Linking Blended Learning to Navy Fleet Performance Requirements, REAL-TIME

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ABSTRACT

The concept of "Blended Learning" has been widely discussed in literature, industry, and very recently in the US Navy as the learning model most likely to effectively address the diverse needs of learners. Although blended learning pockets of excellence may exist in certain Navy communities, no enterprise-wide model or plan has been adopted to ensure that blended learning solutions are both pedagogically sound and current with Fleet (end-user) requirements.

A core tenet of the US Navy’s Revolution in Training (RIT) was to migrate appropriate tracts of content to a learner directed, web-delivered medium. One community, the Strategic Systems Program (SSP) Office, recognized that while web-based learner directed content (LDC) provided benefits for learners, it also possessed an inherent shortcoming--lack of real-time concurrency with changing fleet technical and performance requirements. SSP wanted to offer blended learning to Sailors, but also needed a way to ensure LDC components could remain as current as the instructor-led training (ILT) components it authored, tracked, and managed using a Navy-owned software tool. To that end, SSP undertook a pilot project to leverage the concurrency management capability of the Navy-owned software and the web-based authoring capabilities of another toolset to create blended learning content (ILT, LDC, Performance Testing in labs, and structured OJT) that is quickly and accurately updated to ensure alignment with fleet requirements.

This paper discusses the challenges of defining new business rules and data models, creating integrated product teams and capturing lessons learned across multiple government and contractor organizations, implementing non-proprietary interfaces between various software tools to collaboratively achieve current blended content, and automatically linking that blended content to Navy technical and performance data. It also identifies critical challenges that, if left unaddressed, will hamper any organization's effort to implement an effective and affordable real-time blended learning capability.

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INTRODUCTION

The United States Navy's Strategic System Program (SSP) office has owned the charter for development, production, and life cycle support of the Navy's Fleet Ballistic Missile (FBM) Strategic Weapons System (SWS) for over 50 years (*Six Lines of Business*, 2010). The SWS served as a major enemy deterrent during the Cold War, and since the end of the Cold War SSP has leveraged its engineering and program management expertise to continue supporting ballistic missile defense for the US Navy.

A key element of SSP Life Cycle support is training development and management for the SWS systems they produce. One small system-specific community within that training domain is the Navy's Submarine Learning Center (SLC), where sailors in a number of Navy job ratings receive apprentice and journeyman level training in support of their specific maintenance and operation duties (*Welcome to the Submarine Learning Center*, 2010).

One of the Navy ratings for which SSP develops training that SLC delivers to sailors is the Missile Technician (MT) rating. MTs are responsible for the operation and maintenance of advanced electronic equipment, computers, electro-mechanical support systems and nuclear-capable ballistic missiles carried on submarines. MT “C” School (Journeyman-level) training delivery has historically consisted of formal instructor led training (ILT) and practical laboratory exercises delivered in locations on the east and west coast of the United States. That training requires constant updates due to quarterly technical data changes driven by system-specific changes in the equipment which MTs operate and maintain. If MT training materials are not updated in an expeditious fashion, then MTs’ knowledge, skills, and abilities (KSAs) are not maintained current to perform their duties. In their nuclear missile environment, lack of KSA currency could be very problematic. Official Navy documentation on the work of MTs clarifies the importance of fully ready and capable MTs: “MTs are a vital element in the maintenance of strategic deterrence so vital to the security of the United States” (*Missile Technician*, 2009).

The inherent makeup of the greater SSP training content development team might not be unique in other Defense commands or in industry, but merits mention to better understand the complexities that led to core decisions on the MT project. The MT training content development team consists of very few Federal Employees. SSP out sources the analysis, design, and development of training content to a number of different contractor organizations who develop the specific systems used by MTs aboard submarines. Because these contractors develop the systems, they are often the only Subject Matter Experts (SMEs) and, therefore, must provide the training analysis inputs that feed content development, which is also performed by either themselves or other SSP contractors. SSP has at least seven contractor organizations contributing to the analysis, design, and development of the MT training. The contribution from multiple contractors to training content development for the same MT community has made development processes and configuration control difficult for SSP to manage.

To lessen the configuration control burden of so many different organizations developing training content for MTs, SSP has utilized a Government Owned Software Toolset (GOTS) to design, develop, manage, maintain, and update its ILT training curriculum and content. A key reason SSP has used this GOTS toolset is because
it has administrative access capabilities allowing for configuration management and control of which organization possesses the “gold copy” of training content. Even more importantly, it has the capability to link technical data requirements to training content it supports in a nearly real-time fashion. Technical data gets created and published by system manufacturers when they build or update any system for the Navy. When SSP develops training content they take that technical data and link it to very granular levels of training sections, lessons, paragraphs, and diagrams so that training content can all be tied back to specific pieces of technical data upon which that training is based. So, when that technical data changes on a quarterly basis, the GOTS tool can immediately be queried to identify those areas of the training content that might need to be updated to reflect the technical data changes. In addition to ensuring that training content remains aligned with technical data, this GOTS capability has saved SSP significant staff resources in training content revision and maintenance costs over the years they have been utilizing it.

DECISION TO GO “BLENDED”

In October of 2000, the US Navy embarked on a cultural and strategic shift in how it approached training. The Executive Review of Navy Training (ERNT) working group was established to examine Navy training and make substantive recommendations for improving and aligning organizations, incorporating new technologies into Navy training, exploiting opportunities available from the private sector, and developing a continuum of lifelong learning and personal and professional development for Sailors. That working group’s recommendations spawned what came to be known as the “Revolution in Training” (RIT) (Revolution In Training, 2001). A major recommendation for and point of emphasis in the RIT was to incorporate eLearning and web-based distance learning as a Navy training delivery modality. At that time, there were some eLearning/web-based distance Navy pockets, but it was not institutionalized Navy-wide nor did the Navy have a formal enterprise-wide plan for the eLearning/web-based modality. In the years since the ERNT occurred, an increasing number of Navy communities and commands have implemented eLearning/web-based distance learning both as a result of the RIT and as financial, business case analysis, and other reasons have warranted.

Before ERNT and since, SSP has delivered its MT training content as formal ILT and lab content. See Figure 1 for an overview of the current delivery of MT replacement and advanced training.

Pipeline + Advanced Training
- Two-Phase Evolution
- Total Strategic Weapons System (SWS) ILT: 32 weeks

Phase 1
MT "C" School
Kings Bay (KB) only

Formal ILT and Lab

Schoolhouse: IA Account (23 Weeks)

Phase 2
Advanced
KB & Bangor (BA)

7 ILT Courses offered during PDTP*

9 Weeks

Non-SWS (KB/BA)

Small Arms Force Protection

PDTP*

* PDTP = Pre-Deployment Training Period

Figure 1. Current MT Replacement and Advanced Training Approach

SSP, however, recognized a number of reasons identified by the RIT and other sources that caused them to consider moving to a blended modality content execution strategy consisting of ILT, lab, and Learner Directed Content (LDC), a term they use to describe eLearning/web-based distance learning. As
Department of Defense (Department of Defense Instruction, 2006), Navy (Revolution in Training, 2001; Navy Inspector General Report, 2009; Department of Navy Instruction, 2010), and other academic literature (Singh, 2003, Neuhauser, 2002 and Driscoll, n.d.) suggests, a blended modality strategy would be the most effective training approach for the following reasons:

- Allows instructors/facilitators to build LDC support skills in small increments
- Allows SSP to gradually move small increments of MT training content to LDC as schedule, need, and funds allow
- Provides the opportunity to use the best delivery modality to accomplish the required learning objectives
- Allows LDC to be used for knowledge components of content and ILT/Labs for the content that may require a more “human touch”
- Aligns with US Navy Chief of Naval Operation (CNO) initiatives that promote blended learning

Moving toward a blended modality environment required an SSP content migration strategy for those content objects appropriately identified as LDC candidates. See Figure 2 for an overview of the future continuum delivery of MT training content once the blended migration process is complete and compares the current and future approaches.

### Figure 2. Comparison of Current and Future Approaches for MT Training

Elements of the SSP blended content strategy included a new Instructional Systems Design (ISD) approach, Information Technology (IT) Infrastructure updates, revised manpower planning, policy and scheduling coordination with fleet units to support non-schoolhouse training components, and other related considerations. For this paper, a small slice of that larger migration strategy will be discussed—the software tools integration needed to support the delivery of MT Training content. SSP already possessed the GOTS toolset for ILT content creation and management, but it would have been expensive, time prohibitive, and redundant to build an LDC authoring capability into that toolset. SSP had to obtain a tailorable LDC production capability to produce and update the learner directed portions of the blended content and have ongoing access to that toolset for life-cycle maintenance of the LDC by their traditional SME contractor support team.
CONCURRENCY AND CONFIGURATION MANAGEMENT

If a second tool or toolset were introduced into the SSP content creation community to allow for creation of LDC in support of a blended content strategy, then extending the MT community’s current robust concurrency and configuration management capability to that second toolset would become a major issue.

Concurrency Management is a data management process for maintaining consistency and currency of the learning content data while supporting simultaneous access by more than one user (K. Plagis, personal communication, May 26, 2010). Configuration management is a discipline applying technical and administrative direction and surveillance to: (1) identify and document the functional and physical characteristics of a configuration item; (2) control changes to those characteristics; and (3) record and report changes to processing and implementation status. In the past, the single ILT GOTS toolset and business rules established by SSP ensured concurrency and configuration management of training content with the technical data and performance requirements upon which it was based, even with multiple SSP user activities contributing inputs to the development of the training content. Adding the second toolset for LDC creation would potentially create the need for a duplicative concurrency/configuration management process—one for ILT/Lab content, and one for LDC content. SSP quickly decided they did not want to manage concurrency/configuration of two data sets simply because the two content modalities were distinct to content creators and managers (as well as learners). Instead, they decided to acquire an LDC production capability that could leverage the concurrency management and technical data linkage capabilities already present in the GOTS ILT/Lab toolset they use.

Interestingly, a March 2009 Navy Inspector General report on Computer Based Training (CBT) stated that no mechanism was found to ensure curriculum and content was linked to Sailor Work duties (Navy Inspector General Report, 2009). While that statement about lack of linkage between Sailor work duties and training content may be true for CBT in the Navy as a whole, it was not true for historic SSP ILT/Lab training content, which maintained those digital links to authoritative technical data and could be configuration controlled and concurrency managed real-time. SSP reviewed the IG report, considered the blended MT content journey upon which they were about to embark, and embraced the challenge to deliver a blended solution of ILT, Lab, and LDC that would indeed be linked back to Sailor work, real-time.

PROTOTYPE PROJECT

Developing and maintaining this blended, concurrency managed MT training content would force a cultural and business process shift within the SSP community to extend their traditional toolset and business process. It would also obviously require the integration—or at very least communication—of their GOTS ILT production software toolset with some other LDC production toolset. In order to ensure integration of the toolsets, SSP decided to enlist a small sample size of their contractor development community to participate in a one-year pilot project to create the toolset integration, revise and refine content creation business rules, and produce a configuration controlled small sample of MT blended content (ILT and LDC portions, specifically) before moving to full-rate production.

The effort began in August, 2009 with two kick-off meetings in which the selected contractors were given briefings on the SSP vision for the prototype and the overall MT blended content development effort. Over the subsequent months roles and responsibilities of the MT Continuum prototype team were refined, job-task analysis was finalized, learning objectives were validated, content design and production processes were established, communication channels were formalized, validation and approval authority was instilled, and the non-proprietary technical configuration of the two disparate toolsets to support configuration and concurrency managed blended content was built. The configuration of the toolsets—which is a major element of the technical magic of the project—will now be discussed in detail.

TECHNICAL SOLUTION

The overarching requirements of these tools to integrate ILT and LDC development include:

- Basing all configuration-managed learning requirements and learning content structure on SME-validated work performance requirements
- Defining those requirements as standardized learning objectives, which in turn form the basis for the granular structure of the blend of ILT and LDC defined, developed, delivered, and maintained throughout the life-cycle of the MT Continuum project
Linking data products at all stages of learning content design, development, and maintenance to the authoritative technical documentation that is the core source of all MT training and job performance requirements

- Minimizing redundancy of data and business processes across the blend of ILT and LDC
- Automating the identification of potential change triggers such as job-task, learning objective, and technical data updates to minimize the investment in manual surveillance of ILT and LDC by program SMEs and ISDs, thereby leveraging the limited staff expertise and size on making needed changes to learning content quickly and efficiently

As illustrated in Figure 3, there are three basic authoring toolset components in this MT Continuum IT infrastructure:

1. Learning content design (and associated change impact reporting functions for effective life-cycle maintenance)
2. ILT content development and update, LDC detailed design, and blended learning content maintenance across the entire continuum (also with associated change impact reporting functions)
3. LDC development and update, based on initial development data inputs and surveillance data inputs from the design tool and data/metadata feedback to the design tool to enable that comprehensive and integrated ILT/LDC surveillance function

Figure 3. Overview of Toolsets and Data Flow for MT Blended Learning Content
Content Design Toolset

The content design toolset is a Web-based application that enables the user to capture, edit, and configure content design toolset. Once that job-task data is approved, the user can then create granular, standardized terminal and enabling learning objectives to define learning requirements. At this point, the content modality (ILT, LDC, Lab or other) is identified. Based on these learning requirements, the user then assembles the content outline of instruction that defines the structure of the blended course, module, lesson, and section taxonomy of MT Continuum training. The content design tool also supports development and maintenance of the structured planning documents required for managing a large learning content development project.

After the initial design process is complete, the content design toolset assists the user in configuration managing the baseline job-task, learning objective, and content outline data, including generating change impact reports as job-tasks, learning objectives, and content outlines evolve over the life-cycle of the program. These change impact reports allow the MT Continuum maintenance team to quickly identify both those lessons and sections potentially impacted by these various change triggers, focus SME/ISD resources on evaluating impacts and updating learning content, and also confidently ignore the far larger volume of lessons and sections that the change impact report omits.

ILT Development Toolset

Once the blended content data products are complete in the development toolset, they are exported to the content development tool via Web service. Content developers can then begin expanding the initial design for both ILT and LDC, including automated generation of metadata and linking to very granular levels of the technical data.

This tool supports complete development of ILT content and outputs SCORM 2004-compliant XML data packages including technical data hotlinks ready for instructor personalization and delivery in the MT Continuum electronic classrooms managed by SLC.

For the LDC lessons/sections of the content, the user can add media elements and populate storyboard/lesson specification tab with draft narration, screen displays, animations, storyboard notes, table text, interactions, and instructional design comments. Per the MT Continuum business process, the user coordinates this draft material within the development toolset and then exports the approved data to the LDC development tool set via an XML data package model developed by the two toolsets’ technical teams (the process describing what happens to LDC data once exported to the LDC toolset is described in the LDC Development toolset section).

Once the ILT content is finalized and the necessary final LDC content data/metadata has been imported back into the ILT development toolset, the content developer generates a comprehensive change impact report across the whole range of integrated ILT and LDC content based on periodic updates of technical data and other change triggers. This change impact report can track changes down to the individual discussion point or student guide sheets in the ILT materials and to the individual HTML screen in the LDC. Here, even more than in the design tool change impact report, the power of the integrated toolset maximizes the SME/ISD resources to focus with great confidence on analysis of learning content elements that may need to change and, of equal importance, to waste no time on that large percentage that are untouched by the change triggers identified and processed through the comprehensive change impact report.

LDC Development Toolset

The LDC development tool user imports the XML data package generated from the ILT development tool and automatically generates preliminary on-screen LDC segments for comprehensive team review and comment coordination. Once all team comments are coordinated and adjudicated, the content developer incorporates those comments and generates the final LDC content packages. These content packages are published to a prototype project repository and then delivered to the selected LMS ashore and afloat for delivery to MT Continuum students across the whole period of their training pipeline. Source files for the LDC lessons/sections are also exported to the repository from the LDC development toolset.

Another major data output of the LDC development tool is the XML-based data/metadata package exported from the LDC tool back to the ILT development tool to update the original draft data/metadata from which the final LDC content was generated. This import ensures that the ILT development tool has the latest, authoritative data for all ILT and LDC content as a valid basis on which to begin life-cycle surveillance and update of the blended MT Continuum content.
The configuration managed source files exported to the project repository by the content developer once the LDC content is approved become the basis for content updates. Whether these changes are major or minor in nature, they are focused via the change impact report generated in the content development tool and address all change triggers for the blended content all the way back to job-task changes going forward to the latest, most granular change to the authoritative technical data on which small lesson/section increments of the learning content are based.

VALUE OF APPROACH

Although SSP is still in the prototype phase of the project and full-rate production is not scheduled to begin until after this paper is submitted, historical data has been gathered and extrapolated to demonstrate the time and cost value of the process and capability being developed.

When SSP began using the GOTS ILT toolset for concurrency and configuration management of their training content more than ten years ago, they required a staff of forty individuals to maintain and update their training content. In the ten years since they have been able to reduce that staff to less than ten individuals and maintain the same surveillance capability, mainly due to the automated surveillance capabilities of the GOTS toolset.

If that same basic metric were extrapolated to the current MT Continuum effort (in which those same ILT concurrency and configuration management capabilities will be exploited for LDC content), training content maintenance and update could yield 350-400% of time and cost savings. Those savings are estimated based on time required to review and potentially update/modify every LDC “screen” when compared with time required to review only those screens that are affected by technical data or performance requirement changes. When labor costs are multiplied across large tracts of content, the savings potentially realized by this SSP MT approach grow exponentially.

Of even greater importance is the assurance that ILT content and LDC are technically current and accurate due to the processes and capabilities outlined in this paper, which in turn ensure individual MT readiness.

LESSONS LEARNED

Throughout the MT Blended Learning prototype development, various lessons learned have been gathered by the production team. The lessons learned include the following:

Technical Collaboration

The most critical element of beginning the software integration/communication process was a series of phone discussions, web meetings, and toolset demos between the GOTS and LDC toolset software engineers. Those exchanges were necessary to understand the core capabilities of each toolset, and how each toolset would support the non-proprietary exchange of data. Of course, clear functional requirements and design specifications socialized between the technical experts had to be derived before coding could begin.

The exchanges and clarification of requirements was greatly enhanced by the openly trusting and collaborative work of the ILT and LDC toolset software engineers. Their assignment was to make the toolsets pass data back and forth to each other via XML packaging, and the engineers did so with no hint of “toolset territorialism.” They made the tools pass data seamlessly in an open architecture manner, leveraging the strengths of each toolset and focusing on data versus tools. That relationship and work was able to commence immediately after the prototype kick-off meetings due to a prior professional relationship they had. Although the authors do not consider a prior relationship critical to the success of similar projects, it saved significant time and cost in this particular prototype.

Teaming

A unique element of the project has been the requirement for teaming between a number of Government and Contractor organizations, some of which had not worked together previously. After a few communication missteps in the first months of the project, it was decided a monthly status report in which all contributors could submit major accomplishments and barriers for the past month was needed. That report was then socialized among all participants before submittal to SSP for status review. That monthly report was supplemented with frequent web meetings and phone conversations by necessary stakeholders to ensure coordination and common understanding of vocabulary. After the initial communication missteps, it was decided that erring on the side of too much communication was a productive and needed standard operating procedure.

Interestingly, in those first months of the prototype when some problems were occurring in how the
software tools functioned and content was being built, one contributor was hesitant to share their concerns with how the ILT Design toolset performed certain functions. Once those concerns were shared, the ILT Design programming team was able to make changes to the toolset that greatly enhanced its performance. The key to that success was that the ILT Design team did not become defensive about inputs from others on the team! After that learning experience, all contributors have been forthright about speaking up when they recognize issues that could improve the process or performance of the toolsets. Ultimately, an unspoken determination of all participating parties to achieve project success in spite of any apparent contractual, technical, or personal roadblocks has served the project well.

Content Development Process

Since numerous contributors have been involved in the development of the MT blended training content, many processes for content development (unique to each organization) had to be melded into one streamlined process. That proved more difficult than originally thought, but a few elements of success contributed to improvement.

First, as mentioned previously, two very structured and highly detailed kick-off meetings clarified who owned specific parts of the overall development process, and their specific responsibilities in the parts of the process to which they were assigned. In future efforts similar to this, the authors would recommend reviewing lessons learned from all participant organizations on projects from which they are bringing their expertise to ensure the same lessons are not “re-learned” unnecessarily.

Second, the GOTS Design and ILT Development tool provider delivered formal training and continued follow-on support for the toolset’s use to all contributing teams of the project. Key to the success of that training was targeted instruction on the specific functions of the tools to be used, and training using real data from existing MT content so developers could focus on toolset capabilities and not interpretation of the “practice data” they were using for the training.

Third, a series of face-to-face integrated product review (IPR) meetings have been conducted on an as needed basis to resolve concerns unable to be resolved virtually, and to re-baseline certain expectations of the prototype as the work unfolded.

Fourth, the integrated team had to clearly identify who had SME ownership of the content being developed, and who had the rights to modify the content.

Fifth, the LDC courseware developer recognized that an organic MT SME presence at their organization would streamline the courseware development process. Although the LDC developer does not nor should function as the SME for any content in the prototype process as it has been defined, having that organic capability present would shorten development cycles and negate the need to contact SMEs outside their organization for “small questions.”

Finally, one of the contractors provided access to a web-based collaboration portal, where key documentation could be housed for access by all, and where needed storage of other critical data could occur (a “pull” versus “push” environment).

Contractual Relationship

The most obvious lesson learned from the prototype effort is the need for clear contractual responsibilities between collaborating contractors. Some roles and responsibilities were assumed to have been understood as the prototype began, and have had to be clarified as the effort progressed.

Although it was not an original requirement of the effort, the Design/ILT and LDC toolset contractors worked in a prime/sub relationship on the same contractual vehicle. In retrospect, that relationship has been very beneficial because it became much easier for the Design/ILT team (as key functional and technical support for that toolset) and LDC team (as primary ISD and LDC content developers on the project) to integrate both toolsets when operating under the same contractual vehicle and driving toward the same goal.

Although the other contractors contributing to the prototype were not under the same contractual vehicle, the authors recognize the value it has provided to the toolset integration task. However, the authors do not consider it a critical element of success in any similar effort--they believe the indispensable success factor is clear integration of all contracted parties by any project sponsor (like SSP).

CONCLUSIONS

Although this prototype project is under development, the authors are excited about the cost savings and readiness that are being achieved with the work that has been completed thus far. The authors believe blended learning that can be maintained technically current in a real-time manner is necessary for US Navy training, and that blended learning that cannot be maintained
current only realizes a small portion of the potential it purports to offer. The authors are hopeful other organizations can leverage the business rules and data models, the integrated product team lessons learned, and the technical solutions in this paper for their own benefit in implementing blended learning solutions that are completely and immediately aligned with the requirements upon which their blended learning content is based.

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