REENGINEERING THE INSTRUCTIONAL SYSTEMS DEVELOPMENT (ISD) PROCESS MODEL TO FACILITATE COST EFFICIENT PROCESSES

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Subject matter experts (SMEs) arrive at NETPDTC to review and revise Training Manuals (TRAMANs) and Advancement Exams. Using the model of the traditional instructional systems development (ISD) process, a Navy Chief SME, working with a team comprised of an instructional designer, instructional developer, a graphic artist, a videographer, a programmer, and an editor, will tackle the ordeal of producing a paper-based product with a shelf life of 5-8 years. The current production process averages 2-3 years. To reduce this burdensome and time-intensive process and to produce courses that remain relevant in the ever-evolving technology of Navy warfighting systems, the Naval Advancement Center (NAC), a department of NETPDTC, re-engineered the design and development process. NAC looked to industry to provide best re-engineering practices and developed the Reusability Architecture. The Reusability Architecture incorporates conceptual and modularized reengineering of the design and development processes associated with training products. It is the warehousing of the lowest common knowledge structures (text or media) in a massive database, which may be manipulated by the training need or the end user. The formulated Reusability Architecture populates a database accurately and rapidly, and facilitates output in a number of formats. By reengineering the design and development process to maximize the utility of databasing knowledge structures, the SMEs can now move fluidly between the two major assignments of TRAMANs and Advancement Exams. The development process, for the non-authoring members of the team, is transparent. This paper presents training course development model concepts and the newly developed reengineered design model, using an example from business' best practices for re-engineering processes. The paper then provides a brief overview of the Reusability Architecture and how SMEs can use it to simultaneously develop and design new courses and Advancement Exams. The new process uses four fewer personnel per team by providing advanced electronic performance support tools that combine many of the previously distinct personnel functions. The Reusability Architecture also provides fully functioning rapid course prototypes in about two minutes, a significant reduction over the previous process.

Author Biographies

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INTRODUCTORY PREMISE

We, i.e., the military, are in the business of training and readiness. Therefore, in order to ensure quality training programs, we should examine conceptual process models in the business world, particularly, operations management, in order to guide us as we reengineer our business training processes. The goals, in business and in modern training programs are the same – improving quality, service, and speed, while reducing cost. Business process reengineering suggests that product improvement be gained through a radical departure from current modes of operation (Hammer & Champy, 1993).

The Navy Advancement Center (NAC), a department of the Navy Education and Training Professional Development and Technology Center (NETPDTC) in Pensacola, FL, produces many of the training products used by the fleet, the schoolhouses, and the reserve communities. Many of you are familiar with the Navy Rate TRaining MANuals (TRAMANs), and the Advancement Exams. Traditionally, NAC has developed highly effective products following the classic instructional design model of Plan, Analyze, Design, Develop, Implement, and Evaluate (PADDIE). The Center follows established publishing industry practices in the production of its print-based training products. However, these two standards (PADDIE and traditional publishing) no longer meet the rapid response to user requirements and needs that are currently faced by the military.

In the fall of 1998, an intradepartmental task force examined the current means of doing business and identified ways to modify, enhance, or improve the production processes. Using the production technique of concurrent engineering, the task force split into two focused teams. The production team created the reusability architecture and a working prototype. The design team examined the reusability architecture's effect on the traditional processes and the product. What transpired over the course of the prototyping year, was not only a new product and training series which may serve as a model for future training products, but an identification of how technology will allow the Center to redesign and reengineer its production processes.

CONCEPTUAL MODELS FOR TRAINING PRODUCTS

The military is one of the largest organizational systems in America. Its very nature is the embodiment of systems theory, i.e., "a set of interrelated and interacting parts that work together toward some common goal" (Smith & Ragan, 1993). Taking a systems approach to the great need for instruction during World War II, military trainers and educational psychologists developed training programs that were effective and efficient. This systematic approach to instruction is the cornerstone to current military training programs ISD.

PADDIE Model

Figure 1 presents the military's traditional model, the PADDIE, and its inherent linear design structure in which an input equals an output.

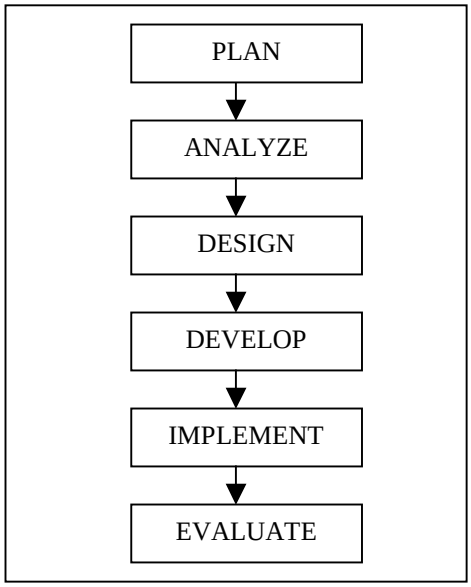

Figure 1. Classic PADDIE Model

Each block or phase has specific tasks associated with it. PLAN: develop organizational structure, tasks, milestones, etc. ANALYZE: identify tasks and job performance requirements. DESIGN: prepare a detailed plan of instruction including methods, media, and strategies. DEVELOP: produce, review, and revise the instructional product. IMPLEMENT: integrate the instructional product into the training

environment. EVALUATE: validate, operationally try-out, and assess tasks or products in the analysis, design, or develop phases (MIL-HNDBK-1379-D).

With the exception of PLAN, notice that each phase is dependent upon the task preceding it. The conceptual model is extremely linear in execution, albeit that ideally EVALUATE should be interwoven within the total process. The model implies terminality. The product is finished and sent to the fleet. End of story.

Quality Based Instructive Design Model

During the mid-1990s, Quality Improvement processes entered the Navy's instructional design process. Figure 2 represents the new and revised instructional design model (MIL-HNDBK-29612).

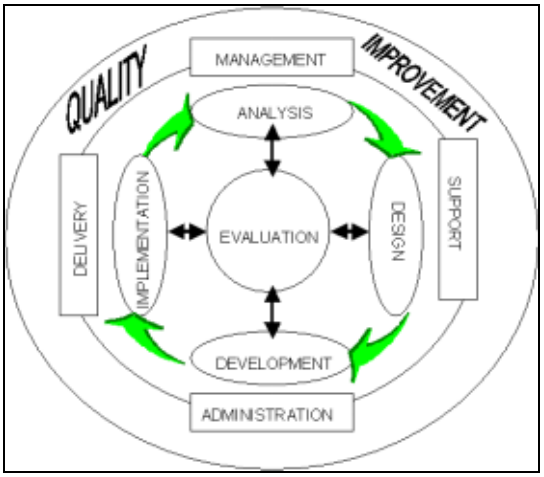

Figure 2. Quality-based Instructional Design Model

The spherical model better illustrates the cyclical nature of the entire process. It also includes the management and support structures that are the underpinnings of any organization, whether engaged in education, training, or business. However, the model continues to present the central phases as independent structures with definite inputs and outputs. The difference between the original and the quality-based model is that evaluation is better portrayed as having impact on the four other phases and that information flows bilaterally between evaluation and the appropriate phase. The position of quality improvement, which encapsulates the process, indicates improvements are made throughout the entire process. The Quality Improvement Process model for instructional product has matured, but it fails to address the interrelationship between product, process, and the impact of technology.

Value Chain Model

Michael Porter (1985) posits a conceptual business model that is more closely applicable to the total process with which military training is involved than the previous two. Porter's model, The Value Chain (see Fig. 3), identifies the strategically important activities and the interrelationships.

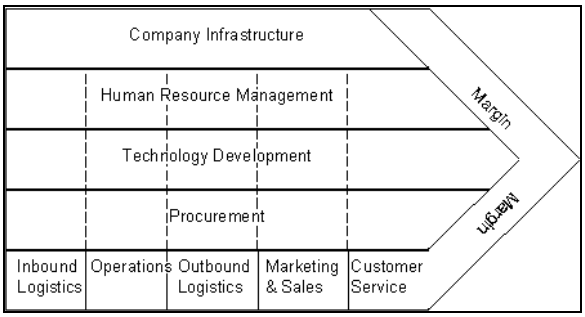

Figure 3. The Value Chain

The model's components are categorized into two major divisions, that of primary activities and support activities. Primary activities include all stages, which deal with the physical creation of the product, its delivery to customers, and follow-up activities, e.g., customer service. Primary activities are further subdivided into subsystems including: INBOUND LOGISTICS: receiving, storing, scheduling, etc. In other words, this stage houses a variety of inputs. OPERATIONS: transforming inputs into final products. OUTBOUND LOGISTICS: collecting, storing, and physically distributing products. MARKETING AND SALES: providing customers (end users) with information about products. CUSTOMER SERVICE: enhancing or maintaining the value of the product. Support activities are the major components of the company, e.g., purchasing, technology, human resources, etc. Margin (Value) is the difference between total value and the collective cost of performing value activities (Markland, Vickery, & Davis, 1995). Within the model, the dotted lines indicate associations between components. The value of the model is its ability to portray the associations or linkages between the component activities and the identification of the trade-offs that may be made within the company. For example:

- Design vs. cost
- Delivery vs. operations
- Human resources vs. customer service

By using the Value Chain model, a production team can examine the linkages between company

components and make recommendations for strategic or competitive advantages. Quite often teams are asked to study a particular issue and find a solution. Without a model, such as the Value Chain, the impact of a great idea, which may solve a problem in one area, may actually generate a greater problem in another area.

The NAC Business Process Model

The business process model, which has evolved from the prototyping process within the NAC, is a derivative of all the previous models (see Fig. 4). It incorporates instructional design guidance from the original PADDIE, recognizes the need for continuous improvement, and addresses the interrelationships needed for product development. Two components set the model apart from the previous discussion. Central to the model's functionality is the concept of data collaboration through the use of the reusability architecture. Unique to the model is the recognition of a continuous search for definitive departures from the current means of doing business. Continuous process improvement seeks to improve the current process through various iterations. The definitive departure mandates looking away from the current process and using radical methods such as benchmarking or experimentation to improve the process. The model is more akin to business process reengineering than to quality improvement. The repositioning of the vertical lines from the Value Chain reflect the synergistic nature and impact of each identifiable component on the whole.

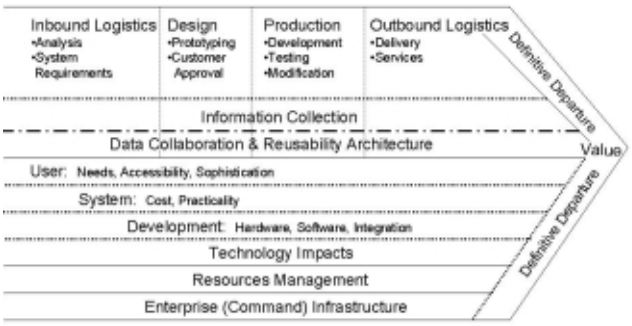

Figure 4. NAC Business Process Model

The Enterprise Infrastructure serves as the foundation to the model. The Navy, as a complete system, determines the way in which the individual commands and activities within the system do business. Those individual commands and activities, then in turn, determine how departments and further subsystems conduct business. Resource Management, either at the enterprise or local level, impacts product development. The NAC relies heavily on the knowledge and productivity of Navy Chiefs assigned to the department as subject matter experts (SMEs). Vacant SME billets and collateral duties have forced the department to examine traditional methods of writing TRAMANs. In addition to personnel shortages, technology issues impact at three levels: User, System, and Development.

For the User, technology may be readily available. In that case, having interactive courseware products or accessibility to the web may be important. On the other hand, if the user lacks accessibility, then products, which are print-based, are needed. However, print-based products no longer result in a bound copy of a book. Excerpts, Portable Document Format (PDF) files, chapters, or condensed versions may address the need more adequately and efficiently than the traditional book. The User's sophistication with computer technology is a major factor as well. Training and experience with technology may impact the effectiveness of the electronic product.

The System, its features, and cost may well determine how technology integrates into the complete infrastructure. Just in the last few years, the Navy has switched to Information Technology for the 21st Century thinking (IT-21, see Note 1) and has addressed the need for a system-wide compatibility of products. However, the dark cloud of cost looms on any one command's horizon. The needs of the fleet are greater in the areas of mission readiness and capability than in computer accessibility for the individual sailor. Practicality plays upon the system as well. If one thinks in terms of larger carriers, computer rooms should be standard features. However, major players within the Enterprise are small vessels less than 250 feet in length. There's no room for a learning resource center. Laptops, while meeting the need, are expensive and pose their own problems to the system.

Developments within the science of computer technology, multimedia and telecommunications probably have the greatest impact on design, development and distribution of courses. Before a production group can create and develop an idea, conduct a prototype, evaluate its effectiveness and produce a product, Navy warfighting technology, the subject of the course(s), has changed. The business model must address how a production team can create and produce quality products in shifting sand.

The upper portion of the model combines the PADDIE and Porter's Value Chain models. The Primary Activities are elaborated by incorporating

Porter's practical nature of the business with the traditional instructional design stages. Information, rather than evaluation, is collected throughout the process. That information collection may alter the primary activities at any given stage rather than waiting for specific input or output times.

Data Collaboration is conducted at an Enterprise as well as command-specific level in order to reduce development time and associated costs. The Reusability Architecture, which is discussed in the next major section, capitalizes on centrally warehousing data for use by the total Enterprise.

Value, in the NAC model, is that product or service provided to the Enterprise (the fleet) which is better, cheaper, faster, or stronger than the competition. In the business of military training, the competition is the training production unit, itself, and its current means of doing business. Again, it is the recognition of the need for definitive departure that brings about value and regenerates the model.

DESIGN

The challenge of serving learners with different learning styles and different means in which they can receive training has tasked NAC development teams to design instruction in a way that it can be used for multiple distribution formats. To achieve this end, NAC is organizing instruction into chunked knowledge structures that can be retrieved for many different product formats.

Knowledge Structures

In the NAC Reusability Architecture, knowledge is categorized into four hierarchical levels:

1. Book
2. Chapter
3. Learning Objectives
4. Individual Topic

The book level is the highest level. A book may contain two or more chapters covering related material. The learning objectives, at the third level, determine relationships of individual topics and questions. Finally, at the lowest level, each individual topic and question within the database is assigned a learning objective and sequence number. SMEs and Instructional Systems Specialists (ISSs) collaborate to "chunk" knowledge into the different levels.

Chunking knowledge structures is crucial to maintaining a useful database. Each record in the database consists of a single idea, usually the size of one paragraph.

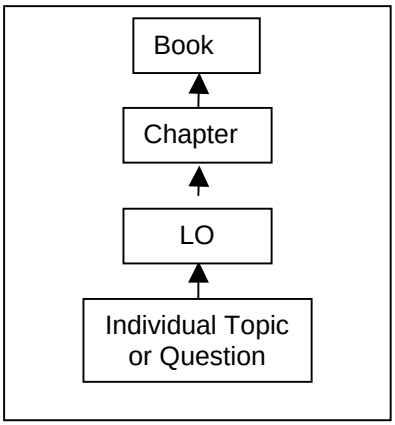

Figure 5. Knowledge Structure

Knowledge Retrieval

Once a knowledge structure enters the database, it can be retrieved for multiple purposes, delivery formats, or use with various types of software. For example, databased content can be distributed for the following uses: interactive multimedia (Asymetrix Toolbook II Instructor), word processing (Microsoft® Word), presentations (Microsoft® PowerPoint), portable document format (PDF) and Internet delivery.

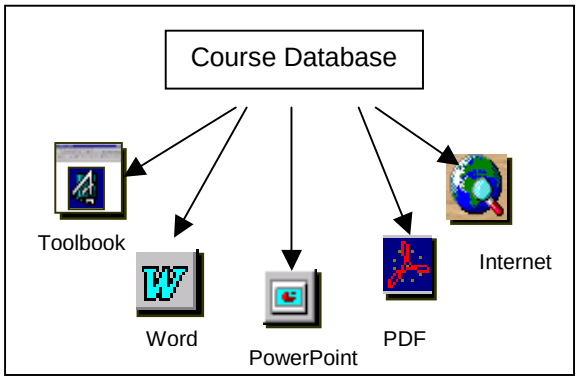

Figure 6. Medium Outputs

DEVELOPMENT

The Reusability Architecture and specially developed electronic performance support tools enable the NAC

to streamline the development process and restructure the composition and assignments of the development team. While many of the tasks and responsibilities have remained the same as in previous models, the doers of those tasks and responsibilities have changed.

Development Team

The change in size and shape of the development team has been necessitated by a lack of personnel, limited expertise, changes in technology, etc. Table 1 illustrates the differences in the composition of traditional and NAC reengineered development teams.

Traditional Development Team	NAC Development Team
Instructional Designer	Instructional Systems Specialist
Instructional Developer	
Editor	
Subject Matter Expert	Subject Matter Expert
Graphic Artist	Graphic Artist
Videographer	
Programmer	

Table 1. Development Team Composition

NAC realizes that every development team will not have a videographer, editor, and programmer. The role of the videographer has been reduced considerably due to lack of personnel. However, most of the video used in NAC's courses will come from existing Navy-owned videos obtained through the Defense Automated Visual Information System/Defense Instructional Technology Information System (DAVIS/DITIS). ISS personnel assume the responsibility of the editor. Electronic performance support tools and course shells have replaced the full-time programmer.

Tools

During the past year, NAC has made the investment in developing electronic performance support tools and databases. Wizards and database forms have been created to assist development teams in producing courses. The wizards assist team members by asking a few basic questions about the task the user is performing. Once the user answers the questions, the wizard performs the task.

NAC Course Builder

After development teams complete the ANALYSIS phase and determine that a training need exists, any member of the team can use a tool called the NAC Course Builder (see Fig. 6).

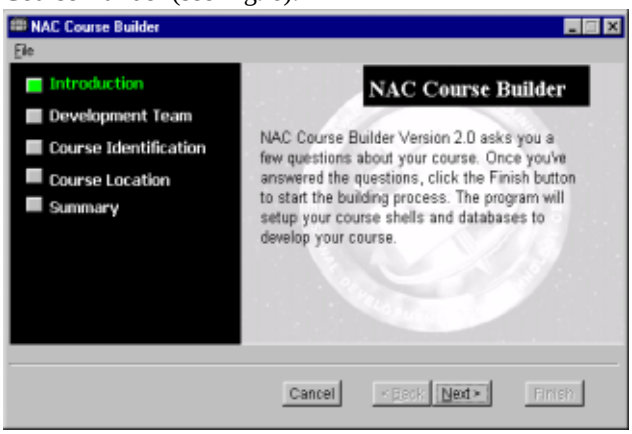

Figure 6. NAC Course Builder

The NAC Course Builder prepares the databases and customizes the course shells. A development team member simply identifies the members of the development team, provides specific course descriptors, and targets the storage location for the modified course shells. The NAC Course Builder does the rest. In approximately two minutes, the development team has a fully functioning rapid prototype of their course.

NAC Course Development Guide

To guide novice team members throughout the course development process, NAC has developed the NAC Course Development Guide (see Figure 7). The NAC Course Development Guide is an electronic guide, which walks the development team member through each step in developing a course. The team member is instructed on the task to accomplish, the stage at which to perform the task, and the support tools to perform the task.

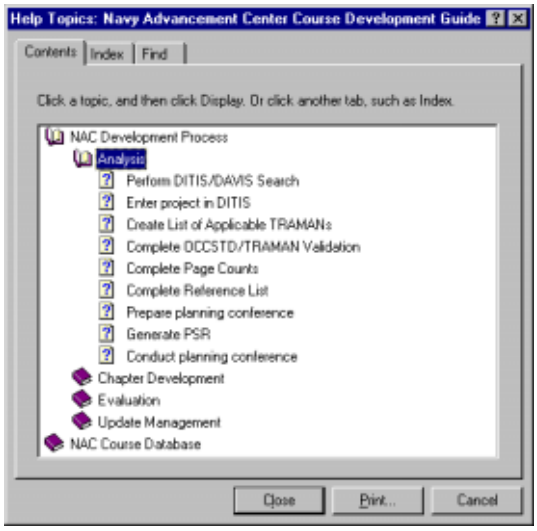

Figure 7. NAC Course Development Guide

Database Forms

Database forms (see Fig. 8) aid the development team member in building the course. All lesson content, questions, media file references, glossary terms, etc., are entered in the database. The development team doesn't worry about the technical issues encountered in working in an authoring system environment. The pre-programmed course shells respond to the form entries and negate the need for authoring expertise by all team members. These pre-programmed shells and forms reduce the learning curve for novice team members to 20 minutes or less, obviate the requirement for expensive commercial training programs and save valuable development time and dollars.

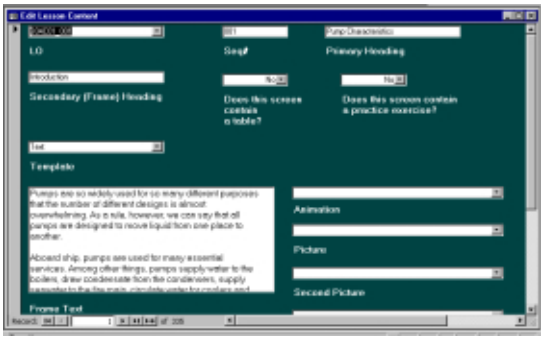

Figure 8. Database Form

USER PERSPECTIVE

The Reusability Architecture allows NAC to operate at a high level of efficiency in producing training courses. The previous section explained the actual architecture, its components, and how production or development teams at NETPDTC can enter information. However, the Reusability Architecture has a much broader applicability than just within the realm of NETPDTC (see Fig. 9). Content stored within the Reusability Architecture may be accessed by both production teams and by end users (commands or individual sailors) based on need.

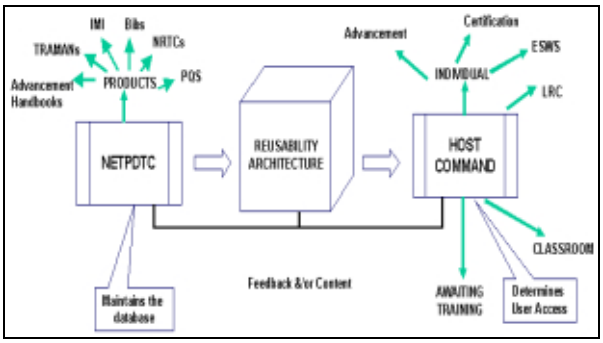

Figure 9. Architecture Accessibility and Responsibility

The three large central blocks represent the major components and illustrate their relationships. NETPDTC maintains the Reusability Architecture and controls content and information input. The Host Commands, e.g., fleet, reserve community, schoolhouses, or learning resource centers, determine access (sailor vice instructor) and use (awaiting training, classroom instruction, enrichment, remediation, or refresher training). Individuals may further delineate the program at log-on by indicating advancement, certification, or Enlisted Surface Warfare Specialist (ESWS) study. The architectural model indicates how content stored within the database may be derived in any number of ways. Feedback from both the Local Command, individuals and NETPDTC users provides for a constant upgrade to the currency and accuracy of the content. Feedback from users also provides impetus for the Reusability Architecture's manager to constantly upgrade the system with functional improvements.

World Class Training

Using the attributes of a world class manufacturing organization (Hayes, Wheelwright, & Clark, 1988) to gauge the components of the Navy's World-Class

Training Architecture proposed by the NAC task force, one finds that the Reusability Architecture provides just-in-time training; has a customer orientation that reflects the vision and customer-focused strategies of the organization; provides and adapts to continuous product improvement; responds rapidly to changes in needs, technology, and resources, and integrates proven principles found in historical models; and most importantly, recognizes that the sailors are the Enterprise's most valuable asset.

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Note 1: "Information Technology for the 21st Century (IT-21) is a FLTCINC-initiated effort to transform the way DON plans and budgets for information technology (IT) acquisition—shifting from acquiring IT as a centralized, large-sale system to considering IT as a disposable, commodity. The IT-21 strategy to optimize IT acquisition across all of DON is based on a two step process: a global DON networking architecture to ensure interoperability and IT acquisition solutions based on best business case analysis within each regional area." For more information about IT-21, visit their web page: http://www.hq.navy.mil/IT-21/about.html