Cyber Training and Education

Cyber training and education has unique challenges and opportunities to enhance cyber crew competencies. This requires a combination of experience, efficiency, quality, and innovation to create meaningful and effective training. MOSAIC Technologies Group, Inc. (MOSAIC) possesses all four of these capabilities and applies them in different Instructional Systems Design (ISD) methods, such as applying Agile Development Methods.

1. Introduction

Founded in 2005, MOSAIC is a Veteran-Owned Small Business that provides Management, Technology, and Mission Solutions to clients primarily in the Department of Defense (DoD) and Intelligence Community. Of the many services we provide, we have three prime contracts which provide services applicable to cyber training and education: one for the Air Force, one for the Army, and one for an Intelligence Community agency. All these contracts follow the same general approach but are tailored to meet specific domain needs, like cyber.

MOSAIC maintains an awareness of USCYBERCOM updates and changes to individual and collective training requirements. MOSAIC adheres to DoD and organizational policies for developing Operating Instructions (OI). Operations training analysts connect with Joint and Service training counterparts to maintain awareness of potential changes to cyber training. Analysts review standing OIs for change or development in conjunction with Cyber Crews, evaluate changes, and incorporate any changes into Training Guidance.

MOSAIC reviews USCYBERCOM and other DoD guidance for training requirements, including future course schedules/exercises, qualification/certification levels, and staff availability. MOSAIC supports New Learning Solutions in order to automate processes and display information for in-progress, monthly and quarterly meetings.

MOSAIC provides effective cyber training to ensure our nation's cyber warfighters are prepared for any challenge. This training encompasses current tools and techniques, establishing a common foundation of knowledge and skills needed by all USCYBERCOM, JFHQ DODIN, and the Service Cybersecurity Service Providers (CSSPs)/Cyber Protection Teams (CPTs). Analysts evaluate and modify current and anticipated training needs, training curriculum, and training events for optimization; we tailor training to meet specific situational needs. To ensure optimized training, MOSAIC coordinates any changes with higher and lower HQ to ensure training intent is met and standardized.

MOSAIC cyber instructors are the core of developing and improving cyber mission effectiveness, thus our personnel are intimately familiar with the particular cyber weapon systems for which they train individuals. Our cyber instructors are Subject Matter Experts (SMEs) on their respective weapon systems - similar to any DoD weapon system training program. We train and certify instructors, who, in turn, administer Cyber Crew level training and standardize/evaluate activity at the mission unit. Analysts develop certification standards and training cycles for instructors from initial training to assisted platform and classroom instruction. MOSAIC utilizes scores and assessment guidelines to enhance cyber training events through 1. Analysis, Design, Development,

Implementation, Evaluation (ADDIE); 2. the Successive Approximation Model (SAM); and 3. the Agile-Scrum ISD (ASI) and evaluate the results through the Kirkpatrick model. Our analysts also act as advisors to cyber crew training authorities by facilitating and coordinating planning sessions and developing, vetting, and disseminating meeting minutes to ensure all parties are onboard with progress, decisions, and outcomes.

MOSAIC works closely with available cyber ranges, which includes within the services, and at the national and DOD level; often utilizing Joint Information Operations Range (JIOR) capability to connect these ranges together or maintain access. We schedule and deconflict training activities as part of a broader training strategy that traces individual training and certification to collective training and certification. This broader strategy is enabled by our intelligence discovery of new adversaries and capabilities, our weapons crew experience, and insights from Unit Visits (UVs). This new information is used to develop new training and certification requirements. These requirements are translated into new training objectives and are integrated by developing training "onramps" to exercise and certification milestones. These onramps ensure the newest information is reflected in the latest operational requirements and reinforced with appropriate training.

For each required mission task, crew members receive corollary training associated with the mission task to ensure that these tasks are properly performed. As cyber operators complete training, MOSAIC assists with post-training evaluation to identify any competency deficiencies and provide recommendations to help remedy those deficiencies.

MOSAIC's approach runs the full training and education lifecycle on our various contracts (e.g., job description creation, staff proficiency analyses, training needs consolidation, curricula matching to new solution development, course scheduling, student registration, facility and materials preparation, course instruction, progress tracking, training comprehension testing, training records management, training effectiveness evaluations). Setting the administrative portions of the lifecycle aside (i.e., course scheduling, student registration, etc.), our cyber training and education support focuses on addressing warfighter and other personnel needs through existing or new training and education solutions.

MOSAIC provides Instruction, Subject Matter Expertise, Curriculum Development, Multimedia Development and Management Administrative Support, Network Management, Equipment Maintenance and Accountability, Facilities Management, a Mobile Training Team, and Surge Training Support. Our overarching instructional design approach (Figure 1) to each learning solution is built on a foundation of expertise, innovation, efficiency, and quality. This foundation supports and guides our team through the phases of learning solution development: define, design, develop, and deliver.

2. Contributing Factors

MOSAIC brings EXPERTISE to support cyber training with applicable experience across multiple domain areas, including Cyber Operations, Intelligence Analysis, Oversight and Compliance, Software Development, and Programming Languages in various Government agencies. Our seasoned Training Developers, Media Specialists, Multi-Media Specialists, and Web Developers possess years of experience in creating courses and learning objects. Our experience gives us the

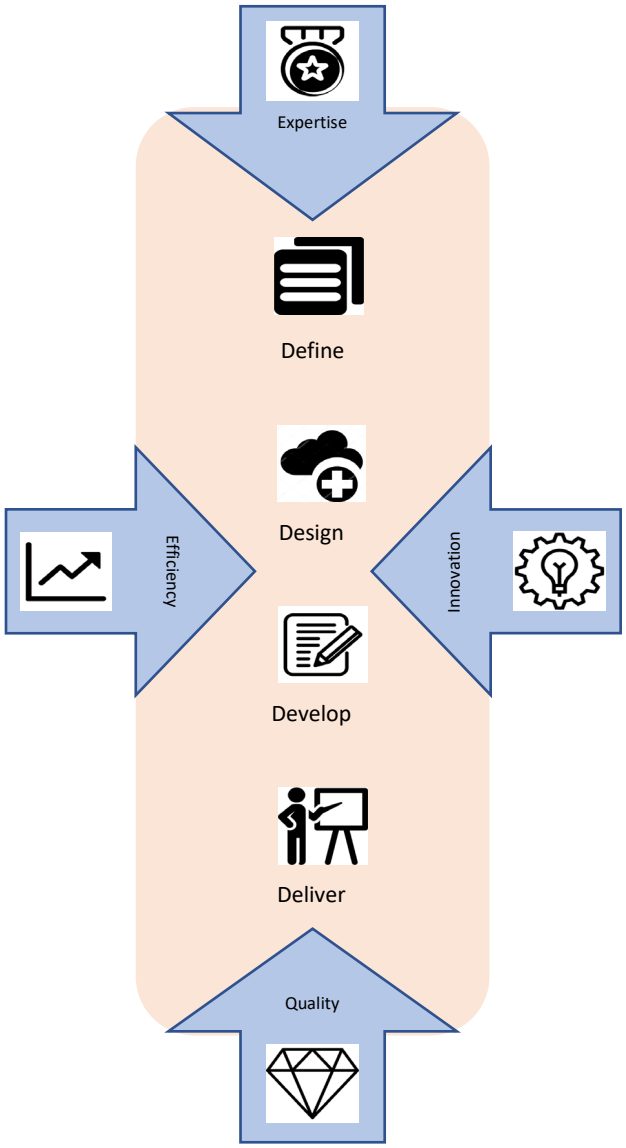

Figure 1: MOSAIC Instructional Design Approach

ability to successfully integrate courses within multiple compliance and technology requirements (e.g., section 508, SCORM, and HTML5). Learning solutions are provided across multiple platforms, to include Blackboard Learn, Saba Centra, K-ZO, Perception Questionmark, SumTotal, and various Enterprise Learning Management Systems (LMS).

MOSAIC applies INNOVATION to provide cutting edge solutions. Our team develops a comprehensive suite of templates for the entire course development lifecycle, which has standardized and stabilized course development, decreased production time, and increased course quality and alignment to training standards. We use templates such as the Design Plan Document, Detailed Content Outline, Creative Treatment Document, and Storyboards for the design phase. Templates for the development phase include: Job Qualification Standard (JQS), Structured on the Job Training, and Instructor-Led Training Instructor Guides, as well as Job Aids, Scenario-based exercises, XML-based quiz tool, HTML5 programming, and Storyline programming. We develop customized evaluation templates for implementation including the Course Maintenance Guide, Close Out Report, and After Action Report. We are trailblazing HTML5 development within browser constraints for Government customers needing to transition away from Flash videos.

MOSAIC emphasizes EFFICIENCY to meet critical time sensitive mission requirements. Our experience with the cyber training processes allows us to decrease ramp-up time developing learning solutions, and our proven methodologies, templates, and collection of reusable content allows for more rapid delivery of new learning solutions. MOSAIC leverages a “best match” staffing assignment approach that aligns staff to customers, providing similar content and multiple courses within a curriculum.

MOSAIC has a history of QUALITY performance to meet and exceed Government standards. MOSAIC defines a standard Quality Assurance testing for interactive and 508-compliant courses. MOSAIC integrates evaluation at every phase of the learning solution process to ensure the highest quality is achieved.

3. The Development and Delivery Process

3.1. DEFINE

Our process is triggered by the receipt of a new learning requirement. We start with the DEFINE PHASE, where we bring together team leaders (training developers, media and multi-media specialists, web developers, and content SMEs) to conduct high-level assessments of the requirement and determine the best task lead and resources for the course.

MOSAIC deconflicts and manages defensive and situational cyber capability requirements. Personnel use existing tools to provide leadership with understanding of Spectrum Management Operations (SMO) and impacts. MOSAIC actively engages with Joint Warfighter exercise development teams throughout the exercise development lifecycle to determine an analytical agenda. Any analysis is organized to deconflict and manage cyber capability requirements. Information is then displayed using a common suite of tools to provide the necessary data which enable commanders to understand the operation, the SMO, and impact.

To support the Joint Exercise Lifecycle (JELC), MOSAIC provides professionals with specific skills to accomplish assigned Red Flag, Cyber Flag, and Green Flag Exercise tasks. This includes SMEs who have been trained or gained experienced across multiple agencies. Our SMES include personnel with Red Team and ethical hacker experience/training from USCYBERCOM, DISA, CIA, and NSA. MOSAIC identifies potential exercises occurring during operational test periods. MOSAIC understands the training aspects of exercise participation and planning is key due in part to operational test and evaluation participation that is transparent to the exercise, requested months in advance, and receives approval from the managing agency for Red Flag. Our team coordinates with environmental planning offices to address handling issues (e.g., exotic materials and unproven technology) that ensure compliance with the National Environmental Policy Act (NEPA). MOSAIC also develops and coordinates safety plans for front line activities, weapons, and range operations with base/range safety offices to obtain approvals before deployment.

Learning Requirements are provided to MOSAIC by the Government through a Tasking Document, which contains many of the upfront requirements gathered by the Government learning team (e.g., mission managers, Curriculum Managers). MOSAIC assists the Government in deriving learning requirements by reviewing job descriptions and performing competency analyses. Combined with Mission needs, MOSAIC works with the Government to prioritize learning requirements. Based on a well-defined set of learning requirements and a deep understanding of the learner qualifications and the mission, we start to design the solution.

3.2. Design

The task lead and project team review the learning objectives, audience, content, schedule, and other considerations to determine the optimal instructional and delivery approach. This approach can be web-based training (WBT), instructor-led training (ILT), virtual classroom, video, gaming, field exercises, performance support or a blend of approaches to best meet the learner's needs and learning objectives.

MOSAIC develops training and exercise objectives and provides input on information technology (IT) infrastructure for range virtual environments. We develop training and certification building

blocks from crew training and integration through potential live fire and team certification activities. MOSAIC coordinates ongoing range requirements as well as exercises and ongoing training activities to ensure range availability. Using JELC to outline specific training and requirements, MOSAIC provides environmental requirements to the Live Virtual Constructive-Operational Training construction team to develop enclaves to support specific training events.

MOSAIC provides Learner Centric Skills Based Training to applicable training environments. This training strategy provides for students to learn at their own pace with facilitators providing guidance and feedback as necessary. MOSAIC ensures students meet the minimum required standards for training while encouraging and supporting early advancement in a structured self-paced training environment. MOSAIC provides additional training opportunities, peer teaching, advanced practical exercises for those students that have met required course standards early.

MOSAIC uses a range of instructional methods, which include traditional classroom, synchronous and asynchronous online training, web-based training, field exercises, structured-on-the-job training, job aids, testing, and formal and informal videos. In many cases, we have applied blended learning approaches bringing together several of these methodologies into one learning solution when it is appropriate. Figure 2 describes the Common Instructional Methods that can be leveraged for cyber training and education.

Traditional Classroom	
Best Use	• Learners require safe environment to practice • Complex/advanced-level content • Scenarios requiring peer interaction
Efficiency & Innovation	We leverage templates for Instructor and Student Guides, job aids and exercises to quickly and efficiently prepare course materials for each learning solution. We leverage scenario-based exercises with case studies to engage the learners and bring the course materials to life.
Synchronous Online Training	
Best Use	• Learners are geographically dispersed • Scenarios requiring peer interaction • Learners require safe environment to practice
Efficiency & Innovation	We leverage templates to quickly and efficiently prepare course materials for each learning solution. We bring innovation to synchronous online training by leveraging technology, such as Adobe Connect, for collaboration among students and Synchronous eLearning to capture sessions for just-in-time access and performance support.
Asynchronous Online Training	
Best Use	• Requires an instructor to facilitate or monitor progress • Time is not a driving factor in delivery • Content requires peer interaction
Efficiency & Innovation	We rapidly and efficiently create courses in an ELMS by using our pre-existing templates as well as re-used materials and developers from previous courses. The course blends multiple approaches to asynchronous training allowing learners to contribute to threaded discussions, engage in peer reviews, and execute group exercises from across the globe.
Web-Based Training (WBT)	
Best Use	• Stable content that needs to reach a large, dispersed learner base • On-demand to support successful performance of the job or to enhance the knowledge, skills, and abilities
Efficiency & Innovation	We use standardized templates for every phase of course development and re-use assets (e.g., graphics, knowledge checks). We build interactive elements, such as coding simulators. We incorporate virtual world scenarios.
Field Exercises	
Best Use	• Operational environment cannot be simulated sufficiently • Multiple roles need to be trained and evaluated simultaneously

Efficiency & Innovation	We incorporate real world scenarios based on recent operations and topics. Data may be taken from previously executed missions. Mission experts are used to validate the simulations and make adjustments for current trends or surprises. Usually, these exercises require instructors traveling to the target audience instead of students coming to the training.
Structured on the Job Training (SOJT)	
Best Use	• Content changes frequently, but needs to be taught in a systematic, repeatable way • Small number of learners • One-on-one coaching is required
Efficiency & Innovation	We leverage reach-back support from Mission SMEs across MOSAIC and Government to quickly get up to speed on the mission environment and learners needs. We design interactive PDFs; "show me" tutorials using tools, such as Camtasia, to provide dynamic on the job learning.
Job Aids (Performance Support)	
Best Use	• Supplements other learning delivery methods (WBT, distance eLearning, SOJT) • Just-in-time recall on-demand, and as building blocks in Performance Support Systems
Efficiency & Innovations	We create Performance Support Systems for use as context-sensitive help using COTS products such as RoboHelp, JQuery Libraries, and WalkMe (on unclassified networks). We re-use Job Aids and Performance Support Systems across other learning solutions whenever possible for efficiency and consistency.
Blended Learning	
Best Use	• When learners will benefit from multiple learning modalities
Efficiency & Innovations	We gain efficiencies in development and implementation by using the VLE tools available, such as the ELMS, for "one stop shopping" to house and access blended solutions. We integrate micro-learning components into traditional courses on the ELMS.
Formal and Informal Instructional Videos and On-Demand Micro-Learning	
Best Use	• Short content is needed on demand • Short content is part of a larger performance support strategy
Efficiency & Innovation	We develop rapidly and efficiently using custom script templates as well as an adapted ASI. We leverage various graphical approaches, virtual worlds, and HTML5 programming to develop cutting edge micro-learning solutions.

Figure 2: Common Instructional Methods

MOSAIC endeavors to design sustainable learning solutions. We design courses upfront based on existing requirements expecting content updates to be made periodically. For each course, we provide a course maintenance guide that describes the structure of the course package and dependent files along with any recommendations from the design team to jump start the course revision/conversion effort. We design courses with Government-standard tools rather than proprietary software to increase ease of updating. For requirements that revise/update or convert existing cyber courses from one mode to another, we perform an upfront quality review to identify any issues from previous development and issues that may arise based on updates to cyber tools, technologies, and standards.

3.3. Develop

MOSAIC works closely with the Government to establish curriculum development, modification, and revision priorities and provides a timeline for completion and delivery of curriculum based on those priorities. If needed, MOSAIC proposes modifications to timelines to support required changes to delivered curriculum to meet Government requirements for acceptance.

MOSAIC and the Government leads determine the best fit and delivery method that leverages principles from industry best practice program management methodologies for Instructional

Systems Design (ISD). Our team uses the following three ISD approaches: 1. Analysis, Design, Development, Implementation, Evaluation (ADDIE); 2. the Successive Approximation Model (SAM); and 3. the Agile-Scrum ISD (ASI).

ADDIE is best used on learning projects where the SMEs have highly limited availability, when the scope of the project is an update to an existing course, or when the design and development resources are not available at the same time. It is most appropriate for WBT greater than 30 minutes, Asynchronous and Synchronous Distance eLearning, ILT, SOJT, and Performance Support projects.

SAM is our model for learning solutions where the content is in flux but development needs to be rapid, when Mission Customer engagement is critical to infuse innovation throughout the project. SAM uses all the phases of the ADDIE model, but in a much more flexible and collaborative way involving the developers and customers throughout the process.

The ASI model (Figure 3) uses an empirical process that provides more dynamic, complex, and flexible learning strategies – with shorter delivery cycles and continuous improvement. This is a model developed to best meet the needs of the cyber customers for rapid training development. The ASI model has been used to successfully develop learning solutions for various platforms. The objective in using the ASI model is to improve teamwork, communications, speed, and ultimately deliver learning solutions that more closely align to the learner's need.

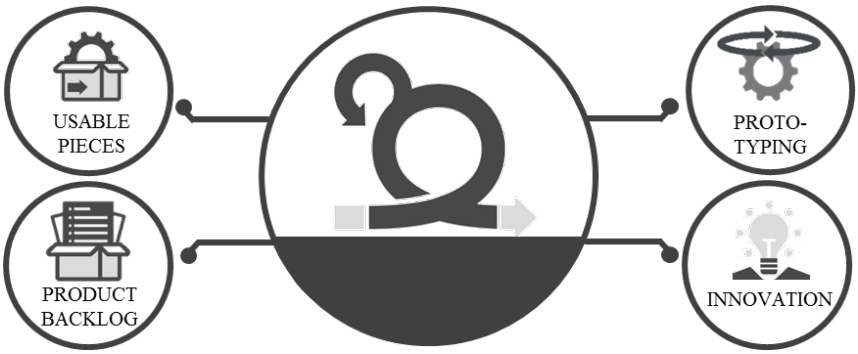

Figure 3: ASI Development Model

The ASI model enables rapid development through iterative review and course-correction spins. This Agile-based model enables us to develop usable pieces of micro-learning throughout development (narrative, illustrated script, video) in a time-boxed single iterative cycle that produces a working, deliverable, and testable learning product. The Learning Product Backlog consists of both high-level learning outcomes as well as functional requirements to satisfy a given learning need. The high-level architecture and technical infrastructure for the micro-learning solutions are determined as well as an overarching media strategy and creative treatment. ASI fosters innovation with open "no idea is a bad one" brainstorming, diversity of team members, and recognition of opportunities early due to rapid prototyping.

MOSAIC produces, maintains, and updates all curriculum-related items, lesson plans, Practical Exercises (PE's), etc. that support changes required by new equipment fielding, equipment software or hardware updates, removal of equipment from the DoD inventory, in response to student end of course critiques and spot critiques with Government approval, changes in the critical task list, changes to training strategy, or other Government required modifications.

MOSAIC produces, maintains, and updates Interactive Multimedia Instruction (IMI) material utilizing existing software in support of all curriculum and equipment taught. MOSAIC produces interactive training materials that supports training strategies and concepts aligned with Government standards, such as the Army Learning Model. MOSAIC updates, designs, and produces small scale training interactive 2D and 3D CBT and 3D IMI products to support training and performance-based assessments to fill gaps between equipment availability and existing simulations as well as additional identified training needs.

MOSAIC ensures all material produced is playable on any device to include Apple, Android, and Windows smartphones and tablets in support of "Bring Your Own Device" initiatives and playability via multiple platforms (e.g., LandWarNet eUniversity) for sustainment and field training capability.

3.4. Deliver

MOSAIC is poised to adjust training delivery based on the needs of the customer. Training needs often change due to fluctuations in student load, changes in training hours, additions or deletions of courses, and addition/removal of equipment into/from a course. MOSAIC provides instructional support via facilitation, small group instruction, and instructional techniques supporting Army Learning Model concepts. MOSAIC ensures Instructor personnel remain technically qualified and up-to-date on classroom instruction methodologies and best practices.

MOSAIC instructors administer automated, written, and hands-on testing in subjects taught, to include grading of exams, evaluation of results, recording of exam results, and conducting of After Action Reviews (AARs) with the students. MOSAIC ensures test scores are input into the student records in the current Government academic record keeping system. MOSAIC conducts test item analysis on all exams given, identifying trends for individual test question modification, adjustments to classroom training, and lesson material updates. Our instructors evaluate students and report academic concerns to the Government, and, when warranted, by classroom performance (i.e., academic test failure, excessive absences, etc.), facilitate assignment to remedial training or other unit contract requirements on the same day.

MOSAIC team members conduct instructor certification training. Team members teach the Instructor Certification Course (ICC) on a monthly basis and as needed at the location of assigned cyberspace weapon system operators. Team members update training curriculum, to include lesson plans, student guides, written tests, and classroom presentations, based on student feedback and changes to Government instructions. Team members perform student evaluation and provide appropriate documentation of training completion.

4. Summary

Effective cyber training and education requires a well-defined process, which emphasizes adjusting for new or changing requirements, stays on top of the latest cyber technologies and techniques, and identifies the optimal delivery method. MOSAIC brings the right experience, efficiency, quality, and innovation to cyber training, producing great results to the people who need to know what to do in times of need.