Measuring Learning Transfer and Decay From Initial Skill Training

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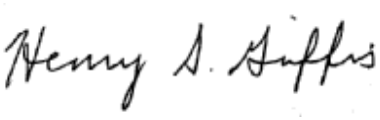

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Contents

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Executive summary

Enlisted schoolhouse training costs the Navy over a billion dollars each year, factoring in both direct costs and the costs of student billets. The fleet benefits from this training investment by receiving Sailors with many of the skills needed to perform their jobs aboard ships. Some of the important skills learned in initial skill training, however, are forgotten before the Sailor applies them to his or her job in the fleet. When that occurs for an important job skill, it hurts the Navy in a number of ways. For example, senior personnel may need to do more on-the-job training (OJT), or the Sailor may perform the job inefficiently. In addition, it may be that these skills are "forgotten" because they were not learned the correct way in the first place.

In this project, our task was to develop a systematic way to measure which important skills from initial training are most likely to decay before the Sailors apply them in the fleet. By knowing which skills are most likely to decay, the Navy could take a proactive approach to the problem, such as increasing initial skill training ("overlearning"), developing memory aids, or anticipating the need for OJT.

We first reviewed earlier research to determine the characteristics of skills that are most likely to decay and to identify important factors to consider when choosing skills to test for decay. We then developed a Microsoft Access-based tool that systematically collects judgments of subject matter experts (SMEs) of the criticality and characteristics of skills and how those characteristics predict the likelihood of decay. We demonstrated the tool on three ratings (Interior Communications (IC), Machinist's Mate (MM), and Engineman (EN)) to show that the tool and method could be applied across ratings in the Navy.

The method that we developed starts with the extensive job task list (occupational standards) that describes all the occupational skills for a particular rating. These lists include hundreds of skills, far more than are taught in Apprentice Technical Training (ATT) and

A-school. The tool assists the systematic reduction of the skill list to focus on skills that (1) are taught in initial skill training, (2) are critically important for the job, and (3) are likely to decay before they need to be used in the fleet.

In this report, we describe our analyses of which characteristics of skills are most predictive of skill decay. To do this, we considered SMEs' judgments of the characteristics of skills, as well as their overall judgment of how likely each skill was to decay. We found that most of the skills have a low likelihood of decay. We also identified a small number of skills that have a high likelihood of decay.

The next steps for this project could include the following:

1. Validating the tool by developing assessment tools to measure performance for important skills that SMEs have identified as most likely to decay

2. Developing assessment tools to determine if transfer of learning from A-school to the fleet took place

3. Developing remediation tools for skills most likely to decay

4. Determining whether changes in ATT and A-school curriculum are needed based on the results of assessment tests

5. Continuing to apply the tool we developed to other Navy ratings.

Introduction

The Naval Education and Training Command (NETC) asked CNA to determine a method for measuring learning transfer and decay of Navy initial skill training. Enlisted schoolhouse training costs the Navy over $1 billion each year, but some of the important skills learned in initial skill training are lost before the Sailor applies them to his or her job in the fleet. When that occurs for an important job skill, it hurts the Navy in a number of ways, such as requiring senior personnel to do more on-the-job training or by having the Sailor perform the job inefficiently. It is also possible that these skills are forgotten because they were never learned the correct way.

Currently, we are not able to measure learning and decay uniformly and efficiently across time. NETC set a task for this project of developing a systematic way to measure which important skills from initial training were most likely to decay before the Sailors applied them in the fleet. We first summarize previous efforts that have studied skill learning, decay, and transfer in the services and then describe the method adopted by this study to measure learning transfer and decay for Navy initial skill training.

Army study looking at predicting skill decay

The U.S. Army Research Institute (ARI) conducted an extensive study using information from basic research as well as applied studies in the field to determine the critical factors involved in skill decay. The ARI researchers set out to address basic issues in skill retention, including determining how fast forgetting occurs for different skills and combating skill decay. Using a large base of research from learning and memory studies, they were able to classify tasks into different categories based on the type of cognitive processing necessary to carry out each task. For example, they referred to tasks that are carried out in a series of steps that require knowledge retrieval as *procedural tasks;* tasks that require troubleshooting and more complex tactical decision-making skills were referred to as *cognitive tasks*. The fact that some tasks require different types of

cognitive processing has implications for how quickly each task is forgotten [1].

Since most Army tasks are procedural in nature, the ARI study focused on the specific factors that could affect procedural skill retention. These factors include:

- *Task complexity:* How many steps are included in the task, if they need to be performed in a sequence, and is there built-in feedback that each step was correctly performed? The more steps there are, the lower retention is.

- *Demands of the task:* Tasks that involve recall of lots of facts result in rapid decay. Similarly, tasks that require complex cognitive skills are subject to greater decay, and tasks that require an intermediate amount of motor control are best remembered.

- *Task conditions:* This category deals with specific task variables that can additionally affect task retention, such as having memory aids to help task performance (less decay) and having time limits or stress (strict limits make the task more difficult to perform).

Using these factors, ARI developed and validated an instrument that assesses how quickly a given skill will decay. A series of questions (the User's Decision Aid) integrating the factors above is used to help predict the percentage of Soldiers in a unit who can perform the task correctly after a given interval of no practice. This assumes that Soldiers start at the level of 100 percent proficiency [2].

A useful consequence anticipated from this effort was to better focus training on skills that have a high potential of decay. This helps to prioritize refresher training, particularly when time and resources are limited. Refresher training has been found by other studies to prevent or ameliorate decay [3, 4, and 5].

Because of the extensive research and validation conducted by the ARI study, and the relevance that the effort has to the current effort with respect to Navy skill training, we adapted the questions and scale from the ARI study as part of the current study. Even though the ARI assessment was developed around Army skills, experts we

consulted who are familiar with the initial skills learned in the Navy felt that the ARI survey questions held face validity for the current effort. For this reason, we integrated it within a multiquestion skill decay assessment tool developed as part of this study.

Developing a method to test learning decay and transfer of Navy initial skills

For the current tasking, as mentioned, we were asked to develop a method to test learning decay and transfer of initial skills for the U.S. Navy. This list is extensive, so we first focused on a subset of ratings, determined what initial skills are taught in A-school for these ratings, and then used a panel of subject matter experts (SMEs) to choose a smaller set of these initial skills within each rating on which to focus, using our tool. This idea was adapted from studies looking at development of job performance tests [6, 7]. A particularly relevant study done by Lammlein and Baker [6] set out to develop measurement technologies that could tie enlistment standards to actual job performance of Navy Radiomen (RM). In this study, a set of critical tasks was selected from a larger domain as a first step in developing performance measures. RM tasks were rated according to frequency, complexity, criticality to mission success, and difficulty—factors deemed relevant given the overall effort. These rated tasks were subsequently assigned weights according to these ratings, rated tasks were then pared down according to a systematic sampling procedure (carried out by an SME panel), and a representative sample of critical tasks was left [6].

In a similar effort, we incorporated questions in our tool to take into account tasks that were deemed important to the ship's operation—questions about frequency, complexity, and difficulty—along with other questions we felt were relevant (see appendix A). We made these changes after discussion with experts at Great Lakes training school, members of the fleet, and NETC.

Thus, we incorporated into our tool questions from [6] (e.g., questions asking about frequency, criticality, and difficulty), questions relating to learning decay assessment [1], and additional questions relevant to A-school training and subsequent skill use in the fleet. We used the tool to select the critical skills for which performance

tests could be developed. The ultimate goal was to develop a method of evaluating whether skills had indeed been forgotten and how schoolhouse training transfers to fleet performance; again, choosing the appropriate skills to test was the first step.

Outline of the current method

Our process consisted of the following steps that finally resulted in determining the most important skills to test for performance deficits:

- We determined what initial apprentice-level skills Sailors in a particular rating need to perform.
- From this list, an SME panel determined which initial skills are linked to ATT/A-school curriculum.
- With this further reduced list, the same SME panel rated each skill using questions in our tool that was developed to evaluate skill acquisition and decay.

Method

Measures

To test our assessment tool, we first focused on three Navy ratings: IC, EN, and MM. We created a Microsoft Access tool for evaluating skill acquisition and decay that was administered to a group of SMEs for each Navy rating. The tool uses apprentice-level occupational standards as the starting point for the domain of skills used by E3s and E4s (because this study is looking at initial skill training out of A-school, we were concerned with only these paygrades). To better focus the panel's evaluation of skills to those trained in ATT/A-school, and those expected to be used by an apprentice in the fleet, the panel was asked three initial questions (see table 1), a first step in paring down our list of occupational standards. If the answer to any of these questions is "no," the skill is not evaluated further.

Thus, our tool consisted of three initial filtering questions, questions asking about skill characteristics, and two sets of questions relating to skill decay—the first set adapted from the Army skill decay scale and a second set developed for the current effort. The skills that were tied to ATT/A-school curriculum were then evaluated on these questions by the SME panel.

Filtering questions

Table 1 lists the three filtering questions in our tool.

Table 1. Filtering questions asked of SME panel

Filtering question	No further evaluation if answer is
Is apprentice expected to use skill within 2 years of completing A-school?	"No"
Where was this skill initially introduced?	"On the Job (OJT)," "C-school"
Can task successfully be performed without C-school?	"No"

Skill characteristic questions

If the occupational skill remained after this first screening, the panel continued to answer questions about the skill. These additional questions follow:

- How important is the skill to ship's operation?
- What is the frequency of use?
- How much time is needed to get up to speed?
- When is the skill initially used on the ship?
- When should performance be assessed on the job, for meeting A-school standards and also for mastery?
- Is the task performed as a team?
- How much assistance is needed before the skill is performed independently?

We anticipated that knowing the answers to each of these questions for a given skill would enable an SME panel to weight each skill appropriately based on these characteristics and to select a subset for performance testing.

Likelihood-of-decay questions

Other questions that relate to skill decay were adapted from the ARI study and include the following factors:

- Presence and quality of job aids
- Number of steps required to perform task
- Mental requirements
- Time requirements
- Difficulty of facts
- Motor control requirements

- Likelihood of this skill to show a performance decrement relative to the level achieved in A-school after 3, 6, or 12 months of *not* using this skill.

Responses to this section yielded a raw skill decay score, which was used to rank each skill in terms of relative skill decay. Together with questions from the first section, the SME panel weighted each skill according to likelihood of decay. The panel also took into account the importance to ship operation, frequency of use, and so forth. We wanted a separate estimate of the likelihood of skill decay from the SMEs, to both validate the skill decay score and identify the contribution of its components to a measure of overall decay. The last bullet in the foregoing list was included for this purpose. Appendix A presents a more detailed description of the tool.

Using SME panels to evaluate skill decay

NETC convened three different panels representing the IC, EN, and MM rating communities. Panel members were senior civilian (GS) and enlisted personnel from NETC and other training commands, each with 20-plus years' experience working in their rating, teaching in A-school, with responsibilities for curriculum design. The CNA study team participated in the IC panel. The MM and EN panels were then conducted solely by NETC.

Panel members were asked to select only those occupational standards corresponding to skills currently taught in ATT or A-school and used during the first 2 years after reporting to the fleet. As table 2 shows, this process considerably narrowed the list of occupational standards/skills that the panel evaluated.

Table 2. Numbers of occupational standards evaluated

Rating	No. of published standards	No. overlapping with ATT/A-school curriculum
IC	350[a]	51
EN	603	23
MM	662	25

a. IC panel members had developed a draft of proposed E3–E4 occupational standards that were used in the evaluation. The list was reduced to 56 from the original 350.

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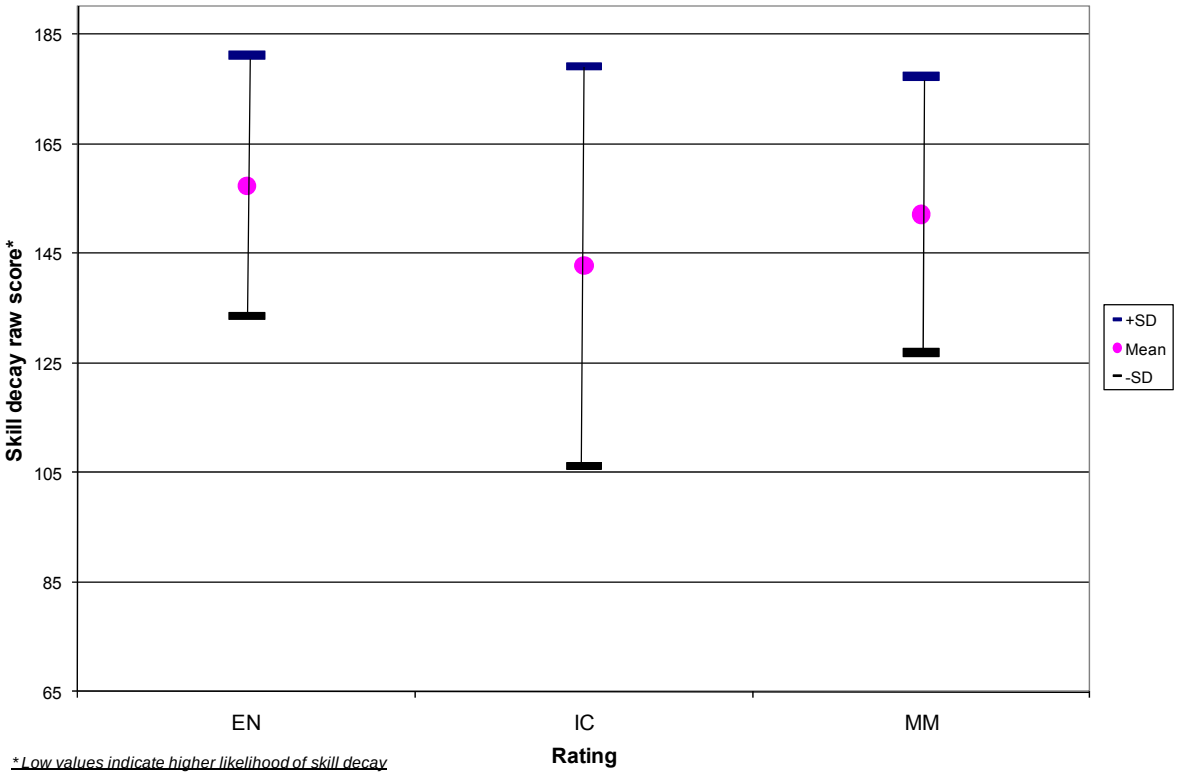
Analysis: Developing a model to measure skills likely to decay

The analysis focused on identifying those skills likely to decay and what those skills have in common. A secondary purpose of the analysis was to calibrate the skill decay scale and its components against the SMEs' estimates of the probability of decay over time of the same skills evaluated by the skill decay scale items.

We begin by examining the distribution of the skill decay scale scores across the three ratings. The data in figure 1 are based on the SME evaluations on questions adapted from the skill decay scale.

Figure 1. Means and variances of skill decay scale scores by rating



The skill decay scale ranges from 65 (greatest amount of skill decay, or conversely, the least amount of skill retention) to 187 (no decay, or maximum retention). The data show that the IC skills examined are more likely to decay than those of the EN or MM skills, and they have a wider range of skill decay scores.

Our second set of questions on skill decay asked SMEs to rate the likelihood of decay, for a given period of nonuse (at 3, 6, and 12 months), using a 3-point scale: not likely (scored as 0), somewhat likely (1), or very likely (2). We used these questions to both validate the skill decay score and identify the contribution of its components to a measure of overall decay. We established three likelihood-of-decay variables for each time period (3, 6, or 12 months), using a 2-point scale, with 0 indicating not likely and 1 indicating either somewhat or very likely.

To explore the relationship between the skill decay scale and the independent assessment of skill decay provided by the SMEs, we estimated the probability of skill decay for each point along the skill decay scale, using logistic regression for a given period of nonuse (at 3, 6, and 12 months) (figure 2). For example, a score of 120 on the skill decay scale is associated with a .40 probability that the associated skill will be very likely to decay if not used in 6 months.

We evaluated the correlations between the skill decay scale and the SMEs' additional estimates of skill decay (table 3). Skills that were rated as very likely to decay after 6 months of nonuse had the highest correlation with the skill decay scale. However, we observe a pattern of increased skill decay with nonuse, but only for the IC rating (figure 3). This 6-month rating, having the highest correlation (shared variance) with the skill decay scale, tends to provide the best discrimination along the range of the scale. We use this measure as our best estimator of skill decay for the three ratings in the ensuing analyses.

Figure 2. Estimated probability of decay from skill decay scale score (all ratings combined)

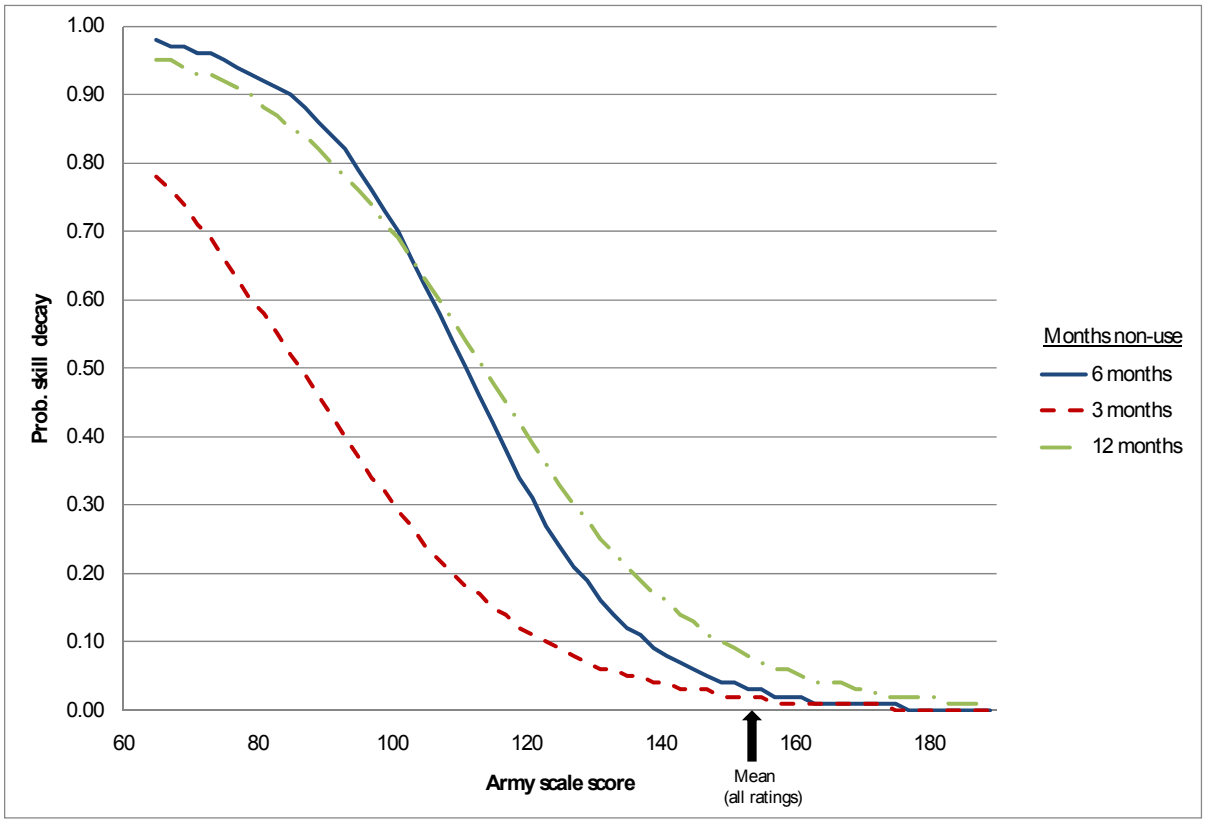
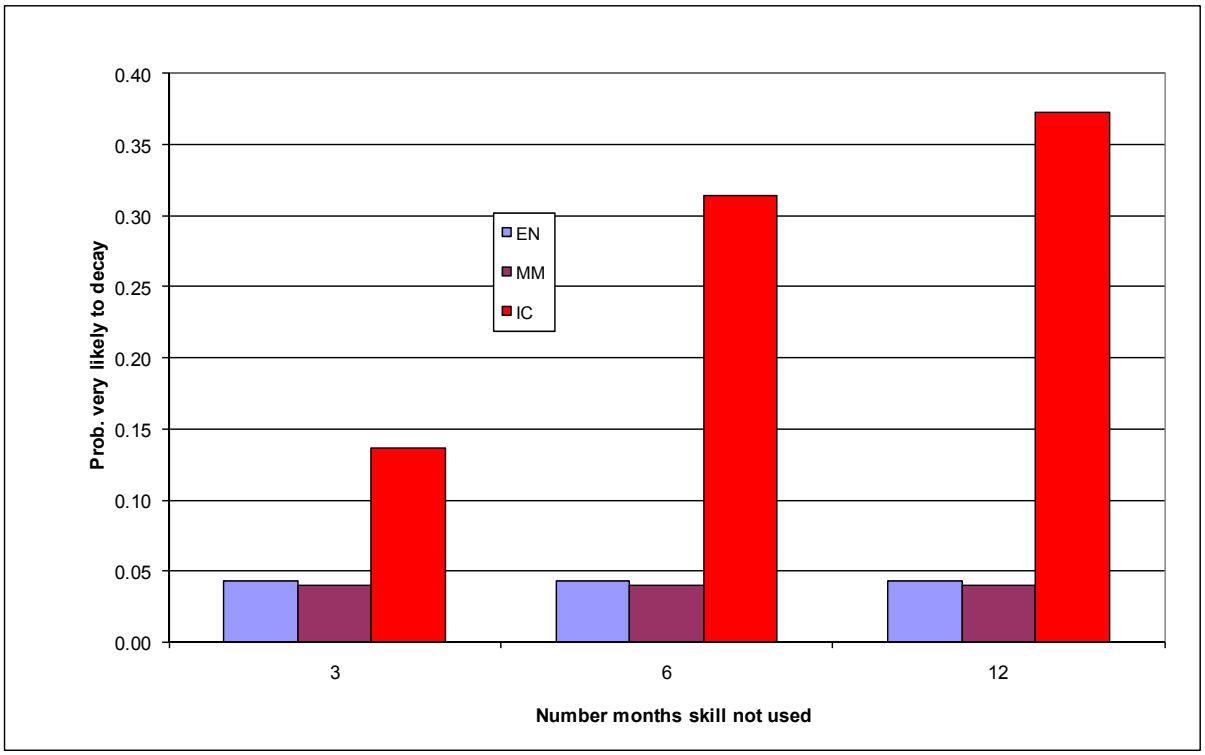


Table 3. Correlations of skill decay scale scores and SME judgments of likelihood of skill decay (all ratings combined)

Measure	Point-biserial correlation
3 months of nonuse (very likely)	-0.50
6 months of nonuse (very likely)	-0.70
12 months of nonuse (very likely)	-0.65

Note: Low scores on the skill decay scale indicate greater likelihood of skill decay with nonuse.

Figure 3. Rating differences in estimated probability of decay from nonuse



Next, we analyze the influence of the skill characteristic questions on learning decay and transfer that were included after our interviews with experts from Great Lakes, NETC, and previous studies conducting performance test development. Table 4 shows the skill characteristic questions that we examined; only the first four were significantly related to the likelihood of decay after 6 months of nonuse. In table 4, we also specify the variable parameters leading to a higher likelihood of decay.

Table 4. Additional job variables that are predictive of a higher likelihood of skill decay

Variable	Effect on skill decay
Where first introduced	Introduced in ATT, more likely to decay
Frequency of use	Less frequently used, more likely to decay
Months to get up to speed	More time to get up to speed, more likely to decay
Mission importance	Important, more likely to decay
Team vs. individual	No effect on skill decay
Month first used on job	No effect on skill decay

Figure 4 shows the probabilities of decay associated with these factors. The probabilities were measured as the proportion of observations (occupational standards) that the panels indicated were very likely to decay after 6 months of nonuse, for a given value of the variables shown in table 4. For example, all (100 percent) of the occupational standards that were used on the job less than once a year were estimated by the panels as very likely to decay. Note that the number of occupational standards associated with the other response options to the additional variables varied widely. Not surprisingly, those skills that are used most infrequently were the most vulnerable to decay.

Figure 4. Effect of additional job variables on skill acquisition and decay (all ratings combined)

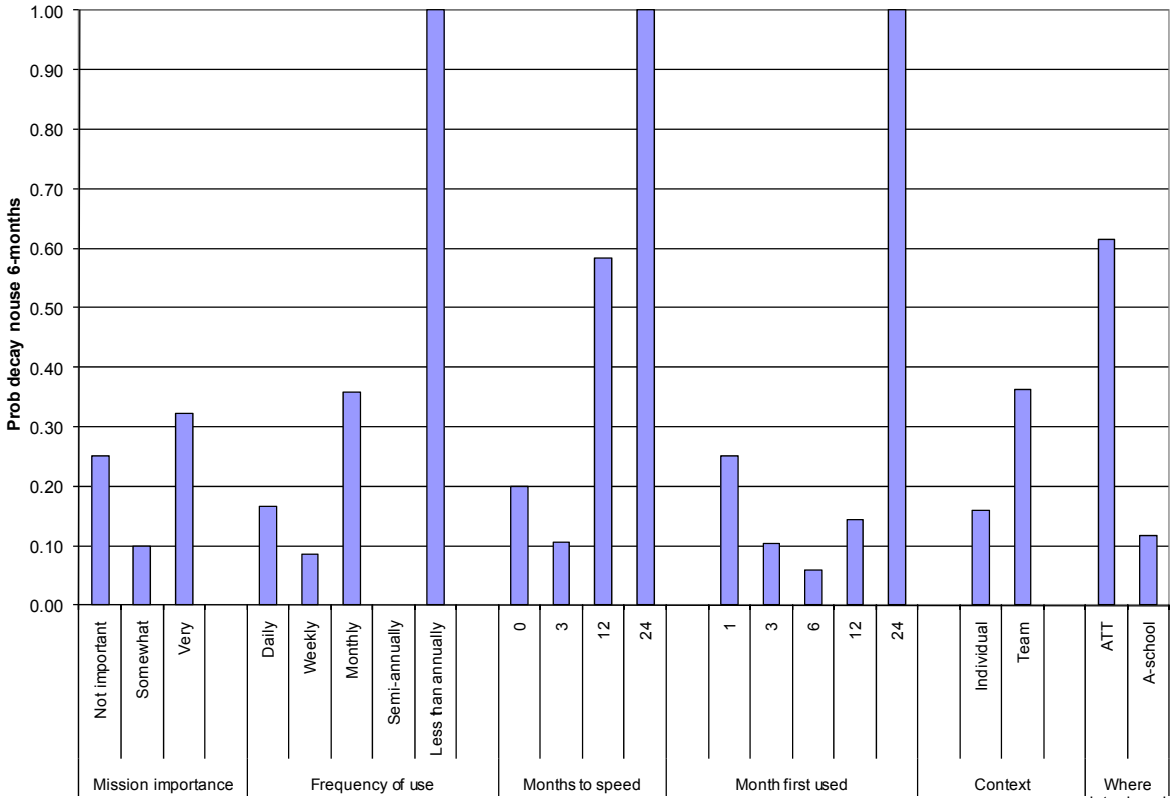
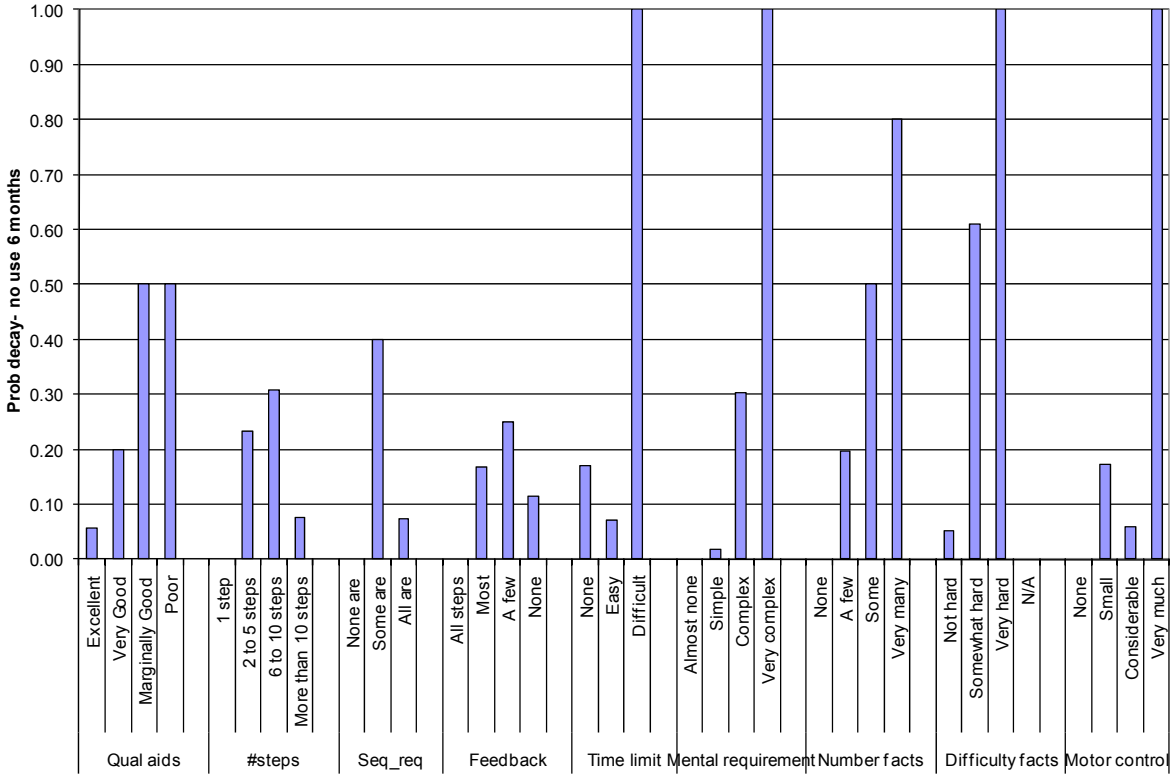


Figure 5 shows similar probabilities of decay as figure 4, but here we look at the skill decay scale components. Earlier, we showed that there is a strong relationship between the skill decay scale score and the SMEs' evaluation of the likelihood of skill decay. In this section, we examine how the individual components of the scale relate to

the probability of decay (i.e., proportion of occupational standards estimated by the panels as very likely to decay, for a given attribute of the skill decay scale). For example, all occupational standards that SMEs evaluated as having complex mental requirements were evaluated as very likely to decay after 6 months of nonuse.

Figure 5. Effects of skill decay scale components on likelihood of skill decay



We performed a logistic regression to determine which of the measures from the skill decay scale (i.e., the skill decay scale components shown in figure 5) contribute significantly to the prediction of the SMEs' estimate of likelihood of skill decay. Based on the statistical significance of the coefficients, the regression results suggest that skills with a higher likelihood of skill decay:

- Have stringent time limits
- Have great mental requirements
- Have difficult and large numbers of facts
- Have large motor control requirements.

The final step in the analysis was to develop a composite predictor of skill decay, using components of the skill decay scale and the additional job variables that had statistically significant (that is, they have a less than 5-percent likelihood of being correlated due to chance) correlations with the SMEs' independent estimate of the likelihood of skill decay. The results are shown in table 5.

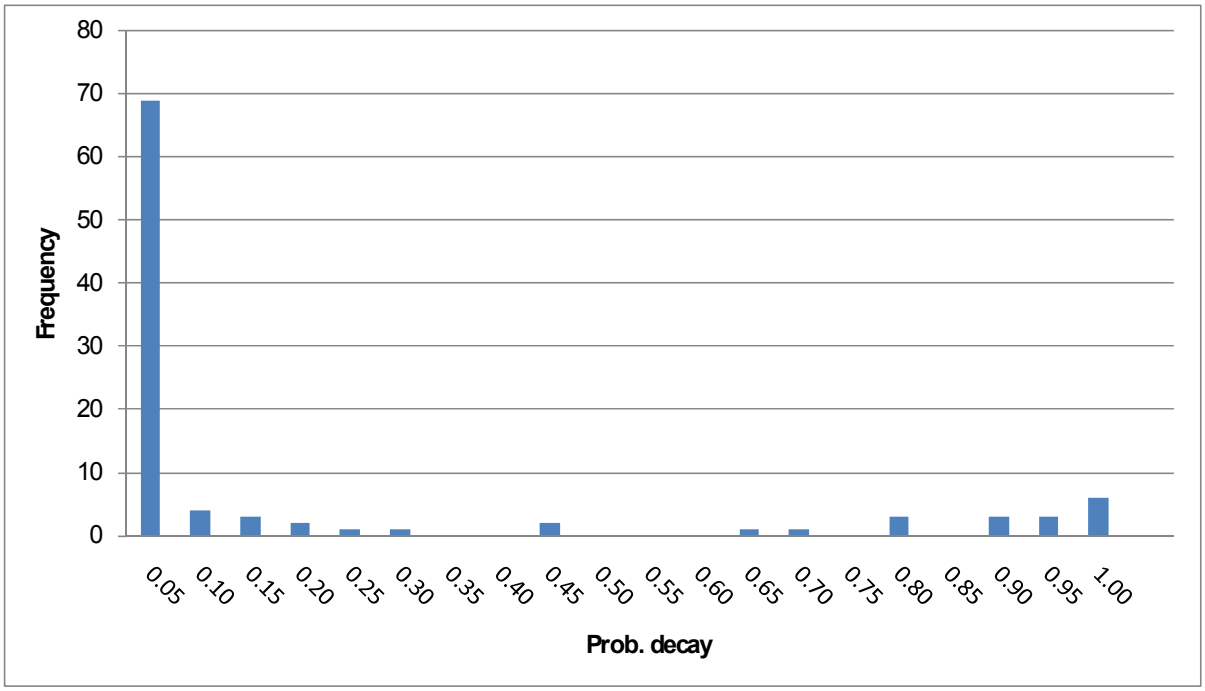
Table 5. Variables used for composite predictor of likelihood of skill decay (all ratings combined)

Nonuse 6-months predictor	p	Leads to decay when
Mental requirements*	0.00	Stringent mental requirement
Introduced in A-school	0.01	Introduced in ATT
Number of steps*	0.04	Large number of steps
When first used	0.06	Skill used late after reporting
Difficulty	0.07	More difficult tasks
Time requirements*	0.03	Stringent time requirement
Constant	0.10	

*Item from skill decay scale.

Figure 6 shows a frequency distribution of the estimated probabilities of skill decay for the 99 task/standards evaluated by the panels, using the logistic regression equation shown earlier. Note that 69 of the skills had a probability of decay of .05 or less.

Figure 6. Frequency distribution of estimated probabilities of decay after 6 months nonuse (all ratings combined)



In table 6, we identify the occupational standards associated with the skills having probabilities of decay of .50 or greater if skill was not used for 6 months (see appendix B for all skill probabilities).

In general, we see:

- IC Technical Core Fundamentals are most vulnerable to decay with nonuse
- Few MM or EN skills top the list.

Table 6. Skills predicted most likely to decay with 6 months of nonuse (.5 or greater)

Predicted prob. decay	Rating/ standard	Occupational standard	Category
0.94	EN494	Perform Precision Mechanical Measuring	Mechanical Systems Operations
0.94	MM350	Perform Precision Mechanical Measuring	Mechanical Maintenance
1.00	IC14	Interpret Electronic Schematics	Technical Core Fundamentals
0.99	IC31	Perform Preventive Maintenance on Wind Speed and Direction Systems	Indicating Systems Maintenance
0.98	IC23	Perform Combat Systems Operational Sequencing System (CSOSS) for Casualty Operation	Technical Core Fundamentals
0.97	IC20	Troubleshoot Power Supplies	Technical Core Fundamentals
0.96	IC55	Perform Digital Logic Numeric Conversions	Technical Core Fundamentals
0.95	IC54	Troubleshoot Electromechanical (Synchro/ Servo) Systems	Technical Core Fundamentals
0.93	IC42	Troubleshoot Interior Communication Systems	Interior Communication Systems Maintenance
0.88	IC36	Test Interconnecting Cables and Connectors	Interconnecting Cables and Connectors Maintenance
0.88	IC37	Troubleshoot Interconnecting Cables and Connectors	Interconnecting Cables and Connectors Maintenance
0.87	IC24	Perform Combat Systems Operational Sequencing System (CSOSS) for Casualty Response	Technical Core Fundamentals
0.78	IC40	Perform Preventive Maintenance on Interior communication Systems	Interior Communication Systems Maintenance
0.76	IC16	Operate General Purpose Test Equipment	Technical Core Fundamentals
0.76	IC18	Troubleshoot Direct Current (DC) Circuits	Technical Core Fundamentals
0.67	IC35	Perform Preventive Maintenance on Interconnecting Cables and Connectors	Interconnecting Cables and Connectors Maintenance
0.62	IC6	Perform Preventive Maintenance on Alarm, Safety and Warning Systems	Alarm, Safety and Warning Systems Maintenance

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Conclusion

The Navy does not currently measure if initial skill learning decays or if schoolhouse learning transfers to the fleet. In this effort, we developed a tool as a first step in uniformly measuring learning decay and transfer. Our SME tool was integral in paring down the list of Navy skills to determine the important ones to focus on for issues of learning decay and learning transfer. To ensure that we chose the correct skills, we included questions that would capture the important characteristics of these initial skills, aspects of their training, and their subsequent performance and decay in the fleet.

We obtained judgments from SMEs on the initial skills that were tied to A-school training for three ratings (IC, EN, and MM). From these data, we were able to determine a composite predictor of the likelihood of skill decay. This type of composite will enable the Navy to anticipate the amount of decay for initial skills. In general, we found very few skills showing a high likelihood of decay among those examined for the EN and MM ratings. More IC skills were found to have a high probability of decay, and, within these IC skills, most of these skills belonged under the category of Technical Core Fundamentals. This may indicate a common family of skills learned in A-school/ATT that could all require similar training remediation. It is possible that the differences between ratings could be caused by differences in the way the panels were conducted, or in the composition of the EN/MM panels, which may have used less stringent criteria to rate the skills than the IC panels. However, without further data, we cannot tell if this was the case.

Our tool can help determine the skills that need to be tested for performance. The next step for the Navy should be to establish performance tests to see if these key skills show decay. The results of the performance tests can be used to correctly allocate additional resources to provide training interventions for skills that do show decay. For instance, if skills that are predicted to have a high likelihood of decay do show a high amount of decay, they should be a high priority for training remediation.

In conjunction with the administration of performance testing of key skills, additional background information should be collected on the Sailors being tested. This information can be factored into the performance testing process, to yield a diagnostic assessment of skill performance for these particular ratings. For example, knowing the aptitude of the Sailor to learn these skills (as measured by ASVAB scores), A-school final grades, when the Sailor reported for duty, how long it took for the Sailor to perform the skill in question, and training background should all be controlled for when evaluating performance in the fleet for a given skill. Knowing how these skills are taught in A-school/ATT and how they are subsequently performed on the job immediately upon reporting to the fleet will determine whether transfer of initial learning took place; therefore, this should also be taken into account.

In addition, performance tests of skills that are important for the fleet, but are not predicted to have a high amount of decay, should be developed. Such tests would be used to measure learning transfer or initial skill learning. If a skill is not predicted to have a high likelihood of decay, and we still find performance detriments, this would possibly indicate a lack of initial learning.

After determining which skills are lacking in performance, and under what conditions, the results of the evaluation can help in suggesting a method of remediation. Knowing how to focus refresher training better can augment or better inform what the fleet already does in terms of OJT and informal training by lead petty officers. The remediation method that is developed will need to be tailored, based on the type of skill. Three types of deficient skills could need remediation:

- Skills that show decay but were not predicted to—that is, skills that did not transfer/were never learned
- Skills that show minimal decay and were predicted to
- Skills that do decay and are predicted to have a high likelihood of decay.

Skills that do not exhibit transfer or were never learned in A-school may necessitate changes in ATT/A-school curriculum. Skills predicted to have minimal decay may require minimal refresher or

additional training since refresher or increased training has been found to be effective in preventing decay for many skills [3, 4, 5]. Two types of training could be done for skills that we predicted to have a high likelihood of decay and do decay—either increased A-school training, closer to when Sailors reach the fleet, or refresher training once Sailors reach the fleet.

Because we conducted this analysis on only three ratings, we cannot be sure that the same composite predictor used here is appropriate to use for other ratings. Therefore, this same analysis should be done on other ratings to validate and extend the findings from our study. Performance tests should be developed to determine what skills will require additional training resources.

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Appendix A:

Skill Acquisition and Decay Evaluation Form User's Guide

BACKGROUND

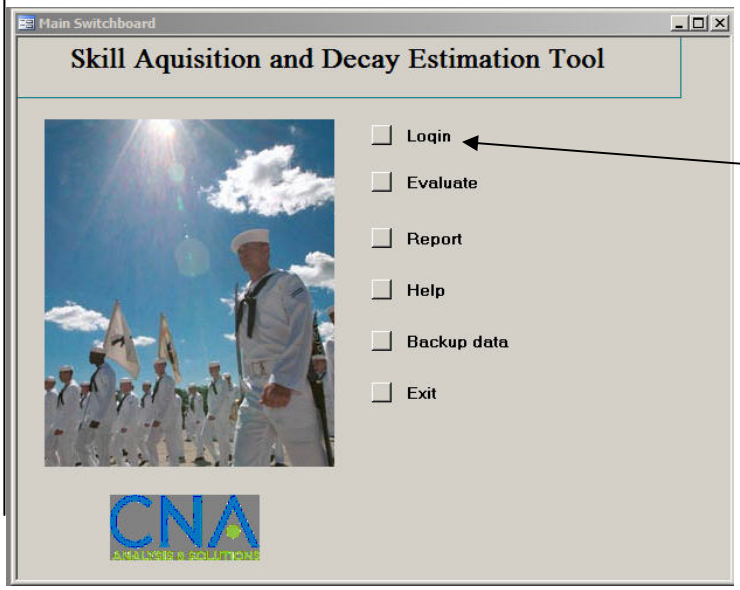
This tool was developed by CNA to aid in identifying apprentice-level Navy Occupational Standards that may show decay due to nonuse in the Fleet. This tool is also useful in identifying skills that were never acquired during A-school training. We use the terms "occupational standard" and "task" interchangeably in this help file and in the evaluation process.

GENERAL INSTRUCTIONS

Important note: The "tool" is a Microsoft Access application that uses macros. It is necessary to allow it to use these macros. When prompted to use macros, please choose the option to do so.

There are five steps: Login, Evaluation, Reporting, Backing-up data, and Exiting.

Login

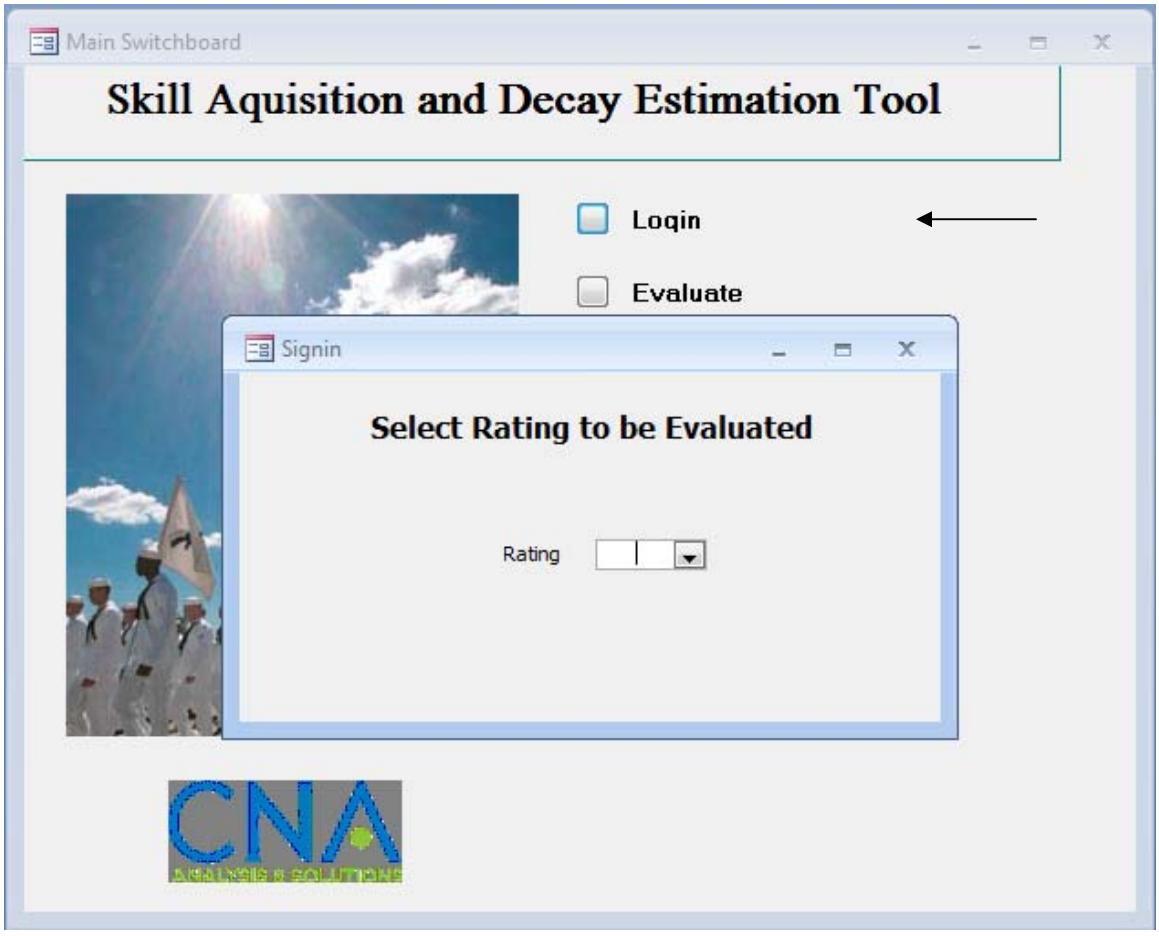


Selecting **Login**:

The tool integrates data for a number of ratings.

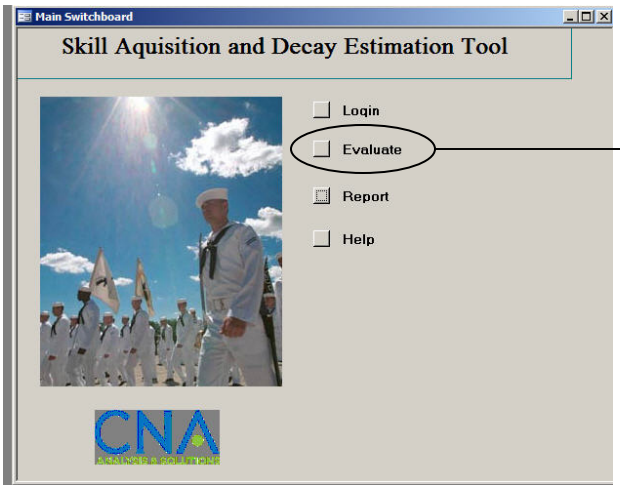
1. Click in the box to the left of the Login caption. This will bring up a window for selecting the rating to be evaluated.

2. Click on the down arrow. This will display a list of ratings that can be evaluated. Click on the rating of interest. The “signin” window will automatically close.



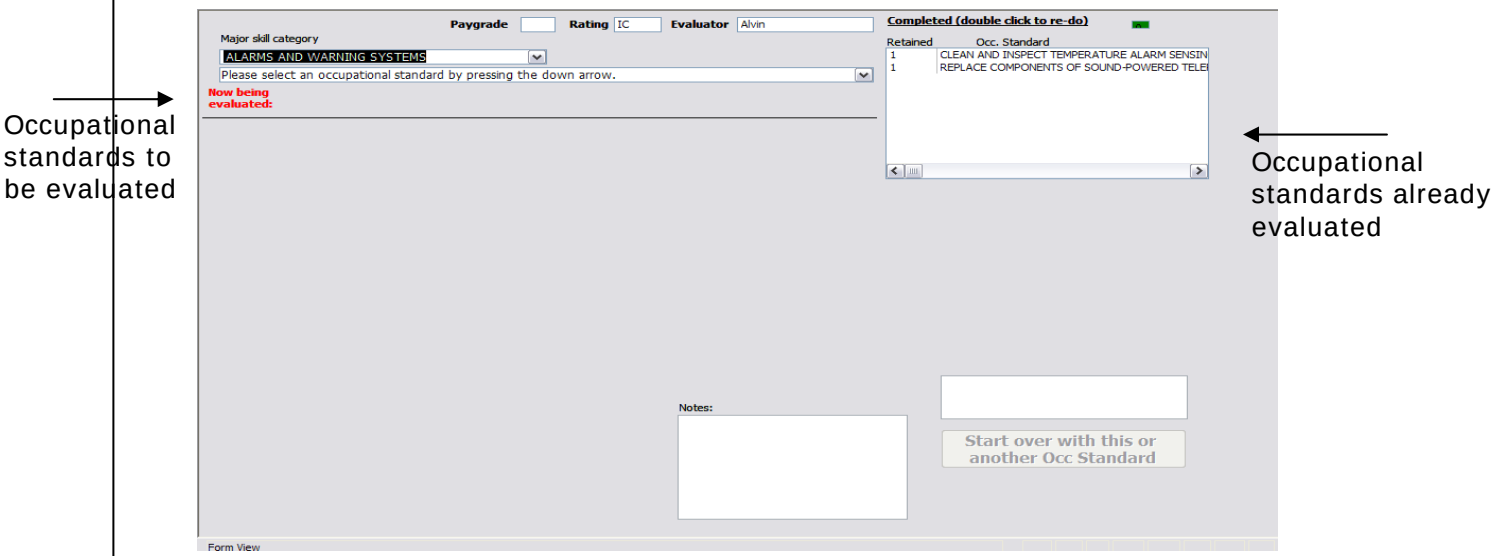
Evaluate

After you login, click on the evaluate button.



First select a "Major Skill Category" of the skill you want to select, then select an Occupational standard from the drop-down box in the **upper left to evaluate.**

Standards that were already evaluated will show up in the box to the **immediate right.**



A "1" in the retained column of the "completed" list means this skill was relevant and evaluated on all questions, while a '0' indicates this skill was not relevant for evaluating acquisition and decay of skills learned in A-school.

NOTE: to start occ standard over/re-evaluating:

Re-evaluate: If you want to re-evaluate a standard that you have already evaluated, double-click on the Occ Standard name in the "completed" list on the **top right** to re-do. When you double click on an item in the "done" panel, it will ask if you want to see previous responses to that standard. If you answer "yes," a report for just that standard is shown. While the report is on the screen, you are asked if you want to re-do. Click on "yes" if so. Note that you must manually close the report.

Start over: If you wish to discard information about the current occupational standard and start over with this standard, or skip over this occupational standard and evaluate another, click the "Start over with this or another Occ Standard" button.

Questions:

You will be asked to evaluate 12 aspects related to each task. Your response to the first 3 questions will determine whether you will be asked to further evaluate the task. After these first 3 questions, if this task is still relevant, then the remaining questions will be shown sequentially.

A description of the questions is below:

1. Relevance. If this is a task an apprentice-level Sailor is likely to use within a two-year period after completing A-school, answer "yes," otherwise, "No."

Answering "no" will categorize this task/Occ. Standard as being outside the scope of the evaluation.

2. Where initially introduced. Where was this skill first **introduced** to the Sailor? Note that this does NOT mean, "where was this skill **mastered,**" although these two may be the same.

Choose either ATT (apprentice technical training, A-school, OJT (on-the-job training), or C-school. Answering "C-school" or OJT will categorize this task as being outside the scope of the evaluation.

3. Can task be performed successfully without C-school training. Answering "no" will categorize this task as being outside the scope of the evaluation.

4. Importance to the ship's operation.

Very important implies that mission completion could be compromised if the task could not be performed successfully. For example, repairing a damaged ship's gyroscope.

Not important implies little or no consequences if the task cannot be performed. For example, making an entry in a routine maintenance log.

Somewhat important would imply this standard's importance is in between Very and Not Important.

5. Frequency of use. How often is the task employed?

6. Time getting up to speed. How long does it take to perform the task successfully, given a consistent opportunity to do it?

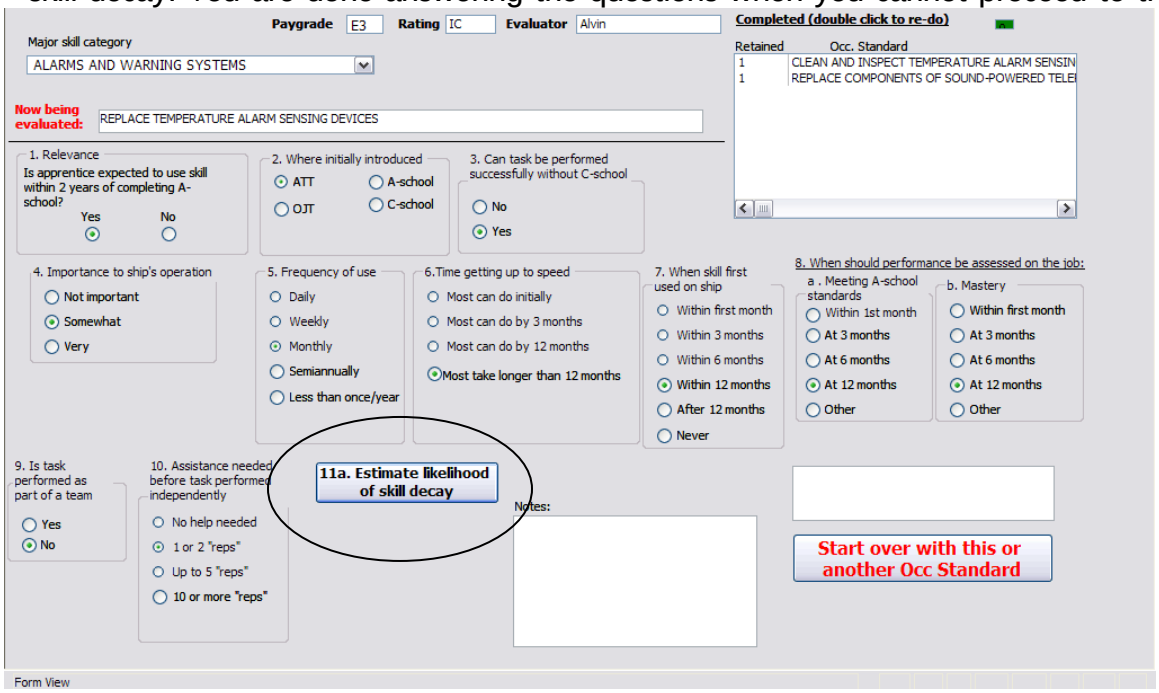
7. When skill first used on ship. Apprentices just out of A-school may not be asked, or have the opportunity to perform the skill(s) associated with a particular occupational standard. Please indicate when, after first reporting on board, an apprentice would be asked to use the skill.

8. When should performance be assessed On the Job (OTJ). We would like to be able to assess performance of the skill(s) associated with the standard. This could be done from two perspectives: performance expected at completion of A-school, and performance after the apprentice has gained experience using the skill on the job, and a higher level of performance may be expected (mastery). The first part of the question (8a) asks for the appropriate time to test for A-school level performance, and the second part (8b) for *skill mastery*.

9. Is the task being performed as a team effort. Some tasks may be performed as a team effort. We wish to identify tasks where successful performance of an apprentice is dependent on the correct inputs and/or assistance from others. We want to distinguish between tasks that cannot be performed alone vs., those where it helps to have the assistance of another person. If the other person does not need to be knowledgeable as an IC, but simply provides assistance (such as, "read this number to me"), ***do not*** consider performing the task as requiring a team effort

10. Assistance needed before task can be performed independently. Some tasks require supervision/assistance from others before they can be performed independently. Please identify the number of repetitions, or "reps" (times practiced under supervision), required for independent performance.

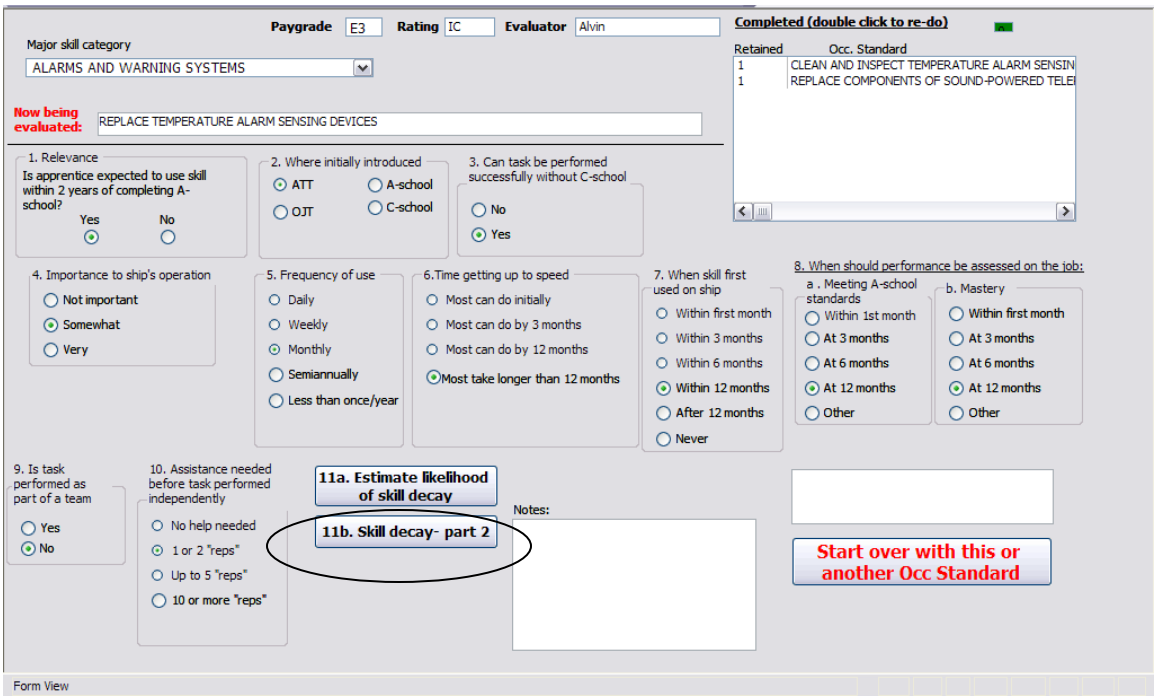
11a. Estimate likelihood of skill decay. Clicking on this button will initiate a series of 10 questions adopted from a tool developed for the Army to estimate likelihood of skill decay. You are done answering the questions when you cannot proceed to the



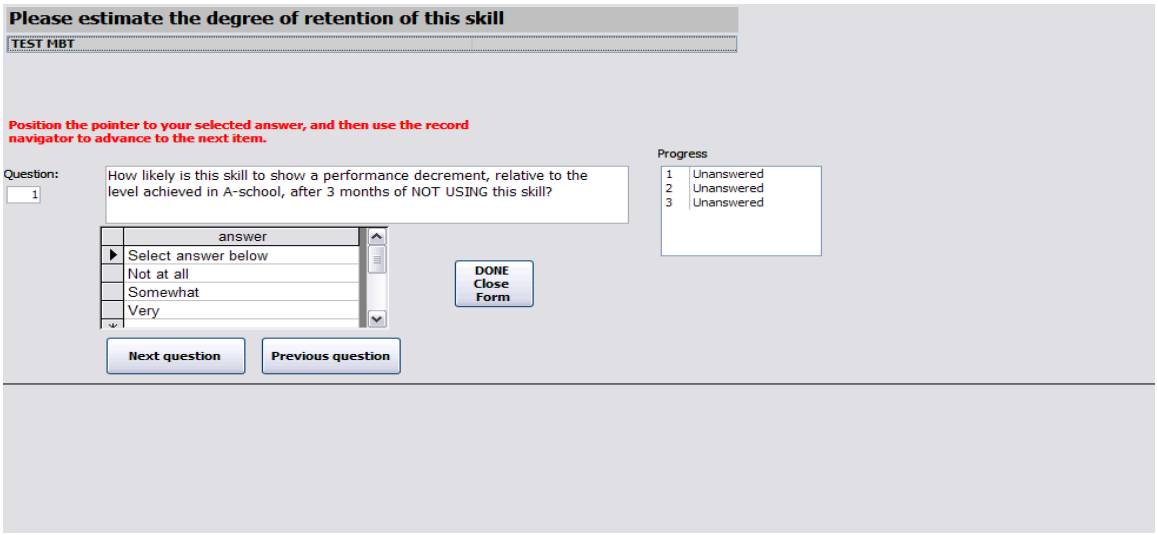
next one. Exit and then go on 11b. This will save your responses for question 11a.

**A separate HELP menu is available for more information on these questions.

11b. Skill decay (part-2) Clicking on this button will initiate three questions about measuring the effects of skill acquisition and decay on task performance in the Fleet. These questions ask about skill decay relative to A-school performance levels, when skills are ***never performed*** on the job.

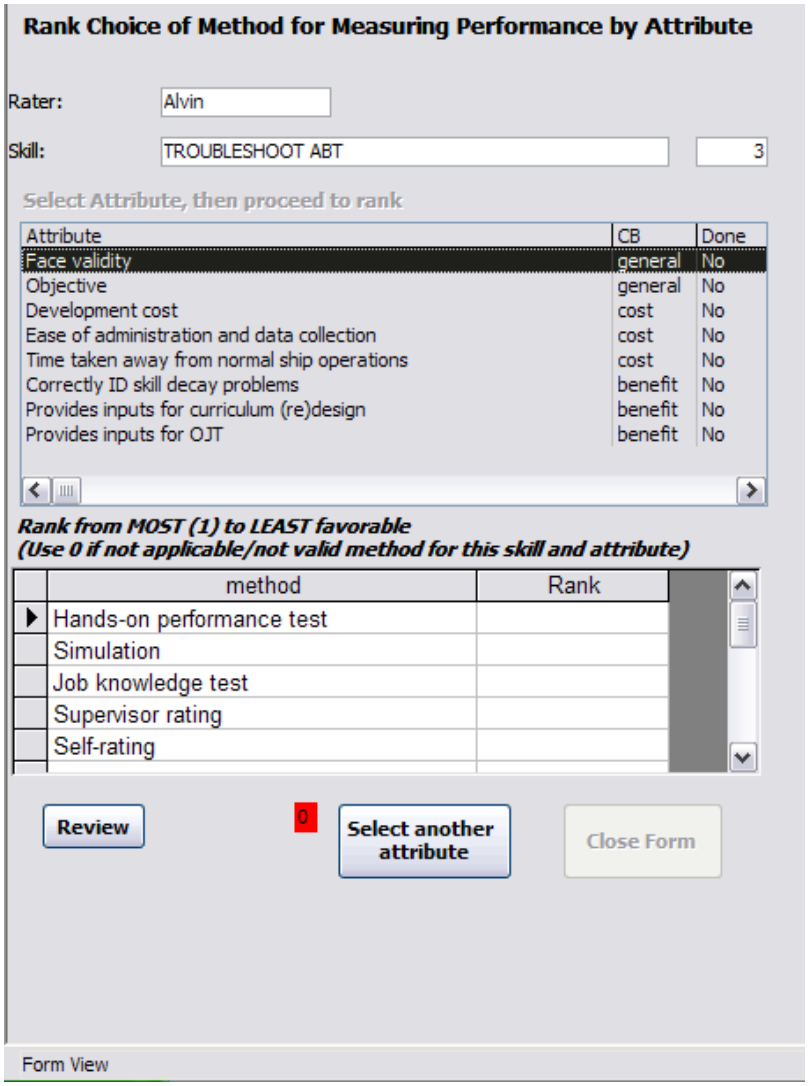


When you are done with all 3 questions, press “DONE Close Form” to save your answers for question 11b and return to the main screen.



Now, proceed to question 12.

12. Measuring performance. Here, you are asked to evaluate the efficacy, costs, and benefits of using five different techniques for assessing skill performance in the Fleet. The evaluation procedure involves ranking each of the techniques on several cost/benefit attributes (shown in the "CB" column).



Please follow these steps.

1. Click on one of the attributes shown in the list box at the top of the form. This will cause the list to turn gray and a grid showing the measurement techniques and a column for a rank to appear.

2. Enter a rank-value next to each technique, with "1" being your top test method choice with respect to the attribute. For example, if you believe that a hands-on test has the greatest face validity, assign it a rank of 1. You may assign the same rank to techniques if they are "tied" with respect to the attribute. If you feel the technique is not applicable to the attribute, you should assign a 0 value as the rank.

3. After ranking each attribute, click the "save, then next attribute" button.

4. After the last ranking the techniques for the last attribute, you may click the "close form" button.

The techniques are:

a. Hands-on tests. These tests require that the Sailor perform a series of standardized tasks, often using operational equipment, to demonstrate meeting the underlying occupational standard. An example of a hands-on performance test would involve having the Sailor diagnose and fix a faulty electric circuit, using test equipment and appropriate tools specified for the maintenance. These tests can be expensive to develop and may require a considerable amount of time to administer, and could involve safety issues. However, they do tend to give the most reliable estimate of job performance.

b. Simulation. There are several types of simulations of hands-on tasks that have been used to assess proficiency. One variety uses a computer simulation of a hands-on job situation to demonstrate proficiency. For example, computer-based simulations have been used to generate sonar grams, which the examinee must resolve to identify the nature of an acoustic signature. Less sophisticated simulations have been developed for testing performance. One such technique is the Q-sort, where examinees are asked to group images/pictures on the basis of similar functionality. This could be applied to grouping components belonging to the same piece of equipment the Sailor may have to assemble or disassemble as part of a maintenance or troubleshooting task. This could be administered as either a computer-based test, or using pictures of the components pasted on index cards.

c. Self-ratings. Apprentices are asked to do a self-appraisal of how well they can perform particular behaviorally specified tasks.

d. Supervisor ratings. Supervisors are asked to evaluate performance of behaviorally specified tasks.

e. Job knowledge tests. These tests could be either paper-and-pencil multiple choice or computer-administered multiple choice. A more sophisticated variety of the computerized test is an adaptive test that determines which items to present, based on previous responses (more difficult items follow a correct response, until an incorrect response occurs, thus establishing a knowledge level).

When you are done with this section, press "Close Form," which will save your responses to question 12 and return to the main screen.

Attributes of these types of performance tests are summarized in table 7 below.

Table 7. Attributes of Performance Evaluation Tests

Attribute	Hands-on test	Simulation	Job Knowledge Test	Supervisor rating	Self-rating
Objective	Yes	Yes	Yes	Moderate	Moderate
Face validity[1]	Yes	Yes	Moderate	Moderate	Moderate
Inexpensive to develop?	No	No	Moderate	Yes	Yes
Ease of admin. and data collection	No	No	Moderate	Yes	Yes
Time taken away from ship ops	Considerable	Considerable	Moderate	Minimal	Minimal
Correctly ID skill decay	Yes	Yes	Moderate	Somewhat likely	Somewhat likely
Provide inputs for curriculum design	Yes	Yes	Yes	Somewhat likely	Unlikely
Provide inputs for OJT	Yes	Yes	Yes	Yes	Unlikely

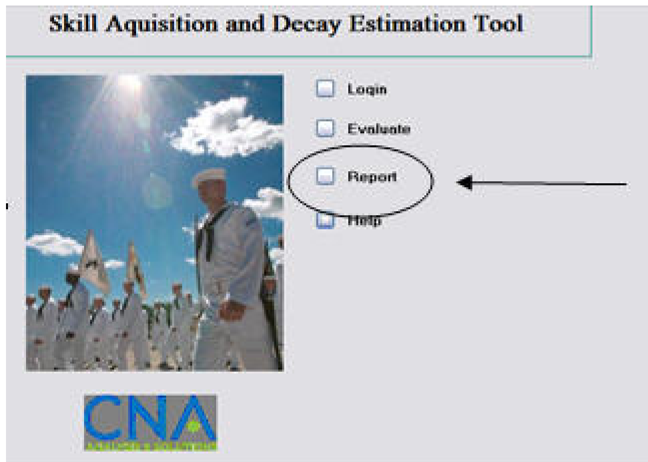
[1] The test "looks like" it is going to measure what it is supposed to measure.

14. Evaluate Another:

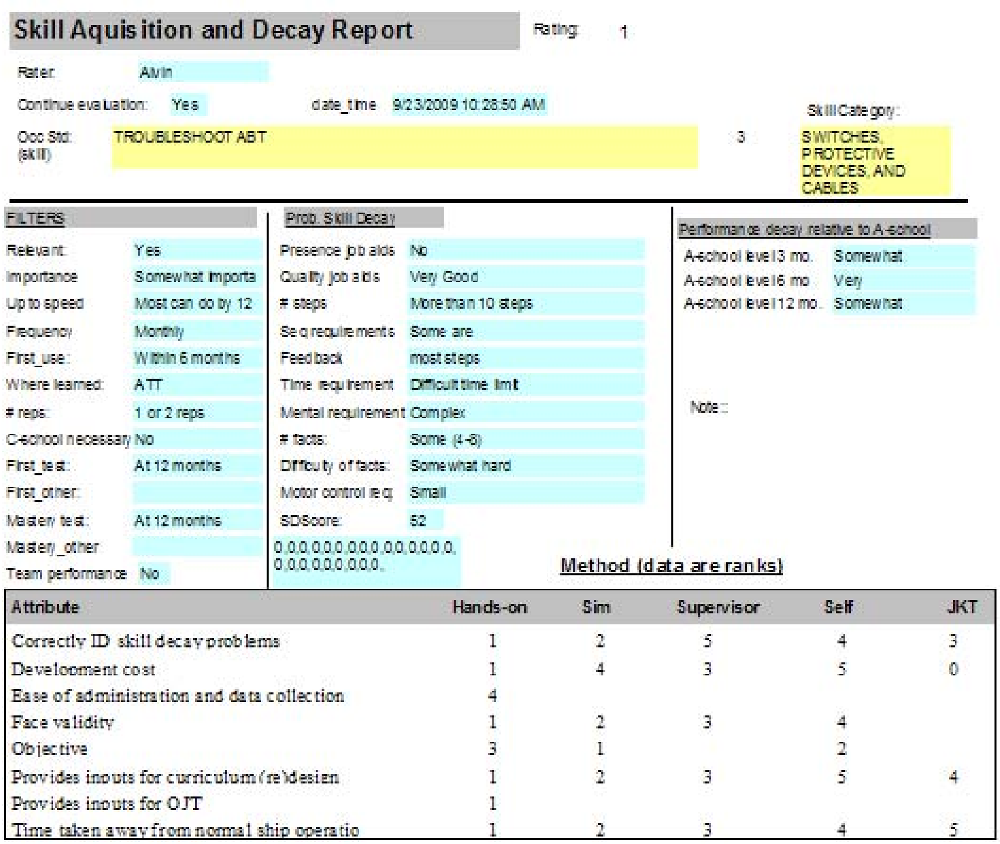
After evaluating an Occ standard, clicking on this will take you back to the main screen and allow you to select another Occ standard to evaluate.

Report

Clicking on the “Report” button will produce a summary of the responses to the survey questionnaire for the person who is logged in. This can be printed out or formatted into an Excel spreadsheet.



A sample report is shown below.



Skill Aquisition and Decay Report Rating: 1

Rater: Alvin

Continue evaluation: Yes date_time: 9/23/2009 10:28:50 AM

Occ Std: (skill) TROUBLESHOOT ABT 3 Skill Category: SWITCHES, PROTECTIVE DEVICES, AND CABLES

FILTERS		Prob. Skill Decay	
Relevant:	Yes	Presence job aids	No
Importance	Somewhat importa	Quality job aids	Very Good
Up to speed	Most can do by 12	# steps	More than 10 steps
Frequency	Monthly	Seq requirements	Some are
First_use:	Within 6 months	Feedback	most steps
Where learned:	ATT	Time requirement	Difficult time limit
# reps:	1 or 2 reps	Mental requirement	Complex
C-school necessary	No	# facts:	Some (4-6)
First_test:	At 12 months	Difficulty of facts:	Somewhat hard
First_other:		Motor control req	Small
Mastery test:	At 12 months	SDScore:	52
Mastery_other		0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0, 0,0,0,0,0,0,0,0,0,	
Team performance	No		

Performance decay relative to A-school	
A-school level 3 mo.	Somewhat
A-school level 6 mo	Very
A-school level 12 mo.	Somewhat

Note::

Method (data are ranks)

Attribute	Hands-on	Sim	Supervisor	Self	JKT
Correctly ID skill decay problems	1	2	5	4	3
Development cost	1	4	3	5	0
Ease of administration and data collection	4				
Face validity	1	2	3	4	
Objective	3	1		2	
Provides inputs for curriculum (re)design	1	2	3	5	4
Provides inputs for OJT	1				
Time taken away from normal ship operatio	1	2	3	4	5

Backup Data

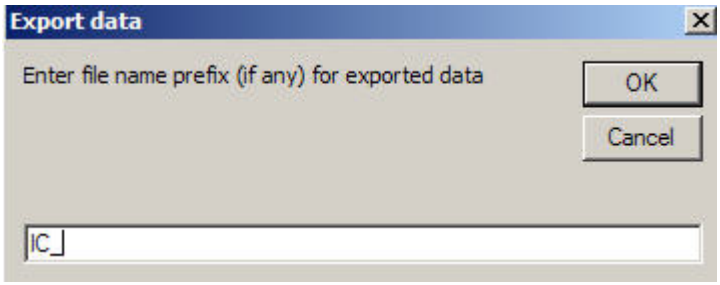
This button does three things:

1. Data tables can be exported to an external Access database for archival purposes.

2. You can use this process to export the data shown in the Report to an Excel spreadsheet.

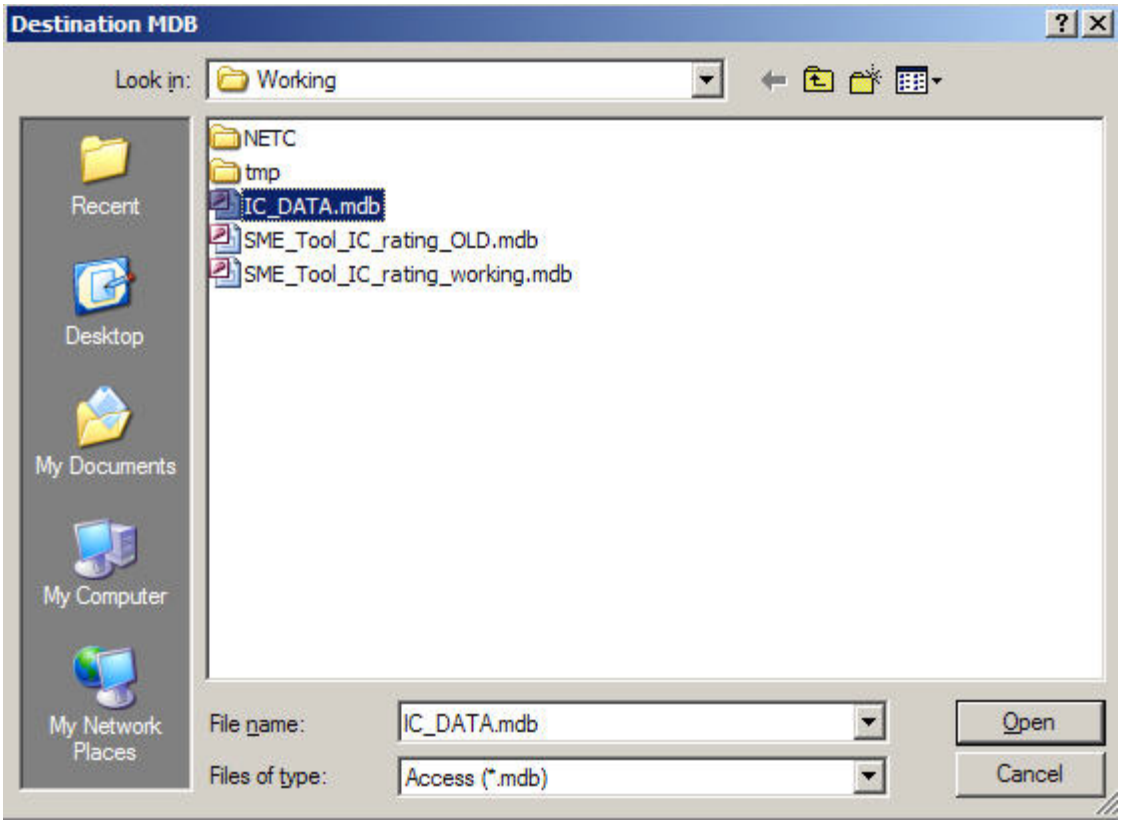
3. You can erase all of the data collected for this rating (***not recommended***).

Data tables from the existing evaluation can be exported to an existing Access database. When "Backup Data" is chosen, you will be prompted to enter a label to identify the exported tables. This label serves as a prefix for the exported data. In the example below, we use "IC_" as the prefix. The exported tables will be identified, something like this: "IC_table1"



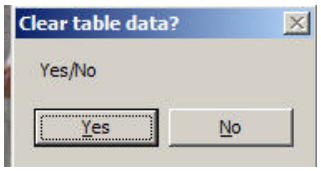
A dialogue box is shown, allowing you to select the Access database ("MDB" file) to receive the exported tables. In the figure that follows, we export to "IC_data.mdb." By default, you are pointed to the folder containing the current Access database. However, you may navigate elsewhere to search for a folder containing the target "MDB" file. (Note that you can create an empty MDB file from Access in the main menu (File/New) to create an empty database. Make note of where Access saves the new file.

The next example saves the data in "IC_DATA.mdb," created beforehand.



When the backup tables are exported, the application will automatically create two Excel workbooks in the same folder as the Access database chosen to receive the exported tables. These files will also use the prefix entered earlier. For the example given, the files are called "IC_q_MRank_OUT" and "IC_q_rpt1_analysis," respectively. These spreadsheets will contain the data corresponding to the ranks the SME panel assigned to the various methods for measuring performance, and the rest of the data collected in the evaluation process.

Finally, you are asked if you want to clear all of the data entered by the SME panel for the evaluation of occupational standards for this rating. This option was included for developmental purposes only. It is strongly suggested that you answer ***NO*** in the dialogue box that follows. (You will need the correct password to delete the data.)



Exit

Pressing this button closes the application.

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Appendix B: Estimated probabilities of decay (p) by occupational standard

Prob. decay	Skill decay scale	Std. no.	Occupational standard	Category
0.94	88	EN494	Perform Precision Mechanical Measuring	Mechanical Systems Operations
0.04	165	EN154	Monitor Diesel Engines	Mechanical Systems Operations
0.04	165	EN152	Start Diesel Engines	Mechanical Systems Operations
0.04	108	EN479	Participate In Engineering Casualty Control Drills	Engineering Management
0.04	165	EN151	Align Diesel Engines	Mechanical Systems Operations
0.04	165	EN155	Secure Diesel Engines	Mechanical Systems Operations
0.04	155	EN93	Align Oil and Water Separator Systems	Mechanical Systems Operations
0.04	155	EN333	Clean and Inspect Oil Purifiers (Fuel Oil and Lube Oil)	Mechanical Maintenance
0.04	170	EN95	Monitor Oil and Water Separators	Mechanical Systems Operations
0.03	147	EN473	Draw Schematic Diagrams	Fabrication and Manufacturing
0.03	137	EN469	Measure, Cut, and Fit Flange Shields	Fabrication and Manufacturing
0.02	155	EN483	Inspect Fluid Samples (Visually)	Laboratory Analysis
0.01	151	EN248	Remove and Replace Flange Shields	Mechanical Maintenance
0.01	151	EN247	Inspect Flange Shields	Mechanical Maintenance
0.01	135	EN257	Repack Valves	Mechanical Maintenance
0.00	146	EN45	Align Fire and Flushing Pumps	Mechanical Systems Operations
0.00	180	EN144	Align Oily Waste Water Systems	Mechanical Systems Operations
0.00	180	EN81	Shift, Inspect, and Clean Oil Strainers (F/O and L/O)	Mechanical Systems Operations
0.00	180	EN23	Align Fresh Water Drain Collection Tank (Fwdct) Pumps	Mechanical Systems Operations
0.00	180	EN2	Align Air Compressors	Mechanical Systems Operations
0.00	180	EN7	Align Air Systems	Mechanical Systems Operations
0.00	180	EN82	Align Oil Purification Systems (F/O and L/O)	Mechanical Systems Operations
0.00	180	EN482	Draw Fluid Samples (Feedwater, Potable Water, Lube Oil, etc.)	Laboratory Analysis

1.00	65	IC14	Interpret Electronic Schematics	Technical Core Fundamentals
0.99	106	IC31	Perform Preventive Maintenance on Wind Speed and Direction Systems	Indicating Systems Maintenance
0.98	73	IC23	Perform Combat Systems Operational Sequencing System (CSOSS) for Casualty Operation	Technical Core Fundamentals
0.97	100	IC20	Troubleshoot Power Supplies	Technical Core Fundamentals
0.96	121	IC55	Perform Digital Logic Numeric Conversions	Technical Core Fundamentals
0.95	105	IC54	Troubleshoot Electromechanical (Synchro/Servo) Systems	Technical Core Fundamentals
0.93	97	IC42	Troubleshoot Interior Communication Systems	Interior Communication Systems Maintenance
0.88	129	IC36	Test Interconnecting Cables and Connectors	Interconnecting Cables and Connectors Maintenance
0.88	95	IC37	Troubleshoot Interconnecting Cables and Connectors	Interconnecting Cables and Connectors Maintenance
0.87	73	IC24	Perform Combat Systems Operational Sequencing System (CSOSS) for Casualty Response	Technical Core Fundamentals
0.78	122	IC40	Perform Preventive Maintenance on Interior Communication Systems	Interior Communication Systems Maintenance
0.76	100	IC16	Operate General Purpose Test Equipment	Technical Core Fundamentals
0.76	128	IC18	Troubleshoot Direct Current (DC) Circuits	Technical Core Fundamentals
0.67	77	IC35	Perform Preventive Maintenance on Interconnecting Cables and Connectors	Interconnecting Cables and Connectors Maintenance
0.62	126	IC6	Perform Preventive Maintenance on Alarm, Safety and Warning Systems	Alarm, Safety and Warning Systems Maintenance
0.42	112	IC4	Troubleshoot Alarm Sensing Devices	Alarm Sensing Devices Maintenance
0.42	105	IC44	Collect Navigation Systems Data	Navigation Systems Maintenance
0.16	120	IC51	Test Steering Control Systems	Steering Control Systems Maintenance
0.11	105	IC46	Collect Ships Console Control Systems Data	Ships Console Control Systems Maintenance
0.11	128	IC52	Operate Steering Control Systems	Steering Control Systems Operation
0.10	174	IC39	Collect Interior Communication Systems Data	Interior Communication Systems Maintenance
0.07	149	IC19	Troubleshoot Alternating Current (AC) Circuits	Technical Core Fundamentals
0.07	103	IC8	Troubleshoot Alarm, Safety and Warning Systems	Alarm, Safety and Warning Systems Maintenance
0.06	119	IC17	Perform Six Step Troubleshooting Technique	Technical Core Fundamentals
0.03	146	IC47	Collect Shipboard Telephone Systems Data	Shipboard Telephone Systems Maintenance

0.02	142	IC15	Interpret Technical Manuals	Technical Core Fundamentals
0.01	177	IC30	Perform Preventive Maintenance on Valve Positioning Indicator Systems	Indicating Systems Maintenance
0.01	175	IC10	Collect Amplified Voice Systems Data	Amplified Voice Systems Maintenance
0.01	174	IC41	Test Interior Communication Systems	Interior Communication Systems Maintenance
0.01	174	IC43	Operate Interior Communication Systems	Interior Communications Systems Operation
0.01	151	IC50	Collect Steering Control Systems Data	Steering Control Systems Maintenance
0.00	179	IC1	Collect Alarm Sensing Data	Alarm Sensing Devices Maintenance
0.00	172	IC12	Operate Bell Ordering Systems	Bell Ordering Systems Operation
0.00	179	IC33	Collect Salinity Indicator System Data	Indicating Systems Maintenance
0.00	174	IC34	Collect Air Flow Indicator Systems Data	Indicating Systems Maintenance
0.00	179	IC38	Collect Interior Communication Switchboard Systems Data	Interior Communication Switchboard Systems Maintenance
0.00	167	IC25	Perform Corrosion Prevention and Control Procedures	Technical Core Fundamentals
0.00	189	IC28	Collect Valve Positioning Indicator Systems Data	Indicating Systems Maintenance
0.00	174	IC29	Collect Wind Speed and Direction Systems Data	Indicating Systems Maintenance
0.00	179	IC26	Collect Rudder Order and Position Indicator Systems Data	Indicating Systems Maintenance
0.00	174	IC27	Collect Ships Speed Systems Data	Indicating Systems Maintenance
0.00	179	IC13	Collect Cathodic Protection Systems Data	Cathodic Protection Systems Maintenance
0.00	179	IC32	Collect Tank Level Indicator Systems Data	Indicating Systems Maintenance
0.00	175	IC7	Test Alarm, Safety and Warning Systems	Alarm, Safety and Warning Systems Maintenance
0.00	169	IC9	Operate Alarm, Safety and Warning Systems	Alarm, Safety and Warning Systems Operation
0.00	179	IC3	Test Alarm Sensing Devices	Alarm Sensing Devices Maintenance
0.00	170	IC2	Perform Preventive Maintenance on Alarm Sensing Devices	Alarm Sensing Devices Maintenance
0.00	155	IC21	Perform Combat Systems Operational Sequencing System (CSOSS) To Energize/De-Energize Equipment	Technical Core Fundamentals
0.00	175	IC22	Perform Combat Systems Operational Sequencing System (CSOSS) for Normal Operation	Technical Core Fundamentals
0.00	175	IC11	Collect Bell Ordering Systems Maintenance Data	Bell Ordering Systems Maintenance
0.00	184	IC5	Collect Alarm, Safety and Warning Systems Maintenance Data	Alarm, Safety and Warning Systems Maintenance

0.94	88	MM350	Perform Precision Mechanical Measuring	Mechanical Maintenance
0.29	107	MM660	Conduct Basic Engineering Casualty Control Exercises	Material Casualty Control
0.21	107	MM516	Participate in Basic Engineering Casualty Control Exercises	Material Casualty Control
0.15	143	MM207	Perform Surface Blowdown	Mechanical Systems Operation
0.08	151	MM313	Inspect Flange Shields	Mechanical Maintenance
0.05	148	MM216	Align Steam Smothering Systems	Mechanical Systems Operation
0.04	170	MM285	Clean and Inspect Components of Oil Service Systems (Fuel Oil and Lube Oil)	Mechanical Maintenance
0.04	170	MM100	Monitor Oil and Water Separators	Mechanical Systems Operation
0.04	155	MM98	Align Oil and Water Separator Systems	Mechanical Systems Operation
0.04	155	MM288	Clean and Inspect Components of Oil Purification Systems (Fuel Oil and Lube Oil)	Mechanical Maintenance
0.03	147	MM514	Draw Diagrams	Technical Administration
0.03	137	MM507	Measure, Cut, and Fit Flange Shields	Fabrication and Manufacturing
0.02	155	MM518	Inspect Fluid Samples (Visually)	Laboratory Management
0.01	135	MM323	Repack Valves	Mechanical Maintenance
0.00	146	MM48	Align Fire and Flushing Pumps	Mechanical Systems Operation
0.00	140	MM317	Clean and Inspect Valves	Mechanical Maintenance
0.00	142	MM103	Sound Tanks or Voids and Record Readings	Mechanical Systems Operation
0.00	146	MM52	Align Main Drain Systems	Mechanical Systems Operation
0.00	180	MM86	Shift, Inspect, and Clean Oil Strainers (Fuel Oil and Lube Oil)	Mechanical Systems Operation
0.00	180	MM22	Align Fresh Water Drain Collection Tank (Fwdct) Pumps	Mechanical Systems Operation
0.00	180	MM149	Align Oily Waste Water Systems	Mechanical Systems Operation
0.00	180	MM5	Align Air Systems	Mechanical Systems Operation
0.00	180	MM87	Align Oil Purification Systems (Fuel Oil and Lube Oil	Mechanical Systems Operation
0.00	180	MM517	Draw Fluid Samples (Feedwater, Potable Water, Lube Oil, etc.)	Laboratory Management
0.00	180	MM1	Align Air Compressors	Mechanical Systems Operation

References

[1] Mark A. Sabol and Robert A. Wisher. "Retention and Reacquisition of Military Skill." *Military Operations Research,* 2001, Vol. 6, No. 1

[2] Andrew M. Rose et al. *Acquisition and Retention of Soldiering Skills,* Feb 1985 (ARI Technical Report 671)

[3] Peter H. Stoloff. *A Comparison of British and U.S. Navy Training of Surface-Ship Acoustic Operators,* May 1991 (CNA Information Memorandum 160)

[4] Joseph D. Hagman. *Effects of Training Task Repetition of Retention and Transfer of Maintenance Skill,* May 1980 (ARI Research Report 1271)

[5] Joel D. Schendel and Joseph D. Hagman. "On Sustaining Procedural Skills Over a Prolonged Retention Interval." *Journal of Applied Psychology,* 67(5), 1982: 605-610

[6] Steven E. Lammlein and Herbert George Baker. *Developing Performance Measures for the Navy Radiomen (RM): Selecting Critical Tasks,* Feb 1987 (Navy Personnel Research and Development Center TN 87-13)

[7] Gerald J. Laabs and Herbert George Baker. "Selection of Critical Tasks for Navy Job Performance Measures." *Military Psychology* 1(1), 1989: 3-16

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