our data, 73 percent of the Information Systems Technician (IT) tasks overlap with both the CTO/Cryptologic Technician Maintenance (CTM) and the Fire Control Technician (FT) tasks. In Communications, 70 percent of the IT tasks overlap with the tasks of the CTO/CTMs.

Sailors in these three ratings go through separate training pipelines to receive their Information Systems Administration or Communications training. This implies that there is a significant potential for consolidating the training related to the tasks that overlap.

## Benefits and costs of enhancing training

We conducted a cost-benefit analysis for three options for enhancing the IT training. Option 1 involves outsourcing the training to a 1-year community college program. Option 2 involves redesigning the Navy IT A- and C-Schools to cover the mission-critical tasks. Option 3 is the same as option 2, but would be run by a college.

We found that enhancing the IT training through any of the three options is cost-effective. The annual net savings ranges from $33 million from outsourcing the program to a 1-year community college program to $69 million for the combined option of redesigning the schools and outsourcing them to a college.

## Mismatch of bonus field and work performed

From the match of the task data to the Enlisted Master File, we found that work performed does not always reflect the competencies for which a reenlistment bonus was paid. We found that 29 percent of the Sailors who received a reenlistment bonus for completion of local area network (LAN) administration training did not even perform tasks related to LAN administration.

We also found that nearly half—47 percent—of the Sailors who perform LAN administration do not get a bonus simply because they do not hold the requisite rating or Navy Enlisted Classification (NEC). Even though they perform the work, because their skills are not documented, they are not eligible for a bonus. Finally, 77 percent of the Sailors (E-1 to E-6) in the Information Systems Administration job perform LAN administration. This suggests that LAN administration should be part of the IT A-School, not the C-School.

Sailors who do LAN administration but do not receive a bonus are 15 percentage points more likely than the bonus recipients to report that they plan to leave the Navy. These Sailors have taken concrete steps for leaving, such as interviewing or applying for a civilian job. In addition to the lower retention, the actual annual cost of the out-of-field bonuses is $2.6 million. The cost of the unused training is $2.9 million, for a combined annual cost of $5.5 million.

### Advancement exam gaps

Advancement exams for the information technology workforce do not cover many critical tasks. Based on exam writers' review of their test banks covering the preceding 2 years, we found that coverage is the most limited for the component of the CTM rating exam related to Installation, Maintenance, and Repair—70 percent uncovered. Coverage is the most comprehensive for the Electronics Technician (ET) rating exam related to Installation, Maintenance, and Repair—only 17 percent uncovered.

The IT rating is made up of two main jobs: Information Systems Administration and Communications. Many ITs perform one of the two jobs uniquely. These Sailors, though, are trained and tested in both fields. Our data show that these are two distinct jobs with different competency requirements.

# Recommendations

Based on the evidence uncovered by our research findings, we make six recommendations:

1. **Enhance the Occupational and Naval Standards**. The Navy should maintain full support for the effort to enhance the Occupational and Naval Standards to capture the competencies and to rate the mission criticality of the tasks performed by Sailors.

2. **Enhance the information technology training**. Redesigning the schools to cover the mission-critical tasks, or outsourcing them, or a combination of the two would produce a positive payoff.

3. **Integrate LAN administration into the A-School.** The Navy should integrate the LAN Administration C-School into the A-School. LAN administration is a major component—not a subspecialty—of Information Systems Administration.

4. **Consolidate training for overlapping tasks of several ratings**. To save resources, the Navy should consolidate the Information Systems Administration training of the IT, CTO/CTM, and FT

ratings. It should also consolidate the Communications training of the IT and CTO/CTM ratings.

5. **Consider splitting the IT rating**. The Navy should consider separating the IT rating into two service ratings for Information Systems Administration and Communications.

6. **Redesign the advancement exams**. The Navy should redesign the advancement exams of the information technology workforce to cover more mission-critical tasks.

The SkillObject method has applications that go beyond the information technology workforce:

- **Training**. SkillObjects can be used to obtain individual Sailors' proficiency in the different competencies of a job. This mapping of the skills would allow for a skill gap analysis—a comparison of what Sailors know and what they should know.

- **Assignment**. The Navy should evaluate the way it matches Sailors to billets. Instead of basing the match primarily on the Sailor's rating and NEC, the Navy could consider basing the assignment on SkillObject proficiency.

- **Retention**. The Navy currently pays bonuses for personnel shortages in specific ratings. Within a given rating, the shortage may be greater in some SkillObjects than in others. Identifying what people do and basing the bonuses on the work performed could save bonus dollars and help target the training to Sailors who will actually do the work.

# Introduction

## Background

The Navy is continually seeking ways for its workforce to meet evolving missions in changing security and technological environments. Understanding Sailors' work and the skills required to perform the work is crucial to their professional development and performance. Understanding the work of Sailors also provides a solid base for manpower, personnel, and training decisions.

Because the Navy is highly dependent on information technology, mission accomplishment depends on the ability to maintain and use a secure information infrastructure. A necessary component of such an infrastructure is a well-trained, competent information technology workforce. This study was the first application of the SkillsNET method to the Navy (explained in the next section, "Data and methodology"). We used this method to produce an inventory of the tasks and the knowledge, skills, abilities, and tools (KSATs) required to perform work. This study also conducted an in-depth analysis of the Navy's information technology workforce.

The Director of Naval Training and Education (N79) asked CNA to analyze the information technology workforce—with an emphasis on strengthening the workforce that will support, administer, and supervise the use of information technology in a network-centric warfare environment. Specifically, N79 asked CNA to address the following:

- What defines the work performed by Navy information technology professionals?

- What are the options for enhancing the information technology training?

- Do reenlistment bonuses and advancement exams reflect the work Sailors perform?

# Defining the information technology workforce

We define the Navy's military information technology workforce as Sailors who facilitate or protect others' use of information and tele-communications systems. It helps other personnel use hardware and software (at unclassified or classified levels) for strategic, tactical, and nontactical systems. Our definition does not include end users of information or communications systems.

Although the information technology workforce in the Department of the Navy includes military (both active duty and reserve), civil service, and contractor personnel, this study focuses on the active-duty military workforce. Our analyses cover personnel performing information technology functions, which includes Sailors in the Information Systems Technician (IT) rating and officers in the Information Professional community. Our analyses also cover Sailors in other ratings running the computer networks and maintaining the equipment.

The Navy's military information technology workforce is made up of the following five jobs:[1]

1. **Information Systems Administration**. The main source ratings for the Information Systems Administration job are IT, Fire Control Technician (FT), and Cryptologic Technician Operations/Maintenance (CTO/CTM). Submarines have no ITs, so FTs do their functions. Some Sailors in other ratings also perform Information Systems Administration. Information Systems Administration covers the following functions:

   a. Local area network (LAN) or system administration

   b. Database administration and support

   c. Computer help desk to assist other technical personnel and end users.

2. **Communications**. Sailors in this job provide technical support to facilitate internal and external communications, including

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1. Sailors in small ships often perform more than one of these jobs, whereas Sailors on large ships tend to specialize in a single job.

bandwidth and frequency management (referred to as "technical control"). It also includes message center administration: receipt, handling, and distribution of naval message communications. The main source ratings are IT and CTO/CTM.

3. **Installation, Maintenance, and Repair**. These Sailors install, maintain, and repair equipment used for information systems and communications. The main source ratings are Electronics Technician (ET) and CTO/CTM.

4. **Information Systems Security**. We identify Information Systems Security Sailors as those who provide computer network defense for their commands. They also protect Navy-wide information and communications assets. The main source ratings are IT, FT, and CTO/CTM.

5. **Management and Supervision**. Officers and senior enlisted Sailors (E7 and above) who manage computer and communications resources, including supervision of Sailors in the other four jobs.

The IT rating resulted from the merger of the Data Processing Technician and Radioman ratings in 1995. The name "Information Systems Technician" for the combined rating was adopted in 1999.

# Methods to describe work

We compare two methods used to describe the work: the Navy's Occupational and Naval Standards and the alternative method of SkillObjects™. Here are some key definitions:

- **Occupational Standards**. The Navy currently defines work through the Occupational Standards, which consist of tasks performed by Navy enlisted personnel. Created in 1976 and updated periodically, Occupational Standards are the primary basis for many important personnel policies, such as planning, procurement, training, promotion, and assignment.

- **Naval Standards**. The Navy also defines work through the Naval Standards, which cover the military and administrative tasks. Also created in 1976 and updated periodically, the Naval Standards apply to all enlisted ratings.

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- **SkillObjects**™. Developed in 1996 by The SkillsNET Corporation, SkillObjects are families of tasks that are performed on the job together, are trained together, or are evaluated in a similar fashion. Each SkillObject contains the associated knowledge, skills, abilities, and tools (KSATs). The KSATs represent some of the most important worker "competencies." SkillObjects are a registered trademark of The SkillsNET Corporation. Figure 1 shows the components of SkillObjects.

Figure 1.    SkillObject components
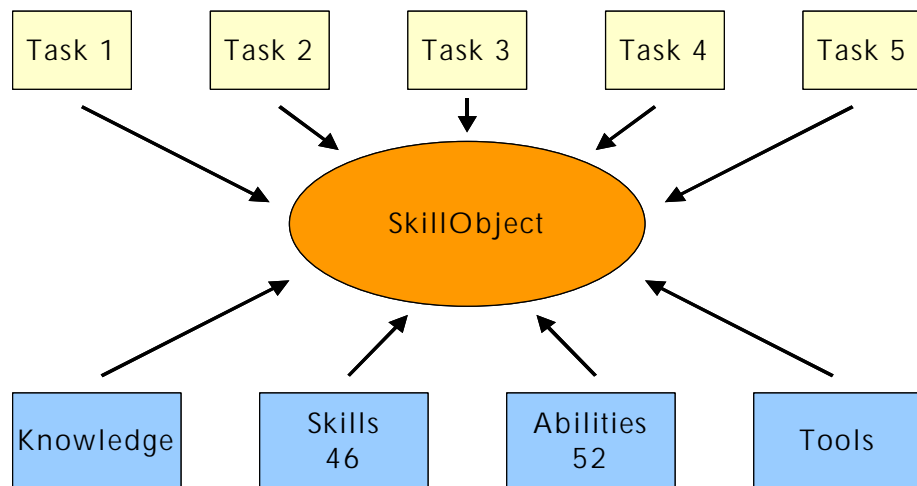


- **Occupational Information Network**. SkillObjects link to O*NET, a U.S. Department of Labor (DOL) database that enhances its predecessor, the Dictionary of Occupational Titles (DOT). Unlike the DOT, O*NET describes worker characteristics, job requirements, and work environment.

- **Task**. Tasks are activities that occur to produce a product or service. They are work functions that typically have a beginning and an end and that are observable. Tasks are made up of one verb, one or more nouns and, in many cases, object and statement modifiers to add specificity. Examples of tasks are: "Climb structures and masts to install or repair equipment (for example, an antenna)" and "Fix circuit outages and interference (such as electromagnetic interference)."

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- **Knowledge**. O\*NET defines knowledge as an organized set of facts and principles necessary for successful job performance (i.e., information that workers need to know to perform their tasks). In this study, knowledge items include processes, procedures, and guidelines, such as technical manuals and Navy instructions. Examples of knowledge items are "Automatic Data Processing Security Program Instruction" for network analysis and the "Naval Telecommunications Procedures" manual.

- **Skills.** O\*NET defines skills as work capabilities obtained from training or experience. O\*NET spells out 46 basic and cross-functional skills. Examples of basic skills are reading comprehension and critical thinking. Cross-functional skills cover the following: solving problems, working with technology, working with people, working within an organizational system, and working with resources.

- **Abilities.** O\*NET defines abilities as work capabilities independent of training or experience. Abilities are personal traits, such as finger dexterity and originality, that tend to be stable over long periods of time.[2]

- **Tools**. Tools consist of resources needed to perform the tasks. Tools can be software, such as Windows NT User Manager in the area of networks, or tangible devices, such as the signal strength meter used in communications. We limited the tools to items that require at least 2 days to learn.

O\*NET makes a clear distinction between skills and abilities. Skills, which depend on experience and practice, are situational and tend to change, whereas abilities are stable (though in some cases they may change over time with exposure to some situations [1]).

Skills and abilities often complement each other. The development of a skill is partially a function of the worker's relevant abilities. The abilities—in combination with the educational background—partly determine the rate of acquisition and final levels of performance that a worker can achieve in particular skills.

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2.  For the definitions of the O\*NET 46 skills and 52 abilities, see [1].

In our data, the number of SkillObjects per job ranges from 26 in Information Systems Security to 34 in Communications and Management and Supervision. In practice, each SkillObject may contain as few as 1 task and as many as 25. The number of tasks per job ranges from 178 in Information Systems Security to 301 in Communications.

## About the current method

The current Occupational and Naval Standards have the following constraints:

- *Top-down*: The tasks in the Occupational and Naval Standards are defined not by Sailors currently performing the tasks, but by senior personnel who, in many cases, have not performed the tasks in many years.

- *Disjointed*: The current standards do not capture the O*NET skills required for performing the tasks and, therefore, are not able to produce a reliable crosswalk to civilian jobs (in O*NET and other DOL databases). Identifying the O*NET skills is necessary for a more reliable crosswalk to civilian jobs.

- *Limited scope:* The Occupational Standards do not cover work related to Navy Enlisted Classifications (NECs). This represents a major gap in the current Occupational Standards.

- *Not specific:* The Occupational and Naval Standards tasks are seldom described in context. A typical task in the current Occupational Standards is phrased as follows: "Connect computers." This statement does not describe what computers are connected, where, or why.

## About the alternative method

The SkillObjects™ method, developed by SkillsNET, solves many of the limitations of the current Occupational and Naval Standards. The SkillObject method has the following characteristics:

- *Bottom-up*: In the SkillObject method, current incumbents participate in the data collection—describing what they do in

structured task statements.[3] The SkillObject method asks, "What do you do?" as opposed to the more constraining question of the Occupational and Naval Standards, "Do you do this?"

- *Integrated*: SkillObjects capture the O*NET skills required for performing the tasks, which enables a more reliable crosswalk to civilian jobs in the O*NET database and, potentially, to the other military services.

- *Comprehensive:* SkillObjects have a greater coverage of the work; they capture tasks associated with NECs. In addition to the tasks, SkillObjects capture the KSATs.

- *Specific:* The tasks in the SkillObject method tend to be more specific than in the Occupational and Naval Standards. Instead of "Connect computers," the phrasing would be "Connect supply Local Area Network (LAN) computers to the battle group network before the start of the training evolutions."

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3. The SkillObject method relies primarily on incumbents for data collection and evaluation. According to [1], incumbents are better able than occupational analysts to provide information about work and worker descriptors, especially complex, difficult-to-observe job characteristics. Incumbents and analysts, however, tend to agree in their descriptions of occupational skill requirements.

# Data and methodology

## Sources of data

To understand the work performed by the information technology workforce and the required competencies, we applied the SkillsNET process. Also, we surveyed the workforce to understand how the limitations of the current Occupational and Naval Standards affect the targeting of the training, reenlistment bonuses, and advancement exams. We matched the survey data to the Enlisted Master File and Officer Master File. Finally, we obtained detailed cost data for training courses.

### SkillObjects

We implemented the SkillObject™ process at four fleet concentration sites: Norfolk, Virginia; San Diego, California; Pacific Northwest commands in Washington (Whidbey Island, Bangor, Everett, and Bremerton); and Pearl Harbor, Hawaii. Participants in our data collection were enlisted Sailors and officers representing the different types of ships—large and small.

Data collection participants also represented shore stations—such as the Naval Security Group Activity (NSGA), the Naval Computer and Telecommunication Area Master Station (NCTAMS), and the Shore Intermediate Maintenance Activity (SIMA)—and the fleet staffs.[4]

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4. Respondents to the final survey represented nearly the full array of Navy ships and activities in the Atlantic and Pacific Fleets: aircraft carriers, cruisers, destroyers and frigates, submarines, service force ships, amphibious ships, and amphibious craft (e.g., LCACs). They also represented afloat staff, training commands, aviation squadrons, sea- and shore-deployed detachments, Special Warfare units, shore-based deployable units (e.g., Seabees), and other shore and staff commands.

The Naval Computer and Telecommunication Station (NCTS) and the Fleet Information Warfare Center (FIWC) were also represented.

To collect the SkillObject data, we followed the five steps outlined below.

**Step 1—Description of the tasks performed**

A minimum of eight Sailors per job (from representative commands) reviewed tasks from an existing information technology task inventory and identified the tasks they perform. We obtained the task inventory from the Space and Naval Warfare Systems Command (SPAWAR), which built it for the Communications, Information Systems, and Networks (CISN) Training Working Group.

Then, participating Sailors selected from 6 to 12 Generalized Work Activities (GWAs) from a list of 42 defined by O*NET. The GWAs describe jobs in broad types of behaviors. Examples of GWAs are "Interacting with computers" and "Inspecting equipment, structures, or materials." Based on their selection of GWAs, the software gave participants a set of verbs and nouns to build task statements. The software also allowed participants to enter their own verbs and nouns. Finally, participants added verb and statement modifiers to add specificity.

**Step 2—Review of the tasks and skill/ability linkage**

We combined the task statements into a single list, combined tasks with similar wording, and removed redundant tasks. After this, subject matter experts (SMEs) worked in panels (at least three per job) to review the list, clarify wording, and add tasks missing from the list.[5]

The SMEs ensured that the tasks represented accurately the work performed in their jobs, including tasks related to emerging job roles. Following the review, skill analysts identified the primary enabling skills and abilities required for each task.

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5. In this study, task generation (step 1) produced a nearly complete task inventory. The number of new tasks added by the task reviewers in step 2 was less than 5 percent of the total number of tasks.

**Step 3—Task clustering and assignment of tools and knowledge**

We then clustered the tasks that have the same skill requirements. A new panel of SMEs (at least three per job) reviewed the clusters based on similarities of the tasks in each cluster. When necessary, the panels rearranged the clusters to ensure that they contained tasks that are performed on the job together, trained together, or evaluated in a similar fashion. The panels assigned a meaningful title and identified tools and knowledge items for each task cluster.

**Step 4—SkillObject editing**

We prepared a clean list of clusters with the tools and knowledge links. At this stage, a separate panel of SMEs (here again, at least 3 per job) reviewed the clusters, cluster names, tools, and knowledge. These SMEs clarified wording of cluster names, tools, and knowledge; when necessary, they added items not on the list.

**Step 5—Survey to rate the criticality of tasks**

In our final step, we conducted a Web-based Navy-wide survey (during August–December 2001) of officers and enlisted Sailors performing information technology functions. Through this survey, we collected the following data about the mission criticality of each task:

- *Consequences of misperformance*—a 5-point-scale indicator of how serious the consequences are for poor performance of the task. For example, misperformance of the task of cleaning computers for viruses can have catastrophic consequences, so this task is likely to be critical.

- *Delay tolerance*—a 5-point-scale indicator of how much delay can be tolerated between the time the need for the task becomes evident and the time actual performance must begin. For example, the task of fighting a fire has no delay tolerance to allow for training.

- *Proportion of the workforce performing task*—the average proportion of respondents that performed the task.

- *Time on task*—a 5-point scale of the number of hours the respondent spent the preceding week on the task. Time on task reflects the frequency and duration of the tasks.

In addition, respondents indicated whether they had adequate training for each task. We used the responses to this question to determine the training gaps for each task and task cluster.

Participants in step 1 were primarily a cross section of E-4–E-6 Sailors. Participants in steps 2–5 were top-performing E-5–E-8s (nominated by their commands). Also, officers (O-3 and below) along with E-7–E-9 Sailors participated in the different steps for the Management and Supervision job. Participants generally had at least one year of experience at their current jobs.

Some steps required individual participation, and others involved group participation. Participants in step 1 worked individually in computer-based data collection sessions. Participants in steps 2–4 worked in panels.

For the final survey (step 5), we sought out a cross section of Sailors at all paygrade levels as well as officers in the information technology field. Sailors used the SkillsNET software for all of the steps.

We built an index of mission criticality based on the following rank ordering of the criticality measures (starting with the most important):

- Consequences of misperformance

- Delay tolerance

- Percentage of the workforce performing

- Average time on task.

Following the method outlined in [2], we compared each of the four measures with one another. We applied a 7-point scale depending on how each pair compared (from a value of 1 for "significantly less important" to 7 for "significantly more important").[6] We then produced an "index of mission criticality" with a value of 5 for the most mission critical task in each job. We labeled tasks "mission critical" if they had an index of 4.0 or higher.

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6. Based on this rank ordering, we obtained the following weights: consequences of misperformance, 0.38; delay tolerance, 0.29; percentage of the workforce performing, 0.21; and time on task, 0.13. The sum does not add to 1.00 because of rounding.

Although other measures of criticality exist, we limited this survey to the items above to maintain a reasonable response time. Alternative measures of criticality are learning difficulty, whether the task requires more than one person to perform (a team task), and safety requirements. See [3] for a more comprehensive list of measures of criticality.

Which tasks are the most mission critical? Here is the task with the highest mission criticality for each of the five jobs:[7]

- *Information Systems Administration*: "Report possible network intrusion or virus."

- *Communications*: "Deliver incoming messages to appropriate personnel (may be classified messages)."

- *Information Systems Security*: "Analyze intrusion alarm patterns across multiple detection sensors for scope of suspicious activity."

- *Installation, Maintenance, and Repair*: "Troubleshoot communications equipment (at the different frequency levels)."

- *Management and Supervision*: "Manage information systems (ex: LAN maintenance, capabilities, and operation)."

**Linking to O*NET**

An important advantage of SkillObjects is that they are based on the O*NET method. O*NET, used for the first time by DOL in January 1995, replaces the Dictionary of Occupational Titles (DOT) as the primary source of occupational information. Unlike the DOT, O*NET is an object-oriented database that links occupations with specific skills.

O*NET is the result of about 50 years of occupational analysis, and provides a common language for defining worker attributes, work content, and outcomes. The most important contribution of O*NET is its content model—captured by about 480 data fields of worker requirements (such as the skills), worker characteristics (such as the abilities), and experience requirements. The O*NET content model also

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7.  Appendix A contains the full list of mission-critical tasks in Information Systems Administration.

includes occupational requirements (such as the generalized work activities), and occupation-specific requirements (such as knowledge items).

## Similar civilian jobs

Using the required O*NET skill, we linked the Navy's information technology jobs to similar civilian jobs in America's Career InfoNet, a DOL database of labor market data, such as salaries, projected employment growth, and educational requirements [4].

Figure 2 shows civilian jobs similar to those held by the Navy's information technology workforce. The U.S. median annual salary for these jobs (for 1998) ranges from $29,000 for Data Processing Equipment Repairers to $52,000 for Systems Analysts. As expected, salaries are highest for the jobs requiring a college degree and lowest for those simply requiring on-the-job or vocational training.

Figure 2.    Labor market for similar civilian jobs[a]

| Civilian jobs | Median annual salary ($) | Education required | Projected growth in employment (percentage) |
|---|---|---|---|
| Systems analysts | 52,000 | Bachelor's | 94 |
| Database administrators | 48,000 | Bachelor's | 77 |
| Computer programmers | 47,000 | Bachelor's | 30 |
| Other computer scientists | 47,000 | Bachelor's | 118 |
| Computer support specialists | 37,000 | Associate's | 102 |
| Phone/cable line repairers | 33,000 | On-the-job training | 30 |
| Data processing equipment repairers | 29,000 | Vocational training | 47 |

a. America's Career InfoNet, 1998. Typical education requirements. Employment growth for next 10 years.

The projected 10-year growth in employment was the highest for Other Computer Scientists (118 percent) and the lowest for Computer Programmers and Phone and Cable Line Installers and Repairers (30 percent each).

The typical educational requirement for four of the civilian jobs is a Bachelor's degree, and an Associate's degree for another. In the Navy, though, the typical Sailor has a high school diploma only.

## Background survey

We administered a Web-based background survey to a sample of enlisted Sailors and officers. Respondents had spent at least 10 percent of their time in the preceding week performing one or more of the five information technology jobs. We conducted the survey during August–December 2001, as an add-on to the survey of tasks.

The survey targeted officers and enlisted Sailors who work in one or more of the five jobs regardless of their rating, NEC, or officer designator or subspecialty. That is, we sought the inclusion of Sailors with no Navy training for the job or who perform the job on a part-time or collateral basis.

Respondents included Sailors who worked on unclassified and classified networks. We pretested the survey instrument with at least 20 Sailors in each job. Appendix B contains a copy of the survey instrument for Information Systems Administration.

**Why did we need a background survey?**

*Measure benefits of enhancing training.* The background survey was the main source for the benefits (cost avoidance) data. Sailors spend a significant amount of time providing on-th-job training (OJT) to recent A-School graduates. To estimate the potential avoidance of OJT from enhancing the Navy school training, we asked Sailors how many hours in the preceding week they spent providing OJT to recent IT A-School graduates. We also asked them how much of that training could have been avoided if Sailors received the necessary training in IT A-School.

To estimate the avoided repairer workload from enhancing the IT training, we asked Installation, Maintenance, and Repair Sailors how many hours in the preceding week they spent answering trouble calls from ITs, FTs, CTOs, and other Sailors. We also asked them how many hours per week they would save if personnel operating computers or communications equipment (their customers) received the necessary training.

The background survey also asked respondents if they were planning to reenlist (or extend for 1 year or more) beyond their current obligation. To those who said "no," we asked what they had done in the last 6 months to explore the possibility of leaving the Navy. We included the following activities: interviewed for a civilian job, applied for a civilian job, talked about leaving the Navy with their immediate supervisors, and attended a training program or seminar to help prepare for civilian employment.

For those who appeared serious about leaving the Navy by taking one or more of these concrete steps, we asked which incentives would definitely convince them to stay. Among these options was the opportunity for a 1-year (or 6-month) assignment to college to complete an Associate's degree (or 50 percent of an Associate's degree) in information systems, computer science, or telecommunications.

*Identify all sources of training.* We needed information, among other things, on informal training, and this information was not available on the electronic personnel or training records. The only way to capture this information was to ask Sailors directly.

Our survey asked respondents to identify where they received their computer or communications training. Respondents selected from a variety of alternatives: A-School, C-School, OJT from other Sailors or technical representatives (tech reps), self-study, college or technical school, commercial certification course, friend not in the work center, and other sources.[8]

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8. The five sources of Information Systems Administration and Communications training most common for E-1–E-4s were (in descending order): OJT from other Sailors (86 percent), A-School (67 percent), OJT from vendors and tech reps (59 percent), C-School (59 percent), and books purchased with their own money (50 percent).

To ensure that the respondents were active-duty enlisted Sailors and officers only, we matched the survey data to the Enlisted Master File and the Officer Master File of September 2001. To match the records, we used the social security number or a combination of the last name and date of birth.

**Sample**

We obtained a total of 781 responses to the survey. The number of responses by job was as follows:[9]

| | |
|---|---|
| Information Systems Administration | 385 |
| Communication | 183 |
| Installation, Maintenance, and Repair | 41 |
| Information Systems Security | 70 |
| Management and Supervision | 102 |

We screened out records for which the number of tasks rated was less than 20. We kept the latest entry for fields that had more than one response from the same person.

# Training course costs

**Navy schools**

We obtained cost data for Navy schools during FY00. We used the data to calculate the cost per participant in the IT A-School and the LAN Administration C-School. The data allowed us to separate variable costs from fixed costs (overhead). The course cost components are supplies, contracts, depot level repairables, operation of simulators, instructors, curriculum development, construction of new facilities, and general activities of the installation. We obtained this file from the Naval Education and Training, Professional Development, and Technology Center (NETPDTC).

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9.  Because it was an open Web-based survey, we were unable to calculate a response rate. Nevertheless, the diversity of the commands represented in the survey indicates that our sample reflects the characteristics of the information technology workforce throughout the Navy.

### Community college program

We also obtained data from the Information Technology University, a small partnership program between the Navy and Tidewater Community College in Virginia. Through this program, a small group of IT Sailors attended an intensive 1-year program. Graduates of the program received an Associate's degree in information systems technology.

In support of this community college program, the Navy paid for textbooks, consumables (such as print cartridges, notebooks, and CDs). The Navy also paid for laptop computers for the students and provided classroom and laboratory space, hardware, and software.

The college charged tuition at the in-state rate. We obtained itemized costs for this community college program from the program administrators. We used these data to calculate the cost of outsourcing the Information Systems Administration training to a community college.

## Evaluation by curriculum developers and exam writers

### Curriculum developers

Developers of the curriculum for the IT and CTO/CTM A-Schools reviewed the list of tasks to identify those covered in their courses (as of September 2001). Curriculum developers for each of these two A-Schools reviewed the task lists for both the Information Systems Administration and Communications jobs.

In addition, curriculum developers at the LAN Administration C-School (NEC 2735) and faculty at Tidewater Community College reviewed the list of Information Systems Administration tasks to identify those covered by their courses.

### Advancement exam writers

Similarly, exam writers reviewed the list of tasks and identified those covered in their exams. To cover a full cycle of exams, we asked the exam writers to do their evaluation for the most recent 2-year period (ending in April 2001). We used these data to assess the alignment between the advancement exams and the work performed by the information technology workforce.

Writers of the IT and FT rating exams reviewed the Information Systems Administration tasks. Also, writers of the IT rating exam reviewed the Communications tasks. Finally, writers for the ET and CTM rating exams worked with the tasks for the Installation, Maintenance, and Repair job.

To ensure that the evaluation made by the curriculum developers and exam writers was verifiable, we asked them to specify the number of the course section or exam item in which each task was covered.

# Method of analysis

Is enhancing enlisted IT training cost-effective? We conducted a cost-benefit analysis that calculates the gains and losses resulting from enhancing IT training. We calculated the costs and benefits for the following three options:

1. *Outsource to a 1-year college program.* This first option involves outsourcing the IT A- and C-Schools (LAN Administration) to a 1-year community college program similar to that run by Tidewater Community College.

2. *Redesign A- and C-School.* This option involves redesigning the IT A- and C-Schools to cover the mission-critical tasks.

3. *Redesign and outsource A- and C-School.* This option combines options 1 and 2; specifically, it is option 2 run by a college.[10]

For each option, we calculated the annual net benefit, that is, the difference between the benefits and the costs. Our estimates are for the new steady state. They reflect the annual benefits and costs in the situation in which *all* information technology Sailors are adequately trained.

Following the guidelines of the Office of Management and Budget for cost-benefit analyses [5], we measured the following benefits:

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10. An alternative is to outsource to a private technical school. We based our analysis of options 1 and 3 on Tidewater Community College only because we had data for its program.

- *Included lost productivity of personnel.* Sailors are not directly productive when providing or receiving OJT. We included the time spent by the Sailors both imparting and receiving the training.

- *Included retention increase from college opportunity.* For options 1 and 3 in our cost-benefit analysis, we measure the benefits resulting from giving Sailors the opportunity to pursue a college degree. Earlier CNA research found that Sailors who participate in a college program experience a significantly higher retention rate than other Sailors [6].

- *Excluded overhead.* We ignore overhead of the Navy schools, that is, cost that would not be avoided if the schools were outsourced (such as the cost of security of facilities). That is, we sought to be conservative in our estimate of the benefits.

## Benefits of enhancing training

More specifically, we calculated the following benefits:

- *Avoided OJT.* Information System Administration Sailors spend an average of 2.5 hours per week giving OJT to recent A-School graduates. This includes only training that would be avoided if the IT A-School graduates received adequate training. We included the savings from both trainer and trainee time.

- *Avoided workload of repairers.* The typical Installation, Maintenance, and Repair Sailor reported potentially saving 8 hours per week if Information Systems Administration and Communications Sailors were adequately trained. This also includes the PC and computer network downtime that would be avoided.

- *Avoided site visits by tech reps.* The typical command represented in our survey would save an average of 20 hours of tech rep visits per month if Navy schools provided adequate training in Information Systems Administration.

- *Avoided school house cost.* According to the school cost data, the cost per IT A-School graduate is $3,162. The LAN Administration C-School is significantly more expensive—$15,684 per graduate. These figures include variable costs only.

- *Retention increase from the opportunity to pursue a college education.* According to our survey, 34 percent of the Sailors not planning to reenlist would be convinced to stay if offered a 1-year assignment to a community college program in information systems or telecommunications. For a 6-month program, the retention effect is 18 percent. This potential increase in the probability of retention applies only to those Sailors who were not planning to reenlist.

Using the responses to our background survey, we obtained the average of the magnitude of the cost avoidance explained above. We assume that the three options result in the same proficiency after the training. Although the community college program is longer than the school house program, the community college curriculum includes a general education component (such as history and English courses). This general education component does not have a direct effect on proficiency in information technology.

## Costs of enhancing training

We calculated the following costs:

- *Increase in student and staff compensation.* The daily compensation of participating Sailors and staff is $114 and $277, respectively.

- *Tuition, personal computers, and consumables.* The community college charged the in-state tuition rate of $44 per credit hour. The cost per student of books, personal computers, and consumables is $6,275.

- *Navy school cost.* Under option 2, the LAN Administration C-School would be part of the initial training. Approximately an additional 1,100 IT A-School graduates would go on to LAN Administration training per year.

As in most cost-benefit analyses, the monetary benefits and costs of enhancing IT training are not fully measurable. For example, enhanced training could reduce absenteeism. We did not have data to assess these effects.

There may also be unmeasurable costs, such as the loss of military acculturation at a community college program (options 1 and 3). In the experience of the Tidewater Community College program, though, there appeared to be minimal loss of acculturation. The instruction was imparted in Navy facilities, and the staff members were senior IT Sailors. Also, students were in uniform, attended mandatory group physical training conducted by military personnel, and used Navy living quarters and facilities.

Our cost-benefit analysis does not reflect the cost to taxpayers in general, but only the cost that is borne directly by the Navy. In particular, the tuition charged by community colleges is lower than the true cost to the taxpayers because community colleges are typically subsidized.

# Findings

## SkillObjects versus Occupational and Naval Standards

SkillObjects™ provide a more comprehensive description of the work than the Occupational and Naval Standards. Figure 3 compares a sample of Information Systems Administration and Communications tasks captured using the two methods. The Occupational and Naval Standards are for 2001, the latest available.

Figure 3. Number of tasks captured by SkillObjects and the Occupational and Naval Standards[a]
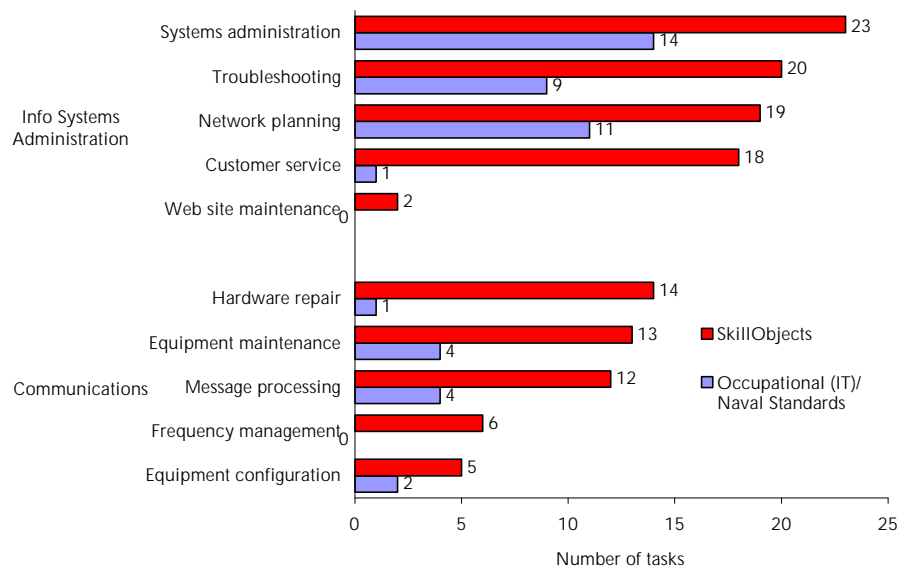


a. Occupational Standards for IT rating, 2001.

SkillObjects captured more Information Systems Administration tasks. For example, in the area of network planning, SkillObjects captured 19 tasks, compared to only 11 by the Occupational and Naval

Standards. In customer service, SkillObjects captured 18 tasks, compared to only 1 by the Naval Standards (the Occupational Standards for the IT rating had no customer service tasks).[11]

SkillObjects also captured more Communications tasks. For example, in the area of hardware repair, SkillObjects captured 14 tasks, compared with only 1 by the Occupational Standards. In the area of radio frequency management, SkillObjects captured 6 tasks, and the Occupational and Naval Standards did not capture any.[12]

Overall, SkillObjects for the information technology workforce identified 200 more tasks than the Occupational and Naval Standards. What about tasks captured by the Standards but not by the SkillObjects? The SkillObjects missed 15 Occupational Standards tasks—mostly for obsolete technologies.

Examples of tasks missed by the SkillObject method follow:

- "Correct printer ribbon and paper movement problems."

- "Reset tape drives or tape controllers."

- "Perform system dumps."

The Occupational and Naval Standards, however, missed tasks that we found to be mission critical, such as:

- "Clean work stations or media infected with viruses."

- "Teach other computer or technical personnel about hardware or software operation and procedures."

- "Assist customers with problems (such as LAN connectivity, desktop, or account problems)"

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11. The difference in the number of tasks covered is not attributable to the level of aggregation of the tasks. In fact, the SkillObject tasks generally had a greater scope than the tasks in the standards.

12. Appendix C contains a SkillObject database report for Information Systems Administration and Communications. Appendix D contains the SkillObjects in Information System Administration at the apprentice, journeyman, and master levels.

- "Enable tunnels (such as encapsulation of IP packet headers)."

The implications of the Occupational and Naval Standards missing critical tasks are significant. Occupational Standards provide a primary basis for the following [7]:

- Formal school curricula (except for NEC or sponsor-stated requirements)

- Training packages (such as rate training manuals)

- Advancement exams.

# Training

## Navy schools do not cover many critical tasks

The information technology A-Schools do not cover many mission-critical tasks. This is based on the curriculum developers' identification of the tasks they covered in the most recent curriculum at the time (September 2001) (see figure 4).[13]

According to our data, the IT A-School fails to cover 79 and 60 percent of the mission-critical tasks in Information Systems Administration and Communications, respectively. Similarly, for the CTO A-School, the training gaps in these two areas are 53 and 60 percent. This includes technical tasks only; that is, it does not include military or administrative functions.

## Many Sailors do not find A-School useful

We also sought the perspectives from both Sailors in the information technology workforce and their supervisors. Their responses corroborated that the Navy information technology schools do not cover many critical tasks. According to our data, 62 percent of junior Sailors (E-4 and below) found that their A-School was not useful or only slightly useful.

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13. We limited our analysis to items that had at least 15 respondents. According to [1], 15 to 30 incumbents are typically sufficient to obtain adequate interrater agreement.

Figure 4.    Percentage of mission-critical tasks covered by A-Schools[a]
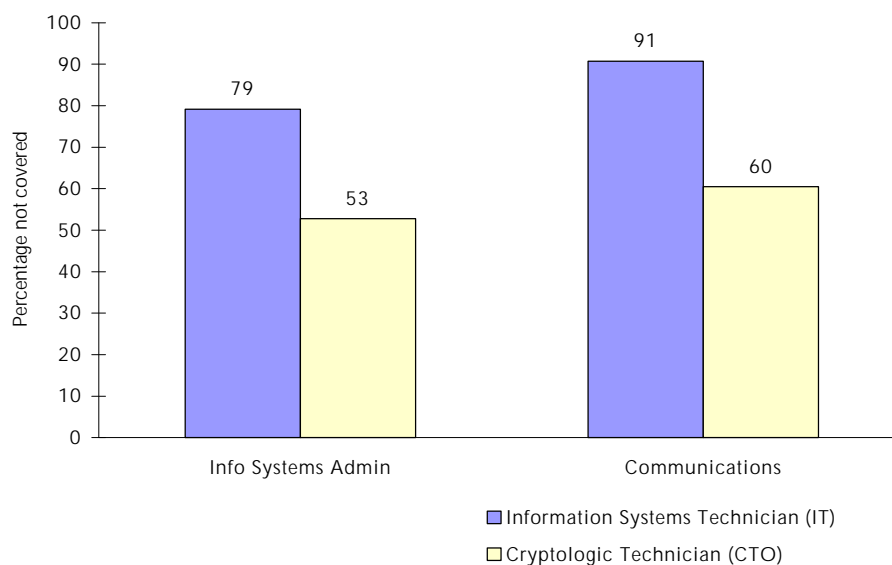


a. IT and CTO A-Schools. September 2001 curriculum. Technical tasks only.

We asked supervisors—officers and E-7–E-9 Sailors—to identify ways to improve A-School. The four most frequently selected recommendations (with percentage of respondents selecting option) follow:

- Add LAN Administration to the A-School: 25

- Cover more up-to-date materials and equipment: 25

- Cover more hands-on learning and labs: 25

- Cover more material about operating systems: 20.

Interestingly, not a single officer or senior enlisted Sailor responding to our survey recommended leaving the A-School as it is. Taken together, our findings indicate that Navy IT A-Schools fail to adequately prepare Sailors for the challenges they face in the fleet.

## Training gaps

Sailors resort to a variety of training sources to prepare themselves for their work tasks. When one considers all sources of training (including OJT and self-study), the percentage of tasks lacking adequate training is significantly smaller than for A-School alone (see figure 5).

32

Figure 5.    Tasks lacking adequate training[a]
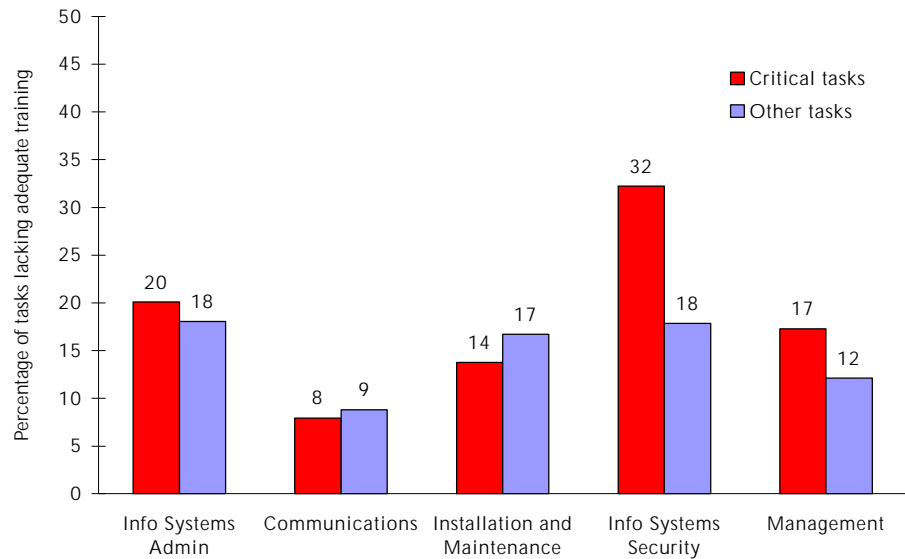


a. Reported by Sailors in our survey (all sources of training, including on-the-job training and self-study).

Nevertheless, Sailors reported a significant lack of adequate training for critical tasks even when all sources of training are considered. According to our data, the training gap is highest in Information Systems Security, where 32-percent of the mission-critical tasks lack adequate training.

In Information Systems Administration and Communications, 20 and 8 percent of the mission-critical tasks lack adequate training, respectively. In Installation, Maintenance, and Repair, the percentage of mission-critical tasks lacking adequate training is 14 percent. In Management and Supervision, it is 17 percent.

In three of the five jobs (Information Systems Administration, Information Systems Security, and Management and Supervision), the percentage of mission-critical tasks lacking adequate training is higher than for other tasks. This is likely to reflect that curriculum developers currently lack data to identify the mission-critical tasks.

Figure 6 shows the SkillObjects with the largest training gaps in each of the five jobs. The largest training shortfall is in Information

Systems Security. Specifically, 48 percent of the tasks related to analysis of suspicious network activity lack adequate training. Managers and Supervisors also report that in the area of computer network defense, 47 percent of the tasks have a training shortfall.

Figure 6.   SkillObjects with the largest training gaps[a]
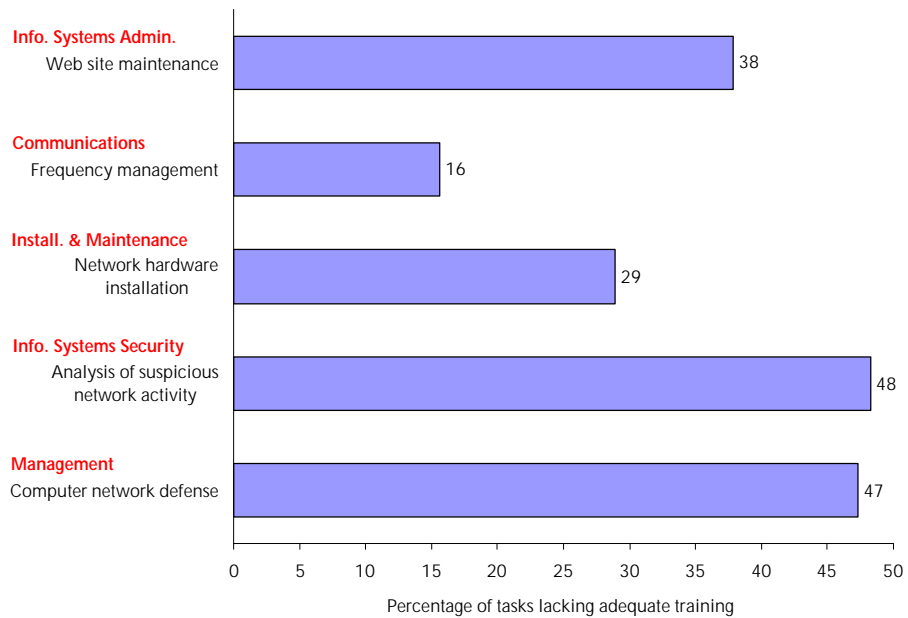


a. For each of the five jobs in the information technology workforce.

We should point out that four of the five SkillObjects with the largest training gaps were not captured at all by the Occupational or Naval Standards. The remaining SkillObjects was only partially covered by the Occupational Standards. This suggests a relationship between the content of the Occupational Standards and that of the training.

## Potential for training consolidation

There is a significant overlap in the tasks performed by Sailors in different ratings. Based on our data, we found that three ratings—IT, CTO/CTM, and FT—perform largely the same Information System Administration tasks. According to our data, 85 percent of the IT tasks overlap with each of the CTO/CTM tasks and the FT tasks.

Furthermore, 73 percent of the IT tasks overlap with both the CTO/CTM and FT tasks (see table 1).

Table 1.   Overlap of tasks for three Navy ratings

| | Percentage of IT rating tasks that overlap with | |
| --- | --- | --- |
| | Info. Systems Administration | Communications |
| Cryptologic Tech (CTO-CTM) | 85 | 70 |
| Fire Control Tech (FT) | 85 | |
| Both | 73 | |

In Communications, there is also a significant overlap of the tasks performed. According to our data, 70 percent of the IT rating tasks overlap with the tasks of CTO/CTMs in Communications. Obviously, CTO/CTMs and FTs perform tasks more specific to their ratings; these tasks are not reflected in our data. Sailors in the IT rating perform all of the Information System Administration tasks performed by CTO/CTMs and FTs. Sailors in the IT rating also perform all of the Communications tasks performed by FTs.

Why is the overlap of tasks important? Sailors in these ratings receive separate training. This implies that there is a significant potential for consolidating the training related to the tasks that overlap.

## Community college program

In this section, we assess the coverage of mission-critical tasks by a community college program. The Navy ran a partnership IT program with Tidewater Community College for a few years. Sailors who graduated from an intensive, 1-year, full-time program received Associate's degrees.

Faculty at Tidewater Community College reviewed our list of Information Systems Administration tasks and identified those they cover in their courses. Here again, we focus on the technical tasks, not on the military or administrative functions.

The Tidewater Community College program fails to cover only 10 percent of the mission-critical tasks (see figure 7). Some of the tasks not covered by the community college are Navy-specific tasks.[14] The main training pipeline for the IT rating (the IT A-School and the LAN Administration C-School), however, fails to cover 38 percent of the mission-critical tasks. The evaluations of the community college courses and the Navy courses were for May 2001 and September 2001, respectively, reflecting the latest curricula at the time.

Figure 7.   Critical tasks not covered by Navy schools and community college[a]
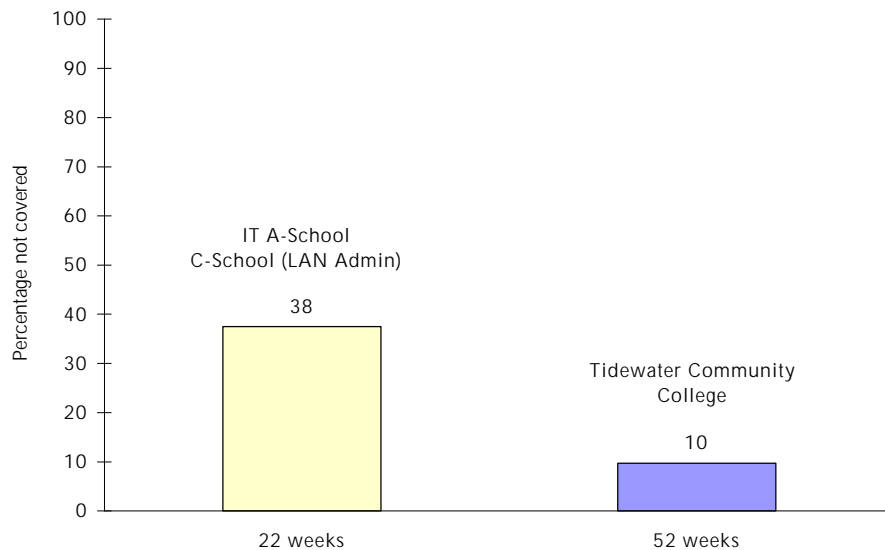


a. Navy curriculum as of September 2001; college curriculum as of May 2001. Includes technical tasks only.

A direct comparison of the community college program and the Navy IT schools is not fair because the community college program is more than twice as long. The community college program lasts 52 weeks,

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14. If the Navy recruited civilian graduates of a similar community college at a middle level (such as E-4), some occupational and military-specific training would still be needed. This training would cover the 10 percent of the mission-critical tasks not covered by the community college.

compared with 22 weeks for the combined IT A- and C-School. Also, the community college program is not constrained to the more stringent course development guidelines used in the Navy.

## Benefits and costs of enhancing training

To account for the different duration of the Navy and community college programs, we conducted a cost-benefit analysis of enhancing the IT training. Figure 8 summarizes the impact of enhancing IT training for the following three options:

- *Option 1—Outsource the IT training to a 1-year college program.* Our analysis is based on the Navy experience with Tidewater Community College.

- *Option 2—Redesign the Navy IT A- and C-Schools to cover the mission-critical tasks.* This option maintains the duration of the training at 22 weeks.

- *Option 3—The same as option 2, but run by a college (redesign and outsource the Navy schools).* This option also maintains the duration of the training at 22 weeks.

Figure 8.    Benefits and costs of enhancing IT training[a]
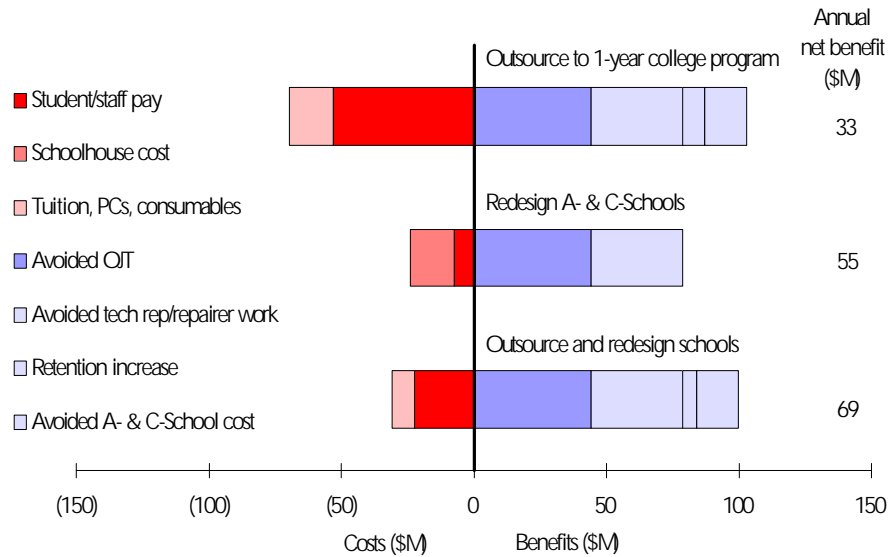


a. For combined IT A-School and LAN Administration C-School (in FY02 dollars).

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According to our analysis, enhancing the IT training through any of the three options is cost-effective. The annual net savings ranges from $33 million for completely outsourcing the program to a 1-year college program to $69 million for the combined option of redesigning the IT schools and outsourcing them to a college.[15]

The benefits from enhanced IT training result largely from the avoided OJT and the avoided workload of tech reps and repairers. For options 1 and 3, the benefits also include the avoided A- and C-School cost and the increased retention (which translate into a reduced requirement for recruiting and training replacements). We obtained the benefits (cost avoidance) of enhanced training from the responses to our background survey.

The costs vary by option. For option 1, the largest cost is the compensation of staff and students—not surprising for a program that takes Sailors away from direct productive activity for 1 full year. For option 3, the largest cost is also the compensation of staff and students. For option 2, the largest cost results from sending all IT A-School graduates to follow-on LAN Administration instruction.

The Navy can undertake any of the three options without a significant loss of military acculturation. For instance, the Tidewater Community College Program was taught at a Navy facility, and senior Sailors served as staff members. Also, students were in uniform, attended mandatory group physical training conducted by military personnel, and used Navy living quarters and facilities.

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15. In option 2, Sailors do not get credit directly from a college, but, through the Navy College Program, they get recommended credits for their Navy schools. We did not assign a retention benefit to this credit accumulation because no statistical evidence exists about the effect of college credit accumulation from Navy training on retention behavior.

# Mismatch of bonus field and work performed

## Explanation of the mismatch

Actual work performed does not always reflect the skills for which a reenlistment bonus is paid. From the match of the task data to the electronic personnel records, we found that 29 percent of the Sailors who received a reenlistment bonus for completion of LAN Administration training did not perform LAN administration tasks (see figure 9).[16] These Sailors performed unrelated tasks, such as communications and non-information-technology work.

Figure 9.   Share of LAN Administration tasks for bonus recipients and nonrecipients[a]
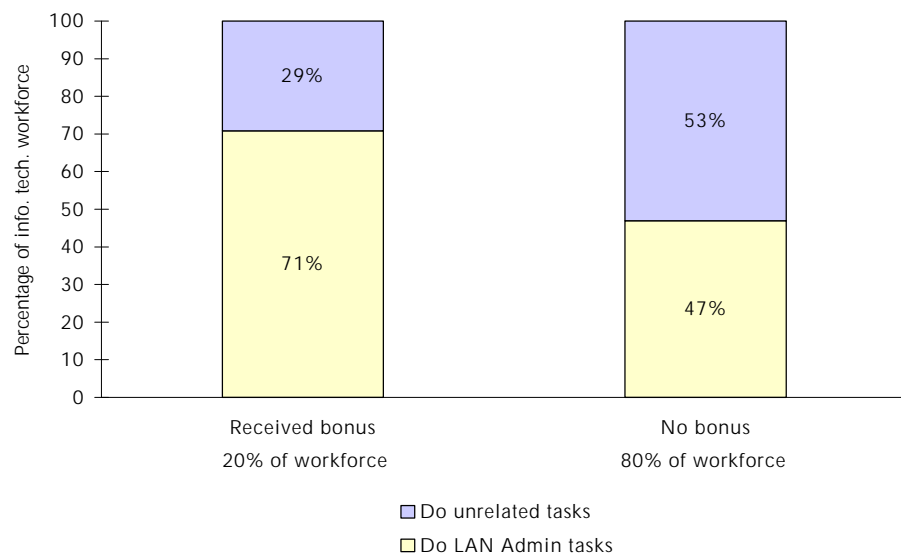


a. Reenlistment bonus for graduation from LAN Administration C-School (paygrades E-1–E-6 only).

Another important finding is that nearly half—47 percent—of the Sailors who perform LAN Administration do not get a bonus simply

16.  Some Sailors earn the 2735 NEC by completing structured OJT.

because they do not hold the requisite rating or NEC. This is a significant source of dissatisfaction for many Sailors who perform LAN Administration. Because their skills are not documented, they are not eligible for a bonus even though they perform the work. According to our survey, 20 percent of the information technology workforce received a reenlistment bonus for completion of LAN Administration training.

Finally, LAN Administration (NEC 2735) is not a subspecialty. The original intent of NECs was to identify Sailors with an occupational subspecialty—skills not required for the rating as a whole. According to our data, 77 percent of the Sailors in the Information Systems Administration job (E-1–E-6) perform LAN administration. This suggests that LAN Administration should be part of the IT A-School, not the C-School.

## Cost of the mismatch

What are the costs of the bonus mismatch? First, Sailors who do LAN Administration but did not receive a bonus are 15 percentage points more likely than the bonus recipients to report that they plan to leave the Navy. These Sailors indicated that they will not reenlist and that they have taken concrete steps for leaving. They have interviewed or applied for a civilian job, talked with their immediate supervisors about leaving the Navy, or attended a training program or seminar to prepare for civilian employment.

Second, the cost of the bonus mismatch includes the actual dollar amount used for bonuses intended for Sailors who perform LAN Administration but end up performing unrelated tasks. Graduates of the LAN Administration C-School earn the NEC 2735 and receive a bonus of up to $45,000.

The mismatch between the bonus field and the work performed is often a result of the lack of fidelity in the personnel distribution system. The large number of Sailors performing LAN Administration tasks with no training is partly a result of installation of computer systems on ships that is not immediately accompanied by the assignment of properly trained personnel.

40

Finally, the cost of the bonus mismatch includes the LAN Administration training that was not used. Our cost figures are in FY02 dollars.

For this particular example of the LAN Administration C-School, the annual cost of the out-of-field bonuses is $2.6 million. The cost of the unused training is $2.9 million. The combined cost of the mismatch of the bonus field and the actual work performed is $5.5 million per year (excluding the retention effect).

The LAN Administration C-School was established in 1998, only 3 years before we administered the survey. The Navy provided the training to Sailors with the expectation that they would do the work in their current assignments. It is possible that some of the bonus recipients who were not currently performing LAN administration may do it later. The information technology skills, however, are highly perishable and Sailors performing unrelated work may suffer significant loss in their skills.

# Advancement exams

Advancement exams, along with performance evaluations, are the most important determinants of promotion. We found that advancement exams for the information technology workforce do not cover many critical tasks. Exams miss as many as 70 percent of the mission-critical tasks (see figure 10). Our analysis is based on the exam writers' review of their test banks covering 2 years ending in April 2001 (the latest available at the time). We focused on technical tasks only.

The level of task coverage varies by exam. Coverage is the most limited for the component of the CTM rating exam related to Installation, Maintenance, and Repair (70 percent uncovered). It is the most comprehensive for the Electronics Technician (ET) rating exam related to Installation, Maintenance, and Repair (only 17 percent uncovered).

In Information Systems Administration, the IT and FT rating exams fail to cover 60 percent and 47 percent of the mission-critical tasks, respectively. Finally, in Communications, the IT rating exam misses 67 percent of the critical tasks.

Figure 10. Percentage of mission-critical tasks not covered
by advancement exams[a]
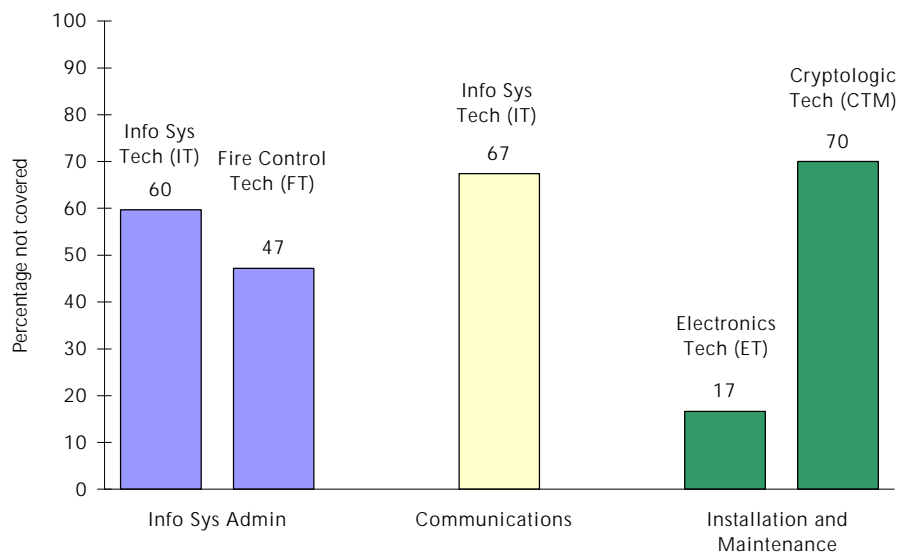
What do the advancement exams cover? Advancement exams often emphasize the wrong topics. In some cases, the exams prompt Sailors to show their capability for memorizing lists, such as codes, rather than their proficiency in performing the mission-critical tasks. One reason for so many mission-critical tasks to be absent from the exams is that the exams are largely based on the Occupational Standards. As we showed above, the current Occupational Standards miss many mission-critical tasks.[17]

The IT rating is made up of two main jobs: Information Systems Administration and Communications. Many ITs perform one of the two jobs uniquely. These Sailors, though, are trained and tested in both fields. Our data show that these are two distinct jobs with different competency requirements.[18]

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17. It is possible that developing test items for some of the mission-critical tasks is difficult. We do not have data to measure how significant a factor this is.

18. For officers, career paths are significantly different. Appendix E contains some results from our survey about officer career paths.

# Enhancing retention

Information technology Sailors planning to leave the Navy could be convinced to stay using a variety of incentives. We focused on Sailors who indicated that they will not reenlist and that they have taken concrete steps for leaving. These Sailors have interviewed or applied for a civilian job, talked about leaving the Navy with their immediate supervisors, or attended a training program or seminar to prepare for civilian employment.

Based on our survey, we found that the top four incentives that would convince Sailors to stay are the following (with percentage of respondents selecting option):

- A $45,000 reenlistment bonus: 45 percent

- A 1-year assignment to college to get an Associate's degree in information systems or telecommunications: 34 percent

- Certification training paid by the Navy, such as Microsoft Certified Systems Engineer (MCSE) and CISCO: 34 percent

- Assignment to an officer commissioning program for a computer or communications specialty: 27 percent.

There are costs associated with each incentive. In our analysis, we looked in some detail at the first two. For the other two, we did not have the data to assess the net payoff to the Navy. Respondents selected all the options that applied.

# Recommendations

## How to improve workforce training and professional development

A well-trained, competent information technology workforce is more important than ever as the Navy seeks to meet evolving missions in changing security and technological environments. Defining—with fidelity—the work Sailors perform and the competencies required to perform the work is necessary to focus on their professional development and performance. Based on the evidence uncovered by our research findings, we make six recommendations:

1. **Enhance the Occupational and Naval Standards**. The Navy should maintain full support for the effort to enhance the Occupational and Naval Standards to capture the required competencies and to rate the mission criticality of the tasks.

2. **Enhance the information technology training**. The Navy should enhance the training for its information technology workforce. According to our analysis, the three options outlined—that involve simply redesigning the schools, outsourcing them, or a combination of the two—would produce a positive payoff.

3. **Integrate LAN Administration into the A-School.** The Navy should integrate the LAN Administration C-School into the A-School to reflect the fact that LAN Administration is a major component—not a subspecialty—of Information Systems Administration.

4. **Consolidate training for overlapping tasks of several ratings**. To save resources, the Navy should consolidate the Information Systems Administration training of the IT, CTO/CTM, and FT ratings. It should also consolidate the Communications training. A core component could contain the common elements, and later training could cover equipment specific to each rating.

5. **Consider splitting the IT rating into Information Systems Administration and Communications**. The Navy should consider separating the Information Systems Technician (IT) rating into two service ratings. This would promote better management of these Sailors. It would also promote more efficient and well targeted training and advancement exams.

6. **Redesign the advancement exams**. The Navy should redesign the advancement exams of the information technology workforce to cover more mission-critical tasks.

## Navy-wide applications

This study of the information technology workforce was the first application of the SkillsNET method to the Navy. Figure 11 shows many of the potential applications of this method to the entire Navy.

Figure 11. Longer term Navy-wide applications of the
SkillObject database

**Recruiting**
- Screen for the right KSATs
- Assess potential for lateral entry

**Readiness**
- Identify mission-critical tasks

**Training**
- Define requirements
- Identify gaps
- Identify courses to combine

**Career structure**
- Absorb some NECs into jobs

**SkillObject Database**

**Assignment**
- Assign personnel based on Skill Group proficiency

**Manpower**
- Enhance input to requirements determination

**Retention**
- Target bonuses to Skill Groups, not rating/NEC titles

**Promotion**
- Write tests that cover the critical tasks

Some of the applications could be implemented in the short term
(such as those for the advancement exams and the training curric-
ula). Others, however, would require major policy changes (such as
for personnel assignment and retention).

**Readiness**. The SkillObject database can be used to prioritize the
tasks according to their contribution to the mission.

**Training**. SkillObjects can be used to define training requirements
based on the mission-critical tasks performed and the competency
requirements. SkillObjects can also be used to obtain an individual
Sailor's proficiency in the different competencies of a job. This map-
ping of the skills would allow for a skill gap analysis—a comparison of
what Sailors know and what they should know. Finally, the SkillObject
database can be used to identify tasks that overlap for more than one
occupation and, therefore, consolidate the training.

**Assignment**. The Navy should evaluate the way it matches Sailors to
billets. Instead of basing the match primarily on the Sailor's rating
and NEC, the Navy could consider basing the assignment on Skill-
Object proficiency. This way of matching Sailors could produce

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significant efficiency enhancements, such as improved job performance and higher job satisfaction and morale.

**Promotion**. As we demonstrated for the information technology workforce, the current advancement exams are not tailored to the mission-critical tasks. Writing exam items related to the tasks and work competencies that really matter to the mission would produce efficiencies. These efficiencies would come from the more effective identification and promotion of the Sailors who have the most solid mastery of the mission-critical tasks.

**Retention**. The Navy currently pays bonuses for personnel shortages in specific ratings. Within a given rating, the shortage may be greater in some of the SkillObjects than others. In fact, it is possible that there are personnel surpluses in specific SkillObjects for ratings that overall have a shortage. Basing the bonuses on the work performed could save resources in bonus dollars and help target the training to Sailors who actually do the work.

**Manpower**. Data on the work and the time spent on each task, aggregated at the department, work center, or command level, can be a useful input to the process of manpower requirements determination.

**Career structure**. Many NECs and distribution communities have become occupations in themselves (such as aircrew and SEALs) or major components of their jobs (such as LAN Administration). The SkillObject database facilitates an assessment of the NECs that should be merged into the jobs or established as new jobs.

**Recruiting**. The SkillObject database can also be helpful in identifying the KSATs required for the different jobs.[19] Also, the Navy can assess the potential for lateral entry, such as recruiting pretrained personnel with Associate's degrees. Through the SkillObject database, the Navy can identify the competencies not covered by civilian education programs and prepare the training to compensate for this shortfall.

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19. Appendix F contains the required skills for Information Systems Administration.

**Common language**. The common language of O*NET would facilitate communication between organizations dealing with manpower, personnel, and training. Second, it would allow standardization of personnel records. As the different organizations adopt the same terms, computer systems can link large databases to make vast amounts of information easily accessible to large numbers of people for multiple purposes. Finally, the O*NET language would facilitate the integration of active duty personnel systems with those of the reserve, civil service, and contractors within the Navy and in the other services.

The SkillObject database can help identify the KSATs prevalent in high performance commands, departments, and work centers. Are certain worker attributes emphasized in top-performing organizations? This would help understand the relationship between high performance and human resource practices.

# Appendix A: Mission-critical tasks

This appendix contains the mission-critical tasks in Information Systems Administration. The full list of tasks, their primary enabling skill, the SkillObject™ they belong to, and the index of criticality are available from CNA on request. These data are available for all five information technology jobs.

Table 2.  Mission-critical tasks in Information Systems Administration

| Task | Criticality index |
|------|-------------------|
| Report possible network intrusion or virus | 5.0 |
| Back up systems, software, or data | 4.9 |
| Maintain steady electrical power to the equipment | 4.9 |
| Set information control (INFOCON) posture (in accordance with tactical situation) | 4.9 |
| Monitor computer and network security (to protect against password compromise, viruses, or prohibited use) | 4.8 |
| Scan network or transportable media for viruses | 4.8 |
| Supervise NTCSS equipment use | 4.8 |
| Inform supervisor of problems such as system outages and degradations | 4.7 |
| Maintain electrical and network circuits (ex: to prevent outages or interference) | 4.7 |
| Analyze data (ex: to solve system/circuit problems or choose a troubleshooting method) | 4.6 |
| Answer service calls | 4.6 |
| Assist customers with problems (such as LAN connectivity, desktop, or account problems) | 4.6 |
| Clean workstations/media infected with viruses | 4.6 |
| Configure router (ex: router ports, LAN connections, CISCO routers) | 4.6 |
| Coordinate network troubleshooting and repair | 4.6 |
| Coordinate the implementation of the information security (INFOSEC) plan | 4.6 |
| Formulate plans to respond to a crisis | 4.6 |
| Maintain magnetic media inventory (ex: tape catalog and special compartmentalized information (SCI) inventory) | 4.6 |
| Manage personnel (subordinates, co-workers) | 4.6 |
| Monitor circuits for connectivity rate and stability | 4.6 |
| Monitor network components (ex: servers, workstation,  connections) for performance and availability | 4.6 |
| Adapt facilities, equipment, and procedures to accommodate computers, networks, and people | 4.5 |
| Administer circuit, interface or software configurations (ex: network nodes, devices, application, or system software) | 4.5 |
| Administer user accounts (such as logons, permissions, profiles, account policies, or auditing rights) | 4.5 |
| Advise supervisors/co-workers on current status of computers, network, communications, or information security | 4.5 |
| Allocate materials/resources for repairs (including for recovery from system failures) | 4.5 |
| Analyze network connectivity using routing table, ping, and traceroute commands | 4.5 |
| Communicate orders and rules from the chain of command | 4.5 |
| Conduct pre-underway checks and maintenance | 4.5 |

Table 2.  Mission-critical tasks in Information Systems Administration (continued)

| Task | Criticality index |
|---|---|
| Coordinate outages and restorations of circuits with technical control supervisor or others | 4.5 |
| Diagnose hardware problems | 4.5 |
| Manage Internet communications to/from the ship or unit | 4.5 |
| Manage network security and procedures (ex: with NSM or ISSP to balance performance and security) | 4.5 |
| Manage network traffic/problems | 4.5 |
| Monitor router/router protocol for proper routing, transmission, and receipt of communications traffic | 4.5 |
| Monitor the operation of external communications equipment | 4.5 |
| Power up/down computer systems or components (ex: Unix-, DOS-, or NT-based) | 4.5 |
| Shut down tunnels | 4.5 |
| Troubleshoot computers/networks/peripherals (may involve making replacements) | 4.5 |
| Analyze potential best solutions/methods (such as for troubleshooting) | 4.4 |
| Analyze potential best solutions/methods (such as for troubleshooting) | 4.4 |
| Analyze router access list/configuration for incorrect settings, problems, or interference with protocols | 4.4 |
| Configure operating system (OS) software (such as NT, UNIX, Windows 2000, Netware) | 4.4 |
| Configure operating system security | 4.4 |
| Configure route determination (may include naming device, IP, DNS, WINS, or mail databases) | 4.4 |
| Configure transport protocols (ex: TCP/IP, IP and IPX, or connectivity between ATM and non-ATM devices) | 4.4 |
| Inform chain of command about status of systems and operations | 4.4 |
| Maintain network compatibility among different architectures/systems | 4.4 |
| Operate automated data network system (ADNS) components (may include patching, powering up, or re-setting) | 4.4 |
| Re-boot computer or network | 4.4 |
| Schedule data back-ups and restorations | 4.4 |
| Verify operation of hubs, switches, routers, and ATM devices | 4.4 |
| Verify proper operation of equipment | 4.4 |
| Assist co-workers with their jobs | 4.3 |
| Assist supervisors in the performance of their jobs | 4.3 |
| Configure e-mail system (ex: accounts, addresses, Exchange System Attendant, public folders) | 4.3 |

Table 2.   Mission-critical tasks in Information Systems Administration (continued)

| Task | Criticality index |
|---|---|
| Coordinate circuit plan with other departments (ex: Combat Systems, CSOOW, Radio) | 4.3 |
| Enable tunnels (such as encapsulation of IP packet headers into tunnels) | 4.3 |
| Initialize tactical information system (ex: OTCIXS/TADIXS ON-143(V)6) | 4.3 |
| Manage files, directories, mirror set (also sub-directories, volume sets; includes saves and deletions) | 4.3 |
| Manage system administration rights | 4.3 |
| Manage system maintenance (preventive and corrective) | 4.3 |
| Mediate disputes and complaints (involving customers, co-workers, supervisors, organizations, or others) | 4.3 |
| Monitor sensors/lights/switches and other indicators for normal operating conditions | 4.3 |
| Motivate others to do their best, and challenge their minds | 4.3 |
| Operate equipment (ex: peripheral devices, electronic equipment, or communications devices) | 4.3 |
| Perform service calls for the customer | 4.3 |
| Process original/reconstructed messages to the appropriate recipients (ex: may involve delivery and fixing of errors) | 4.3 |
| Run computer programs in support of message processing | 4.3 |
| Select procedures/strategies (ex: troubleshooting method) to solve problems (ex: fixing computer) | 4.3 |
| Update anti-virus definition files | 4.3 |
| Verify troubleshooting and other user needs | 4.3 |
| Administer disk utilities | 4.2 |
| Administer remote access and connections | 4.2 |
| Configure domains (creation, demotion, or determination of model) | 4.2 |
| Configure network devices (such as hubs and ATM switches) | 4.2 |
| Configure workstation, server, and stand-alone computers for optimal performance (including installations and alignments) | 4.2 |
| Correct computer-stored information (such as data, records, or files) | 4.2 |
| Examine system and audit logs for proper use of systems, circuits, or security awareness | 4.2 |
| Execute computer commands (such as on Unix) | 4.2 |
| Guide individuals and groups in the performance of their jobs | 4.2 |
| Manage processes for efficiency (ex: for best customer service) | 4.2 |
| Monitor change-of-watch activities | 4.2 |

Table 2.   Mission-critical tasks in Information Systems Administration (continued)

| Task | Criticality index |
|---|---|
| Monitor general administrative (GENADMIN) message status | 4.2 |
| Monitor output communications channels | 4.2 |
| Retrieve files/data from local or remote systems, or from backups | 4.2 |
| Verify compliance with communications instructions and regulations (ex: battle group comms plan) | 4.2 |
| Write messages (may involve drafting, typing, and formatting) | 4.2 |
| Analyze network data (performance, traffic; may include the Internet) for problems/solutions | 4.1 |
| Configure applications/utility software (including installation/upgrade of COTS and GOTS) | 4.1 |
| Configure trust relationships between workstation and domain (including routers and message server) | 4.1 |
| Connect computers to the network | 4.1 |
| Coordinate network installation for quality, timeliness | 4.1 |
| Explain issues/problems to users (includes clarification) | 4.1 |
| Explain to customers or supervisors options for fixing or preventing problems | 4.1 |
| Implement communications plans | 4.1 |
| Load user/client data into computer so that they can use the network | 4.1 |
| Maintain equipment cables/drops/cross-connects (ex: modifying cabling/wiring connections) | 4.1 |
| Maintain system and security policy pages posted on workstations | 4.1 |
| Manage CATV, VTC, and entertainment systems | 4.1 |
| Manage the NT Server Desktop and other hyper terminal applications | 4.1 |
| Monitor access through serial ports (ex: RS-232C) | 4.1 |
| Organize work center for maximum efficiency | 4.1 |
| Process data on computers (ex: supply or security data; may involve routing the data) | 4.1 |
| Review information-assurance vulnerability messages for applicability to unit/ship | 4.1 |
| Teach information security procedures (ISSO, OPSEC, and INFOCON) | 4.1 |
| Test computers/networks/instruments for performance and reliability or to determine causes/solutions | 4.1 |
| Verify records and forms (ex: Zone records) for data or format accuracy | 4.1 |
| Ask questions of technical experts or experienced personnel | 4.0 |
| Collaborate with other team members to share problem solutions or troubleshooting tips | 4.0 |

Table 2.   Mission-critical tasks in Information Systems Administration (continued)

| Task | Criticality index |
|---|---|
| Communicate customer complaints to chain of command and all concerned | 4.0 |
| Configure 10 and 100 MBPS Ethernet modules | 4.0 |
| Configure DHCP (Dynamic Host Configuration Protocol) | 4.0 |
| Configure operator and terminal interfaces | 4.0 |
| Coordinate command/control/comms (C3) for customer staffs (ex: carrier group staff embarking) | 4.0 |
| Coordinate connectivity plan and other plans with all concerned (including the Server Administrator) | 4.0 |
| Correct events (such as mistakes, inefficient operating procedures, or operating errors) | 4.0 |
| Determine available options (methods, strategies) to correct computer/network problem | 4.0 |
| Diagnose network malfunctions (ex: sluggishness or incorrect settings) | 4.0 |
| Explain facts/findings/recommendations to customers or chain of command (ex: on network status) | 4.0 |
| Explain problems to all concerned | 4.0 |
| Install computers (workstations and servers) | 4.0 |
| Manage computer and network configuration (including architecture, updates, procedures) | 4.0 |
| Manage power supply (power hookups or power supply removal) | 4.0 |
| Manage share folders and files (ex: intranet training folder) | 4.0 |
| Manage staff record-message communications | 4.0 |
| Perform interfacing and patching of computer networks | 4.0 |
| Perform proper login procedures (ex: following re-boot) | 4.0 |
| Prepare e-mail (including attachments) | 4.0 |
| Prioritize tasks (ex: network projects, repairs) | 4.0 |
| Supervise installation and upgrades of systems/servers | 4.0 |
| Teach other computer/technical personnel about hardware/software operation and procedures | 4.0 |
| Verify connectivity of components (such as the SCSI bus or VMEC) | 4.0 |

# Appendix B: Background survey

This appendix consists of a copy of the Sailors' background survey instrument. We administered this survey to the Sailors in the Information Systems Administration job during August–December 2001. We administered a similar survey to the Sailors in each of the other occupations: Communications; Installation, Maintenance, and Repair; Information Systems Security; and Management and Supervision. These other survey instruments are very similar to the one shown here (they are available at CNA on request).

# ADP Survey

1. What **percent of YOUR time at your Navy job LAST WEEK** did you spend on the following? Make sure that the **sum is 100 percent**.

    _____ %. Trouble calls/help desk—to assist end users
    _____ %. Trouble calls/help desk—to assist personnel in the computer/
          communications field
    _____ %. Database support
    _____ %. LAN/system administration
    _____ %. Information systems security/computer network defense
    _____ %. Tech control
    _____ %. Message center
    _____ %. Installation, repair, and maintenance—ADP equipment
    _____ %. Installation, repair, and maintenance—communications equipment
    _____ %. Management of computer/communications resources, including
          supervision of computer/communications sailors
    _____ %. Other computer-related work
    _____ %. Other duties

     ←  Your total **must be 100**.

2. How many hours did you work **last week** at your Navy job?
   - 40 hours or less
   - 41-50 hours
   - 51-60 hours
   - 61-70 hours
   - 71-80 hours
   - 81 or more hours

3. How much do you **agree** or **disagree** with the following statements in regards to your Navy job in the computer or communications field?

| | Strongly agree | Agree | Neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| a. I have access to adequate technical training | ○ | ○ | ○ | ○ | ○ |
| b. I am satisfied with the amount of time I am given to upgrade my skills | ○ | ○ | ○ | ○ | ○ |
| c. Navy training/education has prepared me well for my current job | ○ | ○ | ○ | ○ | ○ |
| d. I am satisfied with the present Navy advancement system | ○ | ○ | ○ | ○ | ○ |
| e. I have a clearly defined career path or rating | ○ | ○ | ○ | ○ | ○ |
| f. My immediate supervisor has adequate training and expertise to do his/her job | ○ | ○ | ○ | ○ | ○ |

4. How **satisfied** or **dissatisfied** are you currently with the following aspects of your Navy job in the computer or communications field and the Navy in general?

| | Very satisfied | Satisfied | Neutral | Dissatisfied | Very dissatisfied |
|---|---|---|---|---|---|
| a. Pay and benefits | ○ | ○ | ○ | ○ | ○ |
| b. Detailing process | ○ | ○ | ○ | ○ | ○ |
| c. Type of assignment received | ○ | ○ | ○ | ○ | ○ |
| d. Supply of parts and equipment to get the job done | ○ | ○ | ○ | ○ | ○ |

5. What is the highest level of education you have completed?
    - ○ Less than high school completion/no diploma
    - ○ Alternate degree/GED/homestudy/adult-school certification
    - ○ High school diploma/graduate
    - ○ Some college, no degree
    - ○ Associate's degree or other 2 year degree
    - ○ Bachelor's degree (B.A. or B.S.)
    - ○ Master's degree (M.A., M.S., M.B.A., etc.)
    - ○ Doctoral or professional degree (J.D., Ph.D., D.Ph., M.D., etc.)

6. Where did you get **YOUR** computer/communications training? Check **all that apply**.
    - ○ a. A-School
    - ○ b. C-School
    - ○ c. From a book—bought with your own money
    - ○ d. From a book—paid for by the Navy
    - ○ e. On-the-job training—from **other sailors**
    - ○ f. On-the-job training—from **vendors/tech reps**
    - ○ g. Course on network **security** vulnerability or information systems security mgmt.
    - ○ h. Online **discussion group** (for example, TechNet)
    - ○ i. Commercial **certification** program (for example, MCSE, CNE, or CISCO)
    - ○ j. NetG (completed courses)
    - ○ k. **Commercial/factory** training courtesy of your command
    - ○ l. **Manual** for software/equipment
    - ○ m. Fleet technical support center
    - ○ n. Afloat training group/mobile training team
    - ○ o. **College/university** (completed courses)
    - ○ p. Private **technical school**
    - ○ q. **In-house** training program
    - ○ r. Trial and error
    - ○ s. From a **friend** not in your work center
    - ○ t. Other

7. Please enter **ONE letter** from the last question for the training that was **the most useful** for doing your computer/communications job. For example, "p." _____

8. For which of the following schools have you **requested a quota from your command, but have not yet obtained it**? Mark the requests you have pending and those that you were denied. Mark them even if you were told that you do not qualify for them. Leave blank those that don't apply.

| Course | Your request is pending for 3 or more months | Your request was denied |
|---|:---:|:---:|
| IT A-School (does not include old RM and DP schools) | ○ | ○ |
| IT 2735—Information systems administrator | ○ | ○ |
| IT 2779—Information systems security manager | ○ | ○ |
| IT 2780—Network security vulnerability technician | ○ | ○ |
| IT 2781—Advanced network analyst | ○ | ○ |
| IT 2379---Transmission system technician | ○ | ○ |
| IT 2730—SNAP III system administrator | ○ | ○ |
| ET 1678—Shipboard Non-tactical ADP Program (SNAP) III maintenance technician | ○ | ○ |
| ET 1677----Tactical advanced computer (TAC-n) maintenance technician | ○ | ○ |
| CT 9301—Entry level programmer/analyst | ○ | ○ |
| CT 9302—Cryptologic network configuration manager | ○ | ○ |
| CT 9303---Communication information systems | ○ | ○ |
| CT 9304—Database administrator | ○ | ○ |
| CT 9295----Network systems maintenance technician | ○ | ○ |
| Unix | ○ | ○ |
| Certification (such as MCSE or CISCO) | ○ | ○ |
| Other computer/communications course | ○ | ○ |

9. If **you have been denied a quota to one or more of the schools in the last question**, what were the reasons? Check **all that apply**.
   - They won't allow me because of my rating
   - They won't allow me because I don't have the required experience
   - My command does not have the money
   - My workload is too heavy
   - The school doesn't have enough quotas available for my command
   - My supervisor wants me to stay in communications
   - My ASVAB scores are too low
   - My supervisor thinks I will not be successful in the training
   - My command doesn't make it known that the training is available
   - My command believes I am too senior
   - My command believes I am too junior
   - Operational commitments
   - I don't want to reenlist (required for school)
   - I don't have sufficient obligated service to attend
   - Other

10. What do you recommend for improving A-School training in your rating? Check **all that apply**.
    - Use more **hands-on** learning/practical labs
    - Use more **up-to-date** material/equipment
    - Cover the **specific systems, software, or equipment** that are installed on ships
    - Increase its duration to cover more material—by **3-6 months**
    - Increase its duration to cover more material—by **7-12 months**
    - Add the material covered by **NEC 2735** (Information Systems Administrator) to the training pipeline
    - Cover more material-----on **application software**
    - Cover more material-----on **operating systems**
    - Cover more material-----on **computer hardware components**

- o Cover more material-----on **tech control and radio**
- o Cover more material-----on **data connectivity** (switches, routers, multiplexes)
- o Cover more material-----on **information system security**
- o Cover more material-----on **legal or ethical issues**
- o Use more **computer-based** (multimedia) instruction
- o Leave A-School as it is
- o Other

11. Are you planning to reenlist (or extend for 1 year or more) beyond your current obligation? We need your answer even if you just reenlisted.
    - o No
    - o Yes
    - o Does not apply because I am retiring from the Navy

12. During the past 6 months, have you done any of the following to explore the possibility of leaving the Navy? Mark **all that apply**.
    - o Wondered what life would be like as a civilian
    - o Thought seriously about leaving the Navy
    - o Discussed leaving and/or civilian job opportunities with family members or friend(s)
    - o Talked about leaving the Navy with your immediate supervisor
    - o Gathered information on education programs or colleges
    - o Gathered information about civilian job options (for example, read newspaper/Internet listings, attended a job fair, etc.)
    - o Attended a training program or seminar to help prepare you for civilian employment
    - o Prepared a resume
    - o Attended a Navy Transition Assistance Program (TAP) class
    - o Applied for a civilian job
    - o Interviewed for a civilian job
    - o Other
    - o None of the above

13. If you are planning to leave the Navy, which of the following **ALONE** would **definitely convince you to stay**? Check **all that apply**. Make sure you select options that **ALONE** would convince you to stay.
    - o a. The opportunity to do ADP work in your next tour
    - o b. The opportunity to get computer/communications courses in C-School
    - o c. Six-month assignment to college to complete 50 percent of associate's degree in information systems/computer science/telecommunications
    - o d. A $45,000 reenlistment bonus
    - o e. Assignment to an officer commissioning program----for a computer/communications specialty
    - o f. Assignment to an officer commissioning program----for a specialty other than computer/communications
    - o g. Advancement test that includes the type of work you are doing only (for example, ADP)
    - o h. Conversion to the IT rating
    - o i. One-year assignment to college to get an associate's degree in information systems/computer science/telecommunications
    - o j. Special/incentive pay (similar to that for submarine and flight duty)
    - o k. A significant reduction in your workload---by one quarter
    - o l. Certification training paid by the Navy (for example, MCSE or CISCO)

14. **[E5 and below only]**. Have you been assigned to mess cranking, laundry, or other TAD in your unit during the past year?
  ❍ No  ❍ Yes

15. **[E6 and below only]**. If you stay in the Navy and become a chief petty officer, what would you prefer to do?
  o Mostly do hands-on work in the computer/communications field
  o Mostly supervise computer/communications personnel only
  o About the same amount of hands-on work and supervision

16. What is your **rate/rating**? (Example: "IT2") _____

17. What is your **date of birth**? (mm/dd/yy) _____

18. To what type of ship/activity are you currently assigned? (Mark ALL that apply.)
  o Afloat staff
  o Training Command
  o Aviation Squadron/Detachment (sea deployed)
  o Aviation Squadron/Detachment (shore deployed)
  o Aircraft Carrier
  o Cruiser
  o Destroyer types (includes frigates)
  o Minecraft
  o Submarine
  o Tender/Repair ship
  o Reserve Unit
  o Service Force ship (USNS, auxiliaries)
  o Amphibious ship (LSD, LST, LHD, LHA, etc.)
  o Amphibious craft (LCAC, etc.)
  o Special Warfare Unit
  o Shore based deployable unit (Seabees, EOD, etc.)
  o NSGA
  o NCTAMS
  o NCTS
  o FIWC
  o Other Shore or Staff Command
  o Other

19. How long have you been at your present duty station?
  o Less than 6 months
  o 6 months to less than 12 months
  o 12 months to less than 18 months
  o 18 months to less than 24 months
  o 24 months or more

20. Are you presently on deployment (i.e., scheduled time away from homeport for 30 days or more)?
  ❍ No  ❍ Yes.

21. **[E5 and below only]** How useful was A-School in preparing you for your job in the computer/communications field?
    o Not useful at all
    o Slightly useful
    o Moderately useful
    o Very useful
    o Extremely useful

22. **[E5 and below only]** How much did your most recent **advancement test** cover **the NAVY WORK you currently do** in the computer or communications field?
    o All of it
    o About three quarters
    o About half
    o About one quarter
    o Almost none
    o Not applicable

23. If all sailors doing ADP work in your command received adequate training, how many hours of visits by tech reps (such as from the Fleet Tech. Support Center or SPAWAR) could have been avoided in the LAST MONTH?
    o _____ hours
    o Does not apply

24. Based on your experience, what percentage of your **end users can perform the following computer basics** effectively? Base your answer on Navy active-duty sailors only. **Do not** include sailors currently working in the computer/communications field.

|  | | Enlisted | Officers |
|---|---|---|---|
| a. | Can **start up** the computer, including entry of user identification and password. Can shut down computer. | _____% | _____% |
| b. | Able to **navigate and manipulate** Windows, such as move and resize windows, drag and drop, shut down frozen programs, and switch between applications. | _____% | _____% |
| c. | Can switch between **printers** and determine the status of a pending print job. | _____% | _____% |
| d. | Able to use **word processing** for text manipulation, such as copy and paste, formatting, grammar/spell check, pagination, and table creation. | _____% | _____% |
| e. | Understand basic uses for **application software other than word processing**, such as spreadsheets and presentation programs. Able to transfer/insert objects between different software applications. | _____% | _____% |
| f. | Able to **find** lost files. Find text strings within documents. | _____% | _____% |
| g. | Able to do **file maintenance.** Copy files to/from network and desktop drives. Archive and delete files. Create directories. Understand file properties, file extensions, and folders. | _____% | _____% |
| h. | Able to send/receive **e-mail** messages and forward, archive, or delete them. Send or read e-mail attachments. | _____% | _____% |
| i. | Can log into the **Internet** and use search engines to locate materials. Understand differences between text, HTML, and PDF formats. Download a file from the Internet and save it. | _____% | _____% |
| j. | Follow basic **computer security** procedures, including appropriate passwords, virus protection, and backup of critical data. | _____% | _____% |

| | | |
|---|---|---|
| k. Follow basic computer **legal and ethical** procedures, including licensing and software copyrights. | _____% | _____% |

25. What percentage of **new sailors** coming to your command from A-School or apprenticeship **can perform all the computer basics** (listed in the last question) effectively? Include end users; **do not** include sailors working in the computer/communications field.
    o Enlisted: _____ %
    o Officers: _____ %
    o Does not apply

26. How many hours do you **personally spend TRAINING END USERS in basic computer skills** in a typical week? Include formal and informal training. **Do not** include training for sailors working in the computer/communications field.
    o _____ hours
    o Does not apply

27. How much of the training **YOU** gave **could have been avoided** if sailors got the necessary **training in basic computer skills**?
    o All of it
    o About three quarters
    o About half
    o About one quarter
    o None

28. When you most recently trained end users in basic computer skills, how many of them did you train **at the same time**? This can be as low as one sailor or as many as an entire classroom. Include active-duty enlisted and officer personnel only.
    o _____ personnel
    o Does not apply

29. How many hours per week do you spend **FIXING end users' workstation problems**? Include the hours that **could have been avoided with basic computer skills** training only. DO NOT include the time you spend fixing network crashes.
    o _____ hours
    o Does not apply

30. If your **end users** received all the necessary **training in computer basics**, how many hours **PER WEEK** would you **personally** save from avoided **WORKSTATION PROBLEMS?**
    o _____ hours
    o Does not apply

31. If your **end users** received all the necessary **training in computer basics**, how many hours **PER MONTH** would you **personally** save from avoided **NETWORK MALFUNCTIONS OR CRASHES?** Do not include problems created by software.
    o _____ hours
    o Does not apply

32. In the most recent network malfunction or crash, how many workstations were degraded in capability or put out of service for an hour or more?
    o _____ workstations
    o Does not apply

33. In the most recent network malfunction or crash, how many sailors worked to solve the problem? Include yourself and the others who worked on the network malfunction.
    o _____ sailors (may include yourself)
    o Does not apply

34. Of the time that you would save from adequate end user training, how much would you use for your own training in the computer/communications field?
    o All of it
    o About three quarters
    o About half
    o About one quarter
    o None
    o Does not apply

35. How many hours last week did you **personally spend training sailors who graduated in the past year from IT A-School** (or IT strikers or FT A-School submariners or CTO A-Schools)? Include formal and informal training.
    o _____ hours
    o Does not apply.

36. How much of the training you gave could be avoided if sailors got the necessary training in IT A-School (or IT strikers or FT A-School submariners or CTO A-Schools)?
    o All of it
    o About three quarters
    o About half
    o About one quarter
    o None
    o Does not apply

37. When you most recently trained **sailors who graduated in the past year from IT A-School** (or IT strikers or FT A-School submariners or CTO A-Schools), how many of them did you train **at the same time**?  This can be as low as one individual or as many as an entire classroom.
    o _____ sailors
    o Does not apply

38. What is your Social Security Number? This is voluntary; however, it will help us greatly with follow-on research. Your confidentiality will be maintained. _____

**Thank you for completing the survey. We appreciate your effort!**

# Appendix C: Database report

This appendix contains SkillObject reports for Information Systems Administration. The reports include the SkillObject titles and, for each SkillObject, the tasks and KSATs. Reports for the other four jobs are available from CNA on request.

# *SkillObject™ Report—Tasks, Knowledge, Skills, and Tools*

## Network Implementation Planning

### *Tasks*

| | |
|---|---|
| 136 | Advise management on future needs for software/hardware for the network |
| 2512 | Configure operator and terminal interfaces |
| 1883 | Coordinate network installation for quality, timeliness |
| 2230 | Determine number of hosts or clients on a network |
| 1616 | Develop functional/organizational goals (ex  prioritization of goals, upgrades/new installations) |
| 1903 | Evaluate software programs to ensure that they will optimize the server |
| 594 | Implement user or command ideas to enhance efficiency |
| 2256 | Maintain network compatibility among different architectures/systems |
| 2666 | Manage computer and network configuration (including architecture, updates, procedures) |
| 1607 | Plan goals, strategy, and policy (ex  to implement ideas) |
| 1609 | Plan projects (such as information systems projects) |
| 1096 | Prioritize tasks (ex  network projects, repairs) |
| 357 | Recommend options to customers or chain of command (such as LAN changes) |
| 76 | Update system/capability data to improve performance |

### *Tools*

| | |
|---|---|
| 4440 | Customer survey |
| 5298 | Diagnostic tools (hardware/software) |
| 4961 | MS PowerPoint |
| 4442 | MS Project |
| 4962 | Network Neighborhood |
| 4672 | Networking software |
| 5326 | Performance Monitor |
| 5160 | Planning software/utilities |
| 5316 | Test system (server/workstation) |

### *Knowledge*

| | |
|---|---|
| 14 | A+ certification |
| 4573 | Cisco Certified Network Associate (CCNA) certification |
| 3289 | Client/server concepts |
| 3662 | MCSE certification |
| 4073 | MS NT Server Workstation |

| 4645 | Network Essentials (Navy course) |
| 4572 | Networking Foundations (Navy course) |
| 3290 | Networking hardware |
| 4632 | Project procedures |
| 4639 | System design |
| 4530 | System functions |

### *O\*NET Skill*

| 23 | Implementation Planning | Developing approaches for implementing an idea. |

## Learning Activities

### *Tasks*

| 485 | Learn computer skills/knowledge |
| 454 | Learn policy guidance from manuals, directives, or other documents |
| 2518 | Learn TDM strapping (super commutation of time-division multiplexing) |
| 880 | Read documents (such as reports, instructions, regulations, and letters; may be conducted online) |
| 1528 | Review forms for reference or information |

### *Tools*

### *Knowledge*

| 4169 | Technical manual |

### *O\*NET Skill*

| 8 | Active Learning | Working with new material or information to grasp its implications. |

## Mathematical Calculations

### *Tasks*

| 650 | Perform math calculations |

### *Tools*

| 4765 | MS Excel |

### *Knowledge*

| 3411 | Mathematics |

### *O\*NET Skill*

| 8 | Active Learning | Working with new material or information to grasp its implications. |

# Technical Coordination

2617    Coordinate command/control/comms (C3) for customer staffs (ex  carrier group staff embarking)

2602    Coordinate connectivity plan and other plans with all concerned (including the Server Administrator)

2664    Coordinate external technical support (ex  in-service engineering agent, parts  representatives, or Fleet Support Desk)

2597    Coordinate information systems interfaces with shore activities (ex  with suppliers to expedite parts)

2603    Coordinate network troubleshooting and repair

2599    Coordinate outages and restorations of circuits with technical control supervisor or others

2600    Coordinate requirements and resources (such as allocation of money, time, or personnel) to meet requirements

2667    Coordinate the implementation of the information security (INFOSEC) plan

## *Tools*

4588        MS Outlook
5160        Planning software/utilities
4589        System maps

## *Knowledge*

3419        C3 instructions/directives
3418        Information Systems Security (INFOSEC) directive
3420        IT-21 (Information Technology for the 21st Century) directives

## *O\*NET Skill*

12   Coordination                              Adjusting actions in relation to others' actions.

# Data Backups

## *Tasks*

2304    Back up systems, software, or data

2276    Schedule data back-ups and restorations

## *Tools*

4640        Backup drives/disks
4639        Backup utilities

## *Knowledge*

4167        Software user manual

## *O\*NET Skill*

34   Equipment Maintenance          Performing routine maintenance and determining when and what kind of maintenance is needed.

# Computer Equipment Maintenance

### Tasks

2799    Clean computers and peripherals (may include parts, disk drives, air filters, and other devices)

2560    Clean workstations/media infected with viruses

2481    Conduct pre-underway checks and maintenance

2758    Maintain equipment cables/drops/cross-connects (ex  modifying cabling/wiring connections)

2129    Manage system maintenance (preventive and corrective)

### Tools

5321    Anti-virus software
4646    Compressed air
4653    Maintenance Index Page (MIP)
4652    Maintenance Requirement Card (MRC)
5319    PC toolbox
4643    Preventive Maintenance System (PMS) cards

### Knowledge

4654    Maintenance and Material Management (3M) System Manual

182    Ships' Maintenance and Material Management (3M) System Manual, OPNAVINST 4790.4

### O*NET Skill

34  Equipment Maintenance      Performing routine maintenance and determining when and what kind of maintenance is needed.


# Troubleshooting Strategy

### Tasks

243    Analyze data (ex  to solve system/circuit problems or choose a troubleshooting method)

2552    Analyze potential best solutions/methods (such as for troubleshooting)

408    Collaborate with other team members to share problem solutions or troubleshooting tips

122    Determine available options (methods, strategies) to correct computer/network problem

472    Develop innovative ideas for saving time, improving process

1069    Evaluate methods for correcting a problem (ex  diagnostic tests or repairs)

2041    Evaluate performance of computers/equipment to decide on upgrades or replacements

130    Exchange information (ex  messages, reports) to improve efficiency, training, or solve problems

999    Select procedures/strategies (ex  troubleshooting method) to solve problems (ex  fixing computer)

| | |
|---|---|
| 4858 | Cable tester |
| 5298 | Diagnostic tools (hardware/software) |
| 4752 | MS Word |
| 5326 | Performance Monitor |
| 5160 | Planning software/utilities |
| 5327 | System analysis software |

*Knowledge*

| | |
|---|---|
| 14 | A+ certification |
| 3629 | Command instructions/directives |
| 4168 | Hardware/software documentation |
| 3054 | Internet discussion groups |
| 3055 | Internet knowledge base |
| 3662 | MCSE certification |
| 4530 | System functions |
| 4169 | Technical manual |
| 4409 | Troubleshooting guide |
| 4598 | Uses of test equipment |

*O\*NET Skill*

| | | |
|---|---|---|
| 21 | Idea Generation | Generating a number of different approaches to problems. |

# Information Gathering

*Tasks*

| | |
|---|---|
| 366 | Ask questions of technical experts or experienced personnel |
| 456 | Contact system manufacturers for information |
| 217 | Identify materials or classes for learning more about the subject |
| 18 | Locate helpful software (to improve operations) |
| 897 | Retrieve files/data from local or remote systems, or from backups |
| 17 | Retrieve reports (such as on equipment, capabilities, or other status information) |
| 2727 | Review information-assurance vulnerability messages for applicability to unit/ship |
| 333 | Search for information (on equipment, procedures, solutions; may be conducted online) |

*Tools*

| | |
|---|---|
| 4661 | Help Desk software |

*Knowledge*

| | |
|---|---|
| 3114 | IAVA Web site |

*O\*NET Skill*

| | | |
|---|---|---|
| 18 | Information Gathering | Knowing how to find information and identifying essential information. |

# Technical Data Maintenance

## *Tasks*

| | |
|---|---|
| 1540 | Correct computer-stored information (such as data, records, or files) |
| 2017 | Distribute documents (instructions, memoranda) (may be conducted electronically on the intranet) |
| 293 | File documents (such as data, receipts, messages, correspondence, or other information) |
| 2529 | Maintain circuit or network logs and drawings (ex  to reflect changes to network topology or devices) |
| 2417 | Maintain Command Configuration Technical Library |
| 57 | Maintain magnetic media inventory (ex  tape catalog and special compartmentalized information (SCI) inventory) |
| 1906 | Manage databases (may include adding, changing, distributing, or removing data tables) |
| 658 | Prepare formatted data for others to use to perform tasks |

## *Tools*

## *Knowledge*

| | |
|---|---|
| 3629 | Command instructions/directives |
| 3628 | Database management |
| 4639 | System design |
| 4530 | System functions |

## *O\*NET Skill*

| | | |
|---|---|---|
| 19 | Information Organization | Finding ways to structure or classify multiple pieces of information. |

# Configuration and Control—Computer

## *Tasks*

| | |
|---|---|
| 2117 | Configure applications/utility software (including installation/upgrade of COTS and GOTS) |
| 2214 | Configure LED indicators |
| 170 | Configure operating system (OS) software (such as NT, UNIX, Windows 2000, Netware) |
| 2577 | Configure operating system security |
| 2158 | Install computer hardware |
| 531 | Install computers (workstations and servers) |
| 2160 | Install icons (ex  imagery icons) |
| 1665 | Issue software programs |
| 619 | Load user/client data into computer so that they can use the network |

| 2188 | Prepare hard disk for installation |
| 2592 | Update anti-virus definition files |

| 4714 | Computer repair toolkit |

| 14 | A+ certification |
| 4655 | Installation manual |
| 3339 | Operating system documentation |

*O\*NET Skill*

| 28 | Installation | Installing equipment, machines, wiring, or programs to meet specifications. |

# Configuration and Control—Network

*Tasks*

| 2122 | Administer remote access and connections |
| 2212 | Configure 10 and 100 MBPS Ethernet modules |
| 2392 | Configure DHCP (Dynamic Host Configuration Protocol) |
| 2306 | Configure directory replication |
| 2405 | Configure domains (creation, demotion, or determination of model) |
| 2216 | Configure e-mail system (ex  accounts, addresses, Exchange System Attendant, public folders) |
| 2742 | Configure multiplexer (ex  FCC-100 (7), timeplex) |
| 2407 | Configure network auditing procedures (such as Configure Windows NT Auditing) |
| 2400 | Configure network devices (such as hubs and ATM switches) |
| 2136 | Configure router (ex  router ports, LAN connections, CISCO routers) |
| 2221 | Configure subnet (such as for appropriate number of hosts) |
| 2398 | Configure transport protocols (ex  TCP/IP, IP and IPX, or connectivity between ATM and non-ATM devices) |
| 2137 | Configure trust relationships between workstation and domain (including routers and message server) |
| 2741 | Configure workstation, server, and stand-alone computers for optimal performance (including installations and alignments) |
| 2066 | Connect computers to the network |
| 2753 | Enable tunnels (such as encapsulation of IP packet headers into tunnels) |
| 261 | Install fiber optic network |
| 2637 | Obtain certification for the system or network (such as ACLS, SINS, or TACN) |

| 1990 | Program modems (may involve connecting, disconnecting, and monitoring) |
|---|---|
| 2185 | Scan network or transportable media for viruses |
| 2754 | Shut down tunnels |
| 2841 | Verify connectivity of components (such as the SCSI bus or VMEC) |
| 2794 | Verify operation of hubs, switches, routers, and ATM devices |

### Tools

| 5321 | Anti-virus software |
|---|---|
| 5323 | Automated Data Network System (ADNS) |
| 5343 | Cabling kit |
| 4714 | Computer repair toolkit |
| 5121 | Computer terminal for user interface |
| 5298 | Diagnostic tools (hardware/software) |
| 4715 | Fiber optic installation kit |
| 4971 | Network Tools |
| 5347 | Unix operating system |

### Knowledge

| 4652 | C4I instructions/directives |
|---|---|
| 4573 | Cisco Certified Network Associate (CCNA) certification |
| 4353 | General internet protocols |
| 4595 | Hardware manual |
| 3662 | MCSE certification |
| 4354 | Microsoft NT server management |
| 4572 | Networking Foundations (Navy course) |
| 3339 | Operating system documentation |
| 4169 | Technical manual |

### O*NET Skill

| 28 | Installation | Installing equipment, machines, wiring, or programs to meet specifications. |
|---|---|---|

## Training of Other Personnel

### Tasks

| 1322 | Assist co-workers with their jobs |
|---|---|
| 2554 | Brief new/visiting personnel on facilities, network diagram, or troubleshooting procedures |
| 360 | Explain computer systems to others |
| 549 | Explain instructions to personnel (such as procedures or compliance) |
| 69 | Schedule user training (ex  security awareness, system capability, user responsibilities) |
| 924 | Teach electrical procedures (circuits, interface/patching techniques) |
| 2686 | Teach information security procedures (ISSO, OPSEC, and INFOCON) |
| 303 | Teach other computer/technical personnel about hardware/software |

operation and procedures

| | |
|---|---|
| 2097 | Teach users the basic functions of the system (login, Internet, e-mail, basic applications) |
| 2555 | Train Information Systems Security Officers (ISSOs) |
| 2557 | Train users to work with networks or systems |

### Tools
| | |
|---|---|
| 4961 | MS PowerPoint |
| 5160 | Planning software/utilities |

### Knowledge
| | |
|---|---|
| 4043 | Applicable instructions |
| 29 | Automatic Data Processing Security Program Instruction, OPNAVINST 5239.1 |
| 4573 | Cisco Certified Network Associate (CCNA) certification |
| 4482 | Extensive vocabulary |
| 3662 | MCSE certification |
| 4643 | Network Essentials (LearnSoft Corporation course) |
| 4644 | NT Workstation (Navy course) |

### O*NET Skill
| | | |
|---|---|---|
| 15 | Instructing | Teaching others how to do something. |

## Training Evaluation

### Tasks
| | |
|---|---|
| 886 | Evaluate knowledge of information systems (technical) personnel to determine training needs |
| 1439 | Evaluate training program/classes for usefulness or effectiveness |
| 2032 | Evaluate users' knowledge to determine training needs |

### Tools
| | |
|---|---|
| 4765 | MS Excel |

### Knowledge
| | |
|---|---|
| 4388 | Commands' Enlisted Distribution Verification Report (EDVR) NEC requirements |

### O*NET Skill
| | | |
|---|---|---|
| 41 | Judgment and Decision Making | Weighing the relative costs and benefits of a potential action. |

## Financial Management

### Tasks
| | |
|---|---|
| 2096 | Compare costs of equipment or supplies to get the best value |
| 791 | Estimate materials cost |

| 762 | Explain costs to the chain of command (ex  financial reports) |
|------|---|
| 1310 | Negotiate contracts with suppliers (may involve advice, discussion, or facilitation) |
| 2781 | Procure equipment (ex  new systems) |
| 2094 | Reconcile spending on materials/services with funding |

### *Tools*

| 4765 | MS Excel |
|------|---|
| 5160 | Planning software/utilities |

### *Knowledge*

| 4482 | Extensive vocabulary |
|------|---|

### *O\*NET Skill*

| 44 | Management of Financial Resources | Determining how money will be spent to get the work done, and accounting for these expenditures. |
|----|---|---|

## Material Resource Management

### *Tasks*

| 660 | Adapt facilities, equipment, and procedures to accommodate computers, networks, and people |
|------|---|
| 2594 | Allocate materials/resources for repairs (including for recovery from system failures) |
| 813 | Arrange supplies and materials for easy access and inventory |
| 790 | Inventory computers and parts |
| 895 | Maintain documents (such as manuals, files, messages, reports, forms, or records) |
| 2703 | Manage CATV, VTC, and entertainment systems |
| 2176 | Manage power supply (power hookups or power supply removal) |
| 1130 | Monitor material and supply stock |
| 368 | Move computers or equipment (may involve lifting, loading, climbing, or walking) |
| 1803 | Order supplies (including software) for repairs or system improvements/upgrades |
| 1715 | Organize tools and other resources for completion of work |
| 775 | Organize work center for maximum efficiency |
| 133 | Prepare requests for additional hardware, software, or training |
| 1716 | Reserve resources for activities, events, or programs |
| 2644 | Supervise procurement and quality control of new/repair parts (including warranty returns) |

## Tools

| | |
|---|---|
| 5318 | Charts/graphs/blueprints |
| 5319 | PC toolbox |
| 5160 | Planning software/utilities |

## Knowledge

| | |
|---|---|
| 4542 | Action reports (Operations Report (OPREP)-3/Navy Blue) |
| 4591 | LAN configuration |
| 4643 | Network Essentials (LearnSoft Corporation course) |
| 4592 | Network security directive |
| 4590 | Safety procedures |
| 4541 | Standard operating procedure (SOP) guidance/directives |

## O*NET Skill

| | | |
|---|---|---|
| 45 | Management of Material Resources | Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work. |

# Personnel Management

## Tasks

| | |
|---|---|
| 2575 | Establish reporting criteria and procedures |
| 1181 | Guide individuals and groups in the performance of their jobs |
| 933 | Inspect personnel for cleanliness and compliance with uniform standards |
| 2099 | Manage personnel (subordinates, co-workers) |
| 1008 | Manage processes for efficiency (ex  for best customer service) |
| 2439 | Monitor change-of-watch activities |
| 2114 | Motivate others to do their best, and challenge their minds |
| 1624 | Organize work-related activities |
| 1135 | Prescribe classes or instruction for others to acquire needed knowledge/skills |
| 1134 | Prescribe knowledge/skills/abilities necessary to perform a job |
| 1974 | Schedule events and meetings with others |

## Tools

| | |
|---|---|
| 5345 | Compass software |
| 4808 | Fitness and Counseling Reports and Evaluations (NAVFIT) software |
| 4752 | MS Word |
| 5160 | Planning software/utilities |

## Knowledge

| | |
|---|---|
| 4170 | Feed Back |
| 4168 | Hardware/software documentation |
| 4643 | Network Essentials (LearnSoft Corporation course) |
| 4530 | System functions |
| 4656 | Watch bill |

| | | |
|---|---|---|
| 46 | Management of Personnel Resources | Motivating, developing, and directing people as they work, identifying the best people for the job. |

## Organizational Oversight

### *Tasks*

| | |
|---|---|
| 1673 | Coordinate work-related programs (such as for tool control, training, or division career counseling) |
| 2346 | Maintain compliance with software license agreements |
| 2126 | Participate in meetings (ex  planning, productivity, or management-change meetings) |
| 1366 | Represent interests of customers, co-workers, or supervisors to chain of command or others |
| 2726 | Represent the command or organization (ex  during inspections/certifications) |
| 2645 | Supervise NTCSS equipment use |
| 2682 | Verify compliance with communications instructions and regulations (ex  battle group comms plan) |

### *Tools*

| | |
|---|---|
| 4794 | NT License Manager |

### *Knowledge*

| | |
|---|---|
| 3931 | Communications instructions |
| 3893 | License agreements |

### *O\*NET Skill*

| | | |
|---|---|---|
| 10 | Monitoring | Assessing how well one is doing when learning or doing something. |

## Basic Computer Operations

### *Tasks*

| | |
|---|---|
| 2402 | Administer disk utilities |
| 2067 | Disconnect computers or equipment from the network |
| 2149 | Download data files/documents to a computer |
| 2334 | Identify type of computer (ex  model, version) |
| 2489 | Initialize tactical information system (ex  OTCIXS/TADIXS ON-143(V)6) |
| 2817 | Maintain steady electrical power to the equipment |
| 2498 | Operate automated data network system (ADNS) components (may include patching, powering up, or re-setting) |
| 501 | Operate equipment (ex  peripheral devices, electronic equipment, or communications devices) |

| 2537 | Operate tactical intelligence (TACINTEL) systems (including warm/cold starts) |
|------|---|
| 2473 | Perform basic computer functions (such as the taskbar, start button, and start menu) |
| 2154 | Perform proper login procedures (ex  following re-boot) |
| 2449 | Power up/down computer systems or components (ex  Unix-, DOS-, or NT-based) |
| 345 | Prepare e-mail (including attachments) |
| 12 | Process data on computers (ex  supply or security data; may involve routing the data) |
| 2435 | Re-boot computer or network |
| 2001 | Send files (such as via e-mail attachments or FTP) |

### *Tools*

| 4817 | E-mail software |
|------|---|
| 4588 | MS Outlook |

### *Knowledge*

| 14 | A+ certification |
|------|---|
| 3629 | Command instructions/directives |
| 3628 | Database management |
| 3339 | Operating system documentation |
| 4169 | Technical manual |

### *O*NET Skill*

| 32 | Operation and Control | Controlling operations of equipment or systems. |
|------|---|---|

## System Administration

### *Tasks*

| 2383 | Administer circuit, interface or software configurations (ex  network nodes, devices, application, or system software) |
|------|---|
| 2206 | Administer user accounts (such as logons, permissions, profiles, account policies, or auditing rights) |
| 2428 | Configure route determination (may include naming device, IP, DNS, WINS, or mail databases) |
| 1416 | Edit system files or program functions |
| 2614 | Establish group account policies |
| 2809 | Execute computer commands (such as on Unix) |
| 2507 | Maintain electrical and network circuits (ex  to prevent outages or interference) |
| 2257 | Maintain site services account (ex  commercial maintenance agreement) |
| 2226 | Maintain system and security policy pages posted on workstations |

| 2700 | Manage Internet communications to/from the ship or unit |
|------|------|
| 2231 | Manage share folders and files (ex  intranet training folder) |
| 2693 | Manage system administration rights |
| 2762 | Perform interfacing and patching of computer networks |
| 2192 | Set account lockout restrictions (including logon time restrictions) |
| 2589 | Set information control (INFOCON) posture (in accordance with tactical situation) |
| 2714 | Supervise installation and upgrades of systems/servers |
| 2792 | Update verify.rec file on backup configuration when new key is used |
| 438 | Write computer software or scripts for specific tasks/functions or batch procedures (ex  using Unix, SQL) |

### Tools

| 4858 | Cable tester |
|------|------|
| 4995 | Message text format (MTF) program |
| 153 | MS Exchange |
| 4671 | MS Windows NT |
| 4672 | Networking software |
| 4857 | NT User Manager |
| 5144 | System compiler |

### Knowledge

| 14 | A+ certification |
|------|------|
| 3992 | Information Operations Condition (INFOCON) directive |
| 3662 | MCSE certification |
| 4647 | Microsoft NT server certification |
| 4354 | Microsoft NT server management |
| 4648 | MS Exchange certification |
| 4073 | MS NT Server Workstation |
| 4643 | Network Essentials (LearnSoft Corporation course) |
| 3339 | Operating system documentation |
| 4167 | Software user manual |
| 4364 | UNIX Fundamentals, NETG A12327 (computer-based training) |

### O*NET Skill

| 32 | Operation and Control | Controlling operations of equipment or systems. |
|------|------|------|

## Communications Administration

### Tasks

| 2514 | Coordinate circuit plan with other departments (ex  Combat Systems, CSOOW, Radio) |
|------|------|
| 2565 | Coordinate system operations plan |
| 2717 | Implement communications plans |

5160       Planning software/utilities

4542       Action reports (Operations Report (OPREP)-3/Navy Blue)
4005       Flt Ops  Cmnd & Ctrl Warfare & Elec Warfare Sys, NSG Mod 2 (NSGTP 683-02-00-99)
4007       Naval Telecommunications Procedures, Fleet Communications, NTP 4
4541       Standard operating procedure (SOP) guidance/directives

*O\*NET Skill*

32   Operation and Control            Controlling operations of equipment or systems.

# Radio Monitoring

### *Tasks*

87       Monitor circuits for connectivity rate and stability

2706       Monitor ordnance alterations

2495       Monitor output communications channels

2708       Monitor the operation of external communications equipment

2769       Verify proper operation of equipment

### *Tools*

### *Knowledge*

4043       Applicable instructions

### *O\*NET Skill*

31   Operation Monitoring           Watching gauges, dials, or other indicators to make sure a machine is working properly.

# Network Monitoring

### *Tasks*

2734       Analyze network connectivity using routing table, ping, and traceroute commands

638       Examine system and audit logs for proper use of systems, circuits, or security awareness

2322       Manage files, directories, mirror set (also sub-directories, volume sets; includes saves and deletions)

2124       Manage network traffic/problems

2263       Manage system performance/capacity (ex  using Task Manager for measuring performance)

2351       Manage the NT Server Desktop and other hyper terminal applications

2633       Monitor computer and network security (to protect against password compromise, viruses, or prohibited use)

| 2434 | Monitor network components (ex  servers, workstation,  connections) for performance and availability |
|------|------|
| 2268 | Monitor router/router protocol for proper routing, transmission, and receipt of communications traffic |
| 2580 | Monitor the implementation of plans for effectiveness (such as plans related to computer network) |
| 2237 | Supervise server administration (ex  FTP server) |

### Tools

| 4858 | Cable tester |
|------|------|
| 4524 | Event Viewer |
| 4426 | Network diagnostic tools |
| 5326 | Performance Monitor |

### Knowledge

| 14 | A+ certification |
|------|------|
| 4573 | Cisco Certified Network Associate (CCNA) certification |
| 3662 | MCSE certification |
| 4073 | MS NT Server Workstation |
| 4592 | Network security directive |
| 3339 | Operating system documentation |

### O*NET Skill

| 31 | Operation Monitoring | Watching gauges, dials, or other indicators to make sure a machine is working properly. |
|------|------|------|

## Operation Monitoring

### Tasks

| 2388 | Manage network security and procedures (ex  with NSM or ISSP to balance performance and security) |
|------|------|
| 2431 | Manage optical configurations (ex  FDDI) |
| 2438 | Monitor access through serial ports (ex  RS-232C) |
| 2267 | Monitor image files |
| 2572 | Monitor security warning indicators to ensure that they are in place |
| 2550 | Monitor sensors/lights/switches and other indicators for normal operating conditions |

### Tools

| 5160 | Planning software/utilities |
|------|------|

### Knowledge

| 4482 | Extensive vocabulary |
|------|------|
| 4168 | Hardware/software documentation |

### O*NET Skill

| 31 | Operation Monitoring | Watching gauges, dials, or other indicators to make sure a machine is working properly. |
|------|------|------|

# Network Analysis

## *Tasks*

1888     Analyze network data (performance, traffic; may include the Internet) for problems/solutions

1959     Analyze router access list/configuration for incorrect settings, problems, or interference with protocols

2755     Establish integrated testing requirements

2535     Perform systems analysis (to include risk analysis)

## *Tools*

5346     MS NT Enterprise
4971     Network Tools

## *Knowledge*

29     Automatic Data Processing Security Program Instruction, OPNAVINST 5239.1

4573     Cisco Certified Network Associate (CCNA) certification
3531     Command instruction related to risk management
4073     MS NT Server Workstation
4645     Network Essentials (Navy course)

## *O\*NET Skill*

17   Problem Identification        Identifying the nature of problems.

# Standard Reports and Documents

## *Tasks*

2806     Document configuration changes to network systems

2569     Document deficiencies to information systems strategic plan (ISSP)

2720     Prepare communications annexes to operation plans, operation orders, or other directives

311     Prepare forms (may include correction, submission, and duplication)

2570     Prepare training report (ex  School of the Ship brief)

2651     Prepare vulnerability assessment reports

1542     Update documents (ex  manuals, inventory reports, instructions) for accuracy

935     Verify records and forms (ex  Zone records) for data or format accuracy

298     Write documents (such as reports, correspondence, plans, or memoranda)

## *Tools*

4995     Message text format (MTF) program
4752     MS Word

## *Knowledge*

30     Automatic Digital Network (AUTODIN) Operating Procedures, JANAP 128

| 4103 | Incident reporting directive |
| 4530 | System functions |
| 205 | Telecommunications User's Manual, NTP 3 (J) |

### *O\*NET Skill*

| 3 | Writing | Communicating effectively with others in writing as indicated by the needs of the audience. |

## Performance Standards

### *Tasks*

| 2151 | Establish baseline performance standards |
| 2232 | Establish standard operating procedures (SOPs) (including changes) |
| 764 | Write instructions or guides to help users understand/troubleshoot their systems or perform admin functions |

### *Tools*

| 4765 | MS Excel |
| 4752 | MS Word |

### *Knowledge*

| 4104 | Correspondence manual |
| 4541 | Standard operating procedure (SOP) guidance/directives |

### *O\*NET Skill*

| 3 | Writing | Communicating effectively with others in writing as indicated by the needs of the audience. |

## Calibration

### *Tasks*

| 2689 | Maintain test equipment (ex  electrical, digital, or GPETE) |
| 2716 | Participate in SEMCIP (Shipboard Electro-magnetic Compatibility Program) |

### *Tools*

| 4653 | Maintenance Index Page (MIP) |
| 4652 | Maintenance Requirement Card (MRC) |

### *Knowledge*

| 3410 | Electromagnetic compatibility manual |
| 4654 | Maintenance and Material Management (3M) System Manual |
| 182 | Ships' Maintenance and Material Management (3M) System Manual, OPNAVINST 4790.4 |

### *O\*NET Skill*

| 34 | Equipment Maintenance | Performing routine maintenance and determining when and what kind of maintenance is needed. |

# Customer Service

| 4530 | System functions |
| 4169 | Technical manual |
| 4634 | Trouble report preparation |
| 4409 | Troubleshooting guide |

### *O*NET Skill*

| 16 | Service Orientation | Actively looking for ways to help people. |

## Messaging

### *Tasks*

| 2730 | Manage staff record-message communications |
| 2266 | Monitor general administrative (GENADMIN) message status |
| 2499 | Process original/reconstructed messages to the appropriate recipients (ex may involve delivery and fixing of errors) |
| 2525 | Run computer programs in support of message processing |
| 916 | Write messages (may involve drafting, typing, and formatting) |

### *Tools*

| 4995 | Message text format (MTF) program |
| 4752 | MS Word |

### *Knowledge*

| 4043 | Applicable instructions |
| 30 | Automatic Digital Network (AUTODIN) Operating Procedures, JANAP 128 |
| 4005 | Flt Ops  Cmnd & Ctrl Warfare & Elec Warfare Sys, NSG Mod 2 (NSGTP 683-02-00-99) |
| 4103 | Incident reporting directive |
| 4655 | Installation manual |
| 4007 | Naval Telecommunications Procedures, Fleet Communications, NTP 4 |
| 3339 | Operating system documentation |
| 4010 | Shipboard standard operating procedure (SOP) guidance/directives |
| 205 | Telecommunications User's Manual, NTP 3 (J) |
| 4219 | Transmission media manual |

### *O*NET Skill*

| 16 | Service Orientation | Actively looking for ways to help people. |

## Web Site Maintenance

### *Tasks*

| 2411 | Develop Web pages (using Web authoring software) |
| 2427 | Maintain command web site |

5148         Web authoring software

*Knowledge*

4373         Web programming

*O\*NET Skill*

29   Programming                     Writing computer programs for various purposes.

# Fault Analysis

## *Tasks*

1543        Correct events (such as mistakes, inefficient operating procedures, or operating errors)

156        Diagnose hardware problems

781        Diagnose network malfunctions (ex  sluggishness or incorrect settings)

270        Diagnose software program errors

2042        Inspect new equipment (including computers and peripherals) to verify that they work

2818        Test computers/networks/instruments for performance and reliability or to determine causes/solutions

2833        Troubleshoot computers/networks/peripherals (may involve making replacements)

## *Tools*

4858         Cable tester
5298         Diagnostic tools (hardware/software)
5326         Performance Monitor
5160         Planning software/utilities
5327         System analysis software

## *Knowledge*

14         A+ certification
4542         Action reports (Operations Report (OPREP)-3/Navy Blue)
4089         Inventory list
4541         Standard operating procedure (SOP) guidance/directives
4530         System functions
4409         Troubleshooting guide
4598         Uses of test equipment

## *O\*NET Skill*

35   Troubleshooting             Determining what is causing an operating error and deciding what to do about it.

# Reporting

## *Tasks*

| | |
|---|---|
| 1273 | Advise supervisors/co-workers on current status of computers, network, communications, or information security |
| 1769 | Communicate orders and rules from the chain of command |
| 1782 | Communicate written or verbal information (such as about findings, actions, questions, or proposals) |
| 1779 | Explain communication (ex  reports, letters, or other communications) |
| 451 | Explain facts/findings/recommendations to customers or chain of command (ex  on network status) |
| 36 | Explain organizational mission and capabilities |
| 2004 | Explain problems to all concerned |
| 1937 | Inform chain of command about status of systems and operations |
| 2513 | Inform supervisor of problems such as system outages and degradations |
| 465 | Inform supervisors when new data are received |
| 149 | Prepare presentations on network status and upgrade proposals |
| 2584 | Report possible network intrusion or virus |

## *Tools*

| | |
|---|---|
| 4752 | MS Word |
| 5160 | Planning software/utilities |

## *Knowledge*

| | |
|---|---|
| 4104 | Correspondence manual |
| 4482 | Extensive vocabulary |
| 4541 | Standard operating procedure (SOP) guidance/directives |

## *O\*NET Skill*

| | | |
|---|---|---|
| 4 | Speaking | Talking to others to effectively convey information. |

# Appendix D: SkillObjects by career path

Table 3 shows the SkillObjects for Information Systems Administration by career level: master, journeyman, and apprentice. We based this grouping on the proportion of respondents by paygrade that indicated they performed tasks in each SkillObject. The master level is for E-7–E-9 Sailors, the Journeyman is for E-5–E-6s, and the apprentice level is for E-1–E-4s.

Table 3.  SkillObjects by career level (Information Systems Administration)

**Master**

| | | |
|---|---|---|
| Financial management | Operation monitoring | Organizational oversight |
| Personnel management | Training of other personnel | Communications administration |
| Learning activities | Radio monitoring | Standard reports and documents |
| Reporting | Network implementation planning | Scheduling |

**Journeyman**

| | | |
|---|---|---|
| Troubleshooting strategy | Information gathering | Computer equipm. maintenance |
| Training evaluation | Technical data maintenance | Technical coordination |
| Material resource mgmt. | Configur. and control—network | Customer service |
| Messaging | | |

**Apprentice**

| | | |
|---|---|---|
| Fault analysis | Network analysis | Web site maintenance |
| System administration | Basic computer operations | Performance standards |
| Mathematical calculations | Network monitoring | Configur. and control—computer |
| Data backups | Calibration | |

# Appendix E: Career preferences of IT officers

This appendix shows some results from our survey related to the career preferences of IT officers. We conducted our survey with officers O-3 and below about the time the new Information Professional community was being established.

Table 4 shows the type of IT community preferred by officers. Table 5 shows restricted versus unrestricted line careers. The number of officers responding to our survey was small (63).

Table 4.   Type of IT community preferred by officers

|  | Percentage of respondents selecting option |
| --- | --- |
| A combination of qualified Limited Duty Officers (LDOs), Chief Warrant Officers (CWOs), and recent college gradates in information technology | 74 |
| In-service procurement of qualified enlisted IT professionals (LDOs and CWOs) | 70 |
| A separate designator | 44 |
| New accessions (with an Associate's degree or higher) into a CWO community | 30 |
| Transition at mid-career to a separate IT community (similar to the Acquisition Professional and Foreign Affairs officers) | 26 |
| Direct commissioning to O-3 or above (similar to doctors and dentists) | 11 |
| Other | 4 |

Table 5.   Restricted versus unrestricted line careers

|  | Percentage of respondents that agree with statement |
|---|---|
| Officers doing IT work should be able to do multiple tours in the IT field | 56 |
| A restricted line puts the priority on IT rather than a warfare specialty | 37 |
| The knowledge required for keeping up with IT developments does not allow for an adequate focus on the warfare specialty | 30 |
| Unrestricted line officers are perceived to have a higher status than restricted line officers | 19 |

# Appendix F: Information Systems Administration skills

Table 6 shows the skills required for the Information Systems Administration job. The skills are sorted by the number of tasks that required the skill.

Table 6.   Skills required for Information Systems Administration

| Skill | Number of tasks requiring skill |
| --- | --- |
| Operation and Control | 30 |
| Operation Monitoring | 22 |
| Installation | 21 |
| Speaking | 17 |
| Programming | 16 |
| Writing | 15 |
| Management of Material Resources | 13 |
| Coordination | 9 |
| Information Organization | 9 |
| Active Learning | 8 |
| Equipment Maintenance | 8 |
| Instructing | 8 |
| Management of Personnel Resource | 8 |
| Service Orientation | 8 |
| Technology Design | 7 |
| Information Gathering | 7 |
| Visioning | 5 |
| Synthesis/Reorganization | 5 |
| Testing | 5 |
| Monitoring | 4 |
| Troubleshooting | 4 |
| Judgment and Decision Making | 4 |
| Idea Generation | 4 |
| Time Management | 3 |
| Idea Evaluation | 3 |
| Implementation Planning | 3 |
| Persuasion | 3 |
| Management of Financial Resource | 3 |
| Product Inspection | 2 |
| Operations Analysis | 2 |
| Systems Evaluation | 2 |
| Foresee Downstream Consequences | 2 |
| Active Listening | 2 |
| Problem Identification | 2 |
| Identification of Key Causes | 2 |

# References

[1]  Norman G. Peterson et al. (eds.). *An Occupational Information System for the 21st Century: The Development of O\*NET.* Washington, DC: American Psychological Association, 1999

[2]  T. H. Athey. *Systematic Systems Approach: An Integrated Method for Solving Systems Problems.* Englewood Cliffs, NJ: Prentice Hall, 1982

[3]  U.S. Department of Defense. *Instructional Systems Development/ Systems Approach to Training and Education*, Jun 1997 (MIL-HDBK-1379-2, part 2 of 4 parts)

[4]  America's Career InfoNet, U.S. Department of Labor, http://www.acinet.org/

[5]  U.S. Office of Management and Budget. *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Program*, Feb 1997 (OMB Circular No. A–94)

[6]  Federico E. Garcia and Ernest H. Joy. *Effectiveness of the Voluntary Education Program*, Apr 1998 (CNA Research Memorandum 98–40)

[7]  U.S. Department of the Navy. *Utilization of Enlisted Occupational Standards (OCCSTDS) for Training and Career Development*, Nov 1992 (OPNAVINST 1500.74)

# List of figures

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