THE NAVY ADVANCEMENT CENTER'S
REUSABILITY ARCHITECTURE

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Abstract

Military downsizing and budget reductions compel Department of Defense agencies to seek effective training interventions, which have great applicability at reduced costs. The Navy Advancement Center's Reusability Architecture is one such technology-based intervention. The architecture features a reengineering of the design and development processes associated with training products. Two very important principles, reusability and maintainability, become an integral part of the philosophy and processes used to develop these products. The use of databases and electronic performance support tools allow the warehousing of the lowest common knowledge structures (text or media) which may be manipulated by the training need or training requirement. This architecture is designed to provide increased efficiencies and could reduce much of the redundancy efforts in training materials production costs.

The first product, currently under development, is the Navy Engineering Training Series (NETS). It is a multi-faceted, multi-media interactive training product. When completed, NETS will contain 18 books designed to present basic Navy occupational standards (OCCSTD) related engineering knowledge common to the mechanical engineering ratings. NETS will eliminate the redundancy of content presentation across ratings and will incorporate the information into a single product delivered primarily by CD-ROM with updates via the Internet. Results of the NETS prototype evaluation will be shared with the Interservice/Industry Training, Simulation and Education Conference (I/ITSEC) audience.

Author Biographies

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INTRODUCTION

Military downsizing and budget reductions compel Department of Defense (DOD) agencies to seek effective training interventions, which have great applicability at reduced costs. The Navy Advancement Center (NAC) is a department of the Naval Education and Training Professional Development and Technology Center (NETPDTC) in Pensacola, Florida. The NAC is responsible for developing and producing training manuals (TRAMANs) for enlisted personnel rate training, nonresident training courses (NRTCs), advancement handbooks, and other training materials and texts as directed by the Chief of Naval Operations (CNO) and the Chief of Naval Education and Training (CNET) in support of Navy training. At NETPDTC, the NAC has developed a technology-based intervention, reusability architecture, designed to increase the efficiencies associated with training product development.

The NAC's reusability architecture features a reengineering of the design and development processes associated with training products. Two very important principles, reusability and maintainability, become an integral part of the philosophy and processes used to develop these products. The use of databases and electronic performance support systems (EPSS) allow the warehousing of the lowest common knowledge structures (text or media) which may be manipulated by the training need or training requirement. This architecture is designed to provide increased efficiencies and could reduce much of the redundancy in training material's production costs.

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NETS will eliminate the redundancy of content presentation across ratings and will incorporate the information into a single product delivered primarily by CD-ROM with updates via the Internet. In this paper, we will describe and demonstrate the reusability architecture used to develop the NETS

prototype, and discuss the results of the NETS prototype evaluation.

Target Audience

The product is primarily designed and developed for use by active duty and reserve forces within the Mechanical Engineering communities including: Machinist's Mate (MM), Engineman (EN), Electrician's Mate (EM), Interior Communications Electrician (IC), and Gas Turbine Systems Technician (GS) and servicemembers in the Ship Maintenance Occupational Fields including: Hull Maintenance Technicians (HT), Damage Controlman (DC), and Machinery Repairman (MR).

Servicemembers in other ratings may find the core concepts useful; however, it will not replace any of their rate training manuals used for advancement. The intention of NETS is to provide an understanding of basic engineering concepts at the apprentice level.

Twenty-one engineering common core topics were identified as necessary for servicemembers in 9 different Engineering ratings at the apprentice skill level. 3 of the 21 common core topics already have specific, topical TRAMANs written.

18 out of the 21 common core topics apply to at least 5 out of the 9 ratings and 8 out of the 21 topics apply to all 9 of the ratings. Only 3 out of the 21 topics apply to 2 or fewer ratings. With so many overlapping topical areas among Engineering ratings, it makes practical sense to manage and reuse as much of the core instructional materials as possible.

REUSABILITY ARCHITECTURE

The authors feel that reusability and maintainability are key to NAC producing effective training solutions in a timely manner. To apply these principles to practice, NAC is developing a reusability architecture to produce its print and electronic courses. The NAC reusability architecture is a system in which knowledge and media is stored in one database and retrieved by multiple applications to serve multiple purposes (Figure 1). Users enter course data in a database and electronic performance support tools are used to retrieve the data for various outputs. Currently, the NAC reusability architecture is being

used to create interactive multimedia instruction (IMI), print based instruction, and PowerPoint presentations.
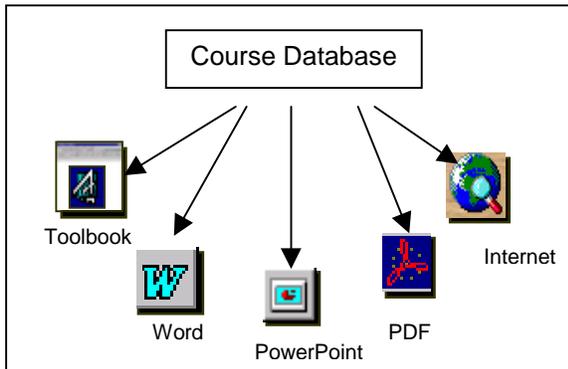
Figure 1.—Media Outputs

Components

There are two components that are key in supporting the NAC Reusability Architecture—the database and electronic performance support tools.

Database
The NAC Course Database is a relational database created in Microsoft Access. Microsoft Acess was chosen because it is a standard database software package that would allow us to transition to other databases if our needs exceed Access's capabilities. The database is used to store, organize, and retrieve knowledge and media. The querying and sorting capabilities of the database environment assist NAC in organizing course and media elements. The database contains the following tables:

- Compact Disc (CD)-Distribution: Identifies which CD each book is assigned.
- Book: Contains all of the books with a course.
- Chapter: Contains each of the chapters with a book.
- Learning Objectives (LOs): Contains the learning objectives for the course.
- Content: Contains lessons in the course.
- Test: Contains all of the test items in the course.
- Glossary: Contains the terms and definitions used throughout the course.
- Picture: Contains all still visual images used in the course.
- Video: Contains all videos used in the course.
- Sound: Contains all sound files used in the course.

- Template: Contains the references to templates used in the course.

Aside from the program benefits of storing information in a database, NAC realizes the following organizational benefits:

- The department will be able to easily transition between authoring systems should the need arise.
- Databases enable the organization to use the same content for both a print and electronic product.
- Database Forms reduce the technology phobia that designers/developers or subject matter experts (SMEs) may have.
- Databases enable the content to be easily shared or reused for other projects.

Electronic Performance Support Tools
The NAC is using electronic performance support tools such as database forms, templates, macros, and wizards to standardize the process for creating its print and electronic courses. The tools assist users by requesting the required information needed to perform a task. The templates and tools respond to the answers that users provide.

Electronic performance support tools are viewed by the authors as a tremendous benefit to streamlining the NAC's design and development processes for the following reasons:

- Standardizes and enforces the process used to develop products.

- Enables individuals who do not possess the necessary skills to implement technological training solutions from day 1 with very little training.

- Leverages the organization to spread technical expertise throughout the organization.

- Ensures that all courses possess a consistent look and feel.

NETS

The NETS product is designed to form a self-study package to help the sailor gain the necessary knowledge to advance in their rate. The topics covered in the NETS project are:

- Engineering Department Organization
- Engineering Administration I
- Engineering Administration II
- Basic Mechanical Components
- Pneumatics
- Basic Thermodynamics
- Distilling Plants
- Air Conditioning & Refrigeration
- Theory of Lubrication, Lube Oil and Hydraulic Systems
- Power Transmission
- Instruments & Calibrations
- Sewage Disposal Systems

Platform-Specific Books
- Electrical Systems
- Engineering Training Plan
- Auxiliaries

The prototype involved 4 lessons contained in Book 4: Basic Mechanical Components. The lessons included in the prototype were: Pumps Overview, Centrifugal Pumps, Rotary Pumps and Reciprocating Pumps. The prototype sought to answer 4 basic questions:

1. Can we take the TRAMANS for a community, combine the common topic areas into one product, reduce redundancy of product development, and still produce a training product that meets the fleet's and the sailors' needs?

2. Can we take the traditional, print-based TRAMAN and use it as the cornerstone on which to build various digitized products without starting at square one?

3. Can we reduce the printing and associated costs of TRAMAN delivery and life cycle management?

4. Can we identify and document a process that will allow us to move to electronic formats effectively and efficiently using our resident skills?

Delivery Format

This product is designed for distribution in either an electronic and/or a print format. The content is warehoused in a single database and then exported to the appropriate delivery format. The two formats are a computer-based, interactive multimedia instructional (IMI) format and a print-based (PDF)) format. The primary difference between the two delivery formats involves the use of narratives associated with animations or videos, and the animations or videos. In the electronic format, the text associated with a video or animation is used for the narration. A still graphic or a series of graphics accompanied by text represents the animation or video.

Interactive Multimedia Instruction
The NETS product delivered via CD-ROM contains complete, self-contained study units covering common core concepts for the engineering ratings. Contained within each lesson are interactive practice exercises designed to reinforce the student's learning. The program manages the student's progress and performance. The IMI contains the lesson pretests, lesson posttests, and chapter tests. The IMI CD-Rom will also contain the course content in PDF file format and a supplemental study tool called "rack reading". Rack reading is a graphic organizer provided to the user that may be viewed on a computer or printed out for easy and portable reference.

Figure 2.—Rack Reading

Additionally, the CD will contain an index (Figure 3) of all the media files used within the IMI. Users can browse, view, and/or save the files. This feature was designed to increase the practical usefulness of the product. Engineering instructors may find it useful to use the media for classes they teach or presentations. Students might find it useful to review specific media to supplement their studies or refresh certain concepts.

Figure 3.—Media Index

Print-Based Format

The NETS product delivered via print contains complete, self-contained study units covering common core concepts for the engineering ratings. Contained within each lesson are embedded questions which are designed to reinforce the student's learning. An education services officer (ESO) manages the student's progress and performance. Lesson and chapter tests are designed for the student to take independently. Book tests are designed for the ESO to administer and proctor. Printed rack reading is provided to the student as an instructional strategy to help reinforce the key concepts.

Future

- Web page for centralized source of information related to course
- remote access to subject matter experts
- asynchronous group interaction via web access
- online registration
- online testing
- online course
- online updates
- electronic training jackets

EVALUATION

The developers felt that before continuing on the NETS project, it was important for the prototype to be evaluated to determine the extent of the instruction's feasibility and its effectiveness. The NETS prototype content evaluation was conducted at Service School Command, Great Lakes, Illinois, May 3-6, 1999. The purpose of the content evaluation was:

- to examine the participant performance scores based on the two types of delivery formats (computer-based, IMI and print-based (PDF)).
- to verify that participants receiving instruction in one delivery format did not have an advantage or disadvantage over a participant receiving the same content instruction in a different format.
- to obtain performance scores for immediate and delayed testing.
- to obtain qualitative data from the target audience about NETS various instructional strategies.

Since this particular evaluation was a content evaluation, the intent of the evaluation was not to formally address the architecture, which is the process, but the product. However, qualitative data was collected from team members and SMEs throughout the development of the prototype addressing the four original questions.

The NETPDTC team conducting the evaluation included a military subject matter expert, and 3 evaluation experts including the primary programmer and instructional systems specialists (ISSs) from the technology and engineering branches.

Methods

The evaluation team used both quantitative and qualitative methods to evaluate the content of the NETS prototype.

Participants

The participants for the evaluation included members of the identified target audience, i.e., entry-level students (military ranks of E1 through E4) in the Engineering ratings. The School's instructors selected the participants from classes based on the least amount of disruption to the school's regular schedule. There were a total number of 57 participants that began the study, including 54 males and 3 females. Several of the participants were foreign nationals. 4 participants did not complete any of the components of the study and 7 participants completed a majority but not all of the components of the study due to illness, conflicting obligations and indeterminate reasons.

The participants were split into 2 groups. Group A included students who were nearing the end of the instructional cycle at the Great Lakes Training Center. These students began the study on Tuesday and were given delayed tests on Thursday morning

(48-hour delay). Group B included students starting the instructional cycle or awaiting training at the Great Lakes Training Center. These students began the study on Wednesday and were given delayed tests on Thursday morning (24-hour delay).

Delivery Format

The NETS series is intended to deliver instructional content in two formats: interactive multimedia (IMI) and print-based (PDF). The purpose of the NETS prototype project was to answer two of the primary questions presented earlier in this paper:

- Can we deliver the same high quality instruction as the TRAMAN in another format?
- Can we reduce production and delivery costs?
- What is the functional practicality of the reusability architecture?

As the prototype developed, the architecture has acquired a robustness that has significant possibilities for the Navy Advancement Center and Navy Training.

Instruments

A number of instruments were used for data collection.

For each of the 4 chapters in the NETS prototype, every participant received a ten-item pretest, an immediate posttest, and a delayed posttest (either 24 or 48 hrs). Parallel test items were used to reduce influencing scores by time, recall, or difficulty. The test items were multiple choice questions using textual and graphical stems and alternatives. The test items used in the evaluation were written and reviewed by subject matter experts within the Engineering Branch of NETPDTC.

Each participant was also asked to complete a post-study questionnaire.

Major findings and Implications

Results of the evaluation concluded that there was:

- no significant difference in the performance scores based on delivery format, thereby there is no significant advantage for participants with access or lack of access to a computer.
- no significant difference in the immediate or delayed testing results.

Generalizations or assumptions should not be made from this data at this time. The study was abbreviated and limited in scope. A number of other variables, e.g., other testing, graduation, moving, and a blood drive may have confounded the data.

Qualitative data indicate that the participants prefer the topical and condensed approach to content presentation. Participants commented that they prefer studying specific chapters and testing; using the IMI and PDF versions to supplement each other; the access to rack reading; and having a greater sense of control over their learning.

Answers to the four original questions became obvious during the development and evaluation of the prototype. The team found the following:

1. We can easily and quickly take the TRAMANS for a community, combine the common topic areas into one product, thereby reducing redundancy of product development, and still produce a training product that meets the fleet's and the sailors' needs.

2. We successfully took the traditional, print-based TRAMAN and use it as the cornerstone on which to build various digitized products without starting at square one. This was accomplished by careful content review analysis by the SMEs and ISSs. The "best" content coverage was selected, modified when necessary and input into the database.

3. We predict that the time and cost associated with the printing and TRAMAN delivery and life cycle management can significantly be reduced by the elimination of 22 number of TRAMANs and by reducing the current 3-5 year TRAMAN modification time to 6 months.

4. The current reusability architecture's design can allow us to move to electronic formats effectively and efficiently using our resident skills with minimal amount of training necessary. By using the EPSS, the authoring and programming skills necessary to produce quality IMI is minimized and can be supported by current staff skills.

CONCLUSION

As the continued impact of military downsizing and budget reductions are felt across the Department of Defense agencies, instructional designer's and developers will continue to seek effective training interventions which have great applicability at reduced costs such as the Navy Advancement Center's Reusability Architecture. Two very important principles, reusability and maintainability, become an integral part of the philosophy and processes used to develop training products. The use

of databases and EPSSs to allow the warehousing of the lowest common knowledge structures (text or media) and to provide for manipulation by the training need or training requirement will provide increased efficiencies and can reduce much of the redundancy in training material's production costs.

The first product, currently under development, is the Navy Engineering Training Series (NETS). NETS is designed to eliminate the redundancy of content presentation across ratings and to incorporate the information into a single product delivered by CD-ROM, or PDF format with updates via the Internet. In this paper, we have described the reusability architecture used to develop the NETS prototype, and discussed the results of the NETS prototype evaluation. The information contained in this presentation is useful to other entities as they strive for cost-effective, efficient ways of developing and managing extensive amounts of training materials.