

Analysis of Trainee Performance for Automating Training and Scenario Recommendations

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Abstract — Thorough trainee evaluation requires subject matter experts to assess current performance and recommend future training that is optimized for each individual. Presently, with limited subject matter expert availability and large volumes of data generated from today's training environments, a comprehensive and consistent trainee assessment is impractical, if not impossible. Typically, this impacts the quality of analysis required to determine a trainee's actual proficiency, which in turn degrades the ability to select the most appropriate future training, which further degrades the ability to determine if a scenario can truly ensure that training objectives are mastered.

To overcome this problem, we have designed a system that ingests training data, calculates predetermined Measures of Performance and then provides scenario recommendations that ensure trainees master warfighting skills as intended. By tracking trainees throughout their career, we can identify when a skill is mastered and how often trainees need to practice that skill to stay proficient.

This presentation will provide an overview of the selected approach, system design, and evaluation. In close cooperation with operational users, a concept of operations has been defined and a system architecture was developed that allows processing of large volumes of training data and is adaptable to various file types and file formats. Leveraging commercial off-the-shelf products, a demonstration system has been built. Using example datasets from two different training environments producing multiple data formats, we were able to successfully demonstrate data recognition and ingestion, Measure of Performance evaluation, trainee tracking, and optimized scenario recommendations.

1 Purpose and Objective

Emerging warfare capabilities offer many novel tactical options to commanders across all facets of warfare. However, the dynamic and complex nature of integrating these new capabilities into existing operations results in a multitude of training challenges. As the complexity of tactics, techniques, and procedures (TTPs) increases, realistic simulated training becomes paramount. Along with the associated increase in simulated training comes the challenge of building and choosing the best scenarios for the training objectives.

Thorough trainee evaluation requires subject matter experts (SMEs) to assess current performance and recommend future training for the individual. With limited SME availability and large volumes of data generated from today's training environments, thorough and consistent trainee assessment by SMEs is impossible. This leads to a common training deficiency where, although the training events are diligently tracked, very little analysis is done to determine a trainee's true proficiency. Without this knowledge, selecting a follow-

on training scenario that is tailored to that individual and ensures mastery of previous deficiencies is impossible. Fleet Operational eXercise Training for Warfighter Optimization (FOX TWO) fills this gap. Trainee proficiency is qualitatively assessed, and the most effective and efficient follow-on training scenario is recommended to minimize training time and maximize trainee's skills.

The objective of this effort was to design and develop a software technology that leverages data science, artificial intelligence, and advanced computational analyses of tactical data sources to improve training assessments and to automatically select future scenario recommendations that make training more adaptive, efficient, and effective.

2 Current Training Shortfalls

In today's live and simulated training, Measures of Performance (MOPs) are used to analyze how well an individual or team performed, to document the training,

and to track their training progress and current readiness. Unfortunately, little analysis is done to determine if the chosen training scenario actually ensures the trainee masters the tactic/procedure, or if there is a more effective scenario for that training objective. Today's typical scenario generation is conceptualized in Fig. 1.

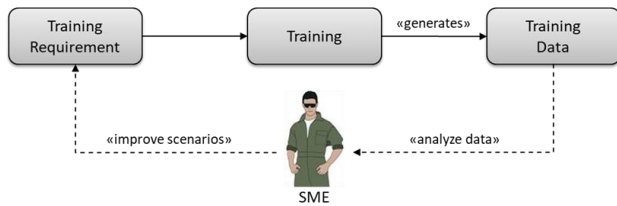


Fig. 1. Typical training cycle today.

The current training cycle has multiple shortfalls and is insufficient to deliver the amount and quality of training that is required to meet the demands in a rapidly changing security environment. In the following, two main challenges are outlined.

Challenge 1 – Insufficient Automation; Dependence on Manual Tasks: Initially, a trainee is required to train to a certain task or skill. An SME (e.g., Training Officer, Simulation Instructor) is then required to develop or select a training scenario that trains to that requirement. That SME is also required to develop the necessary training products (like attack plans, rules of engagement, etc.) for all other participants. Once the training takes place, a large quantity of data is generated that is rarely saved longer than to be used for the immediate training event debrief. In general, the only products saved from current training events are a grade sheet and perhaps some lessons learned. Unfortunately, neither the grade sheets nor lessons learned tend to be used outside the unit conducting the training.

Challenge 2 – Too Few Subject Matter Experts (SMEs): Any change to future training is made by the SME and is limited by the SME's time and availability. The SMEs must use their own personal judgment to determine how well the scenario contributed to the training of the required task compared to all other possible scenarios.

3 Solution Approach

In a recent research effort for the US Naval Air Warfare Center Training Systems Division (NAWC TSD) Team Prevalance, composed of Prevalance Inc., aditerna GmbH and Old Dominion University's Virginia Modeling, Analysis and Simulation Centre (VMASC), designed FOX TWO system to address the outlined training challenges.

Training data is automatically uploaded by FOX TWO, preprocessed and then postprocessed by a variety of analyzers. These analyzers determine how well a trainee met predetermined MOPs. Through individual training performance tracking, FOX TWO provides follow-on scenario and training recommendations that ensure trainees will master the required warfighting skills. By tracking trainees throughout their career, FOX

TWO's learning system can identify when a skill is mastered and how often trainees need to practice that skill to stay proficient.

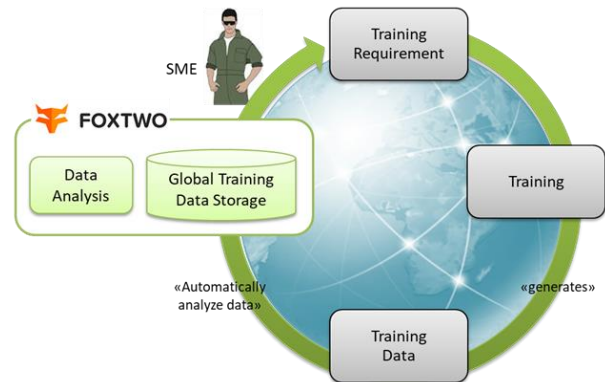


Fig. 2. Data analytics as an integral part of an iterative training cycle.

Fig. 2 illustrates how FOX TWO integrates as an integral part into an iterative training cycle; adding advanced automation to complement the SME's ability to conduct, assess and improve training. FOX TWO replaces manual analysis of training events by advanced automated data processing, analysis, storage, and re-use. FOX TWO accesses the stored global training data from past training events and adjusts an individual's training profile and scenario selection resulting in both a more efficient and effective path to training proficiency.

3.1 User Communities

FOX TWO is designed to integrate seamlessly into a user's current operating environment. It guides the individual user through an easily understood user interface and serves multiple user communities, such as:

- The individual trainee can use FOX TWO to assist them in selecting the ideal training scenario to meet the training objective they are trying to achieve
- Training and operations officers can use FOX TWO to plan training events to provide the most efficient use of the available assets
- Training centers can tailor training events to meet all users' objectives, maximizing available instructional time and minimizing product development time
- Instructors can use FOX TWO to vary a multitude of training parameters to provide scenarios that produce the most effective learning
- Unit Commanders can use FOX TWO to build training events that best integrate multiple assets under their command

3.2 Simulation Resource Planning (SRP)

Simulation Resource Planning (SRP) is the management of all processes and work items (products) throughout the entire planning, development, and usage cycle of simulation models and systems. The critical aspect of SRP includes all lifecycle phases, instead of focusing on dedicated parts. Information collected at an

early stage, like training and exercise planning, is vital in later phases and may not be reconstructed afterward. Processes improve the maturity of preparing and executing simulation-based training and exercises. Processes create work items (products) and must be organized and managed efficiently and effectively.

aditerna SRP is an integrated tool suite that supports SRP. It provides unique capabilities for managing all aspects of simulation-based training and exercises. Team Prevailance used aditerna SRP as the core of the Training Resource Management and User Interface module. Fig. 3 shows an overview of the aditerna SRP capabilities. FOX TWO leverages aditerna SRP and builds upon existing capabilities.



Fig 3. aditerna SRP Capability Overview

3.3 Training Resource Management (TRM)

The FOX TWO Training Resource Management (TRM) module allows the management of all training and exercise-related resources and products. This includes:

- (Manual) definition of scenarios
- Upload of scenario products
- Management of master data, e.g.
 - Training objectives
 - Training and Readiness requirements
 - Mission Essential Task Lists (METLs)
 - MOPs
 - Aircrew information (units, crew members)
 - Platforms

Users can add, modify and delete information as required. Data can also be searched and accessed as required. FOX TWO integrates the existing Training Resource Management (TRM) module provided by aditerna SRP with a newly developed Knowledge Engine to automate scenario recommendations, improve training efficiency and support data assessment through MOPs. To achieve this, FOX TWO merges manually entered information with automatically created results of the FOX TWO knowledge engine and provides a common picture to the user.

4 Conclusions and Way-Ahead

FOX TWO is a novel data analytics approach to improve effectivity and efficiency of training. Key benefits include:

- Support for automatic download, transfer, and analysis of raw training data from simulators, distributed training centers, live ranges and aircraft.
- MOPs are calculated automatically, enabling tracking of an individual's performance over time.

- Recommendations of training scenarios tailored to the individual trainee to minimize training time and maximize skill proficiency.

- FOX TWO integrates seamlessly into current training programs.

To achieve these benefits FOX TWO is leveraging aditerna SRP as an existing training resource management system and adds a newly designed and developed Knowledge Engine to provide data analytics. It is designed

- to ingest various types of training data, including text-based, audio and video files;
- to scale from individual training to large exercises and is designed to operate on very large volumes of training data; and
- to store original training data for analysis improvements and traceability.

The FOX TWO system design and prototype application were successfully evaluated with different training data sets (different simulators, different volume, and format).

Next steps include operationalizing FOX TWO – i.e., moving from a demonstration system to a (cybersecurity accredited) operational system – and transitioning FOX TWO into operational use.

Author/Speaker Biographies

Dr. Robert Siegfried is a Senior Consultant for IT/M&S projects and Managing Director of aditerna GmbH. Robert is serving as NMSG Vice-Chair and is co-chair of NATO MSG-164 (“MSaaS Phase 2”). Robert is a member of the Executive Committee of the Simulation Interoperability Standards Organization (SISO) and is actively engaged in multiple SISO working groups.

Tamme Reinders is a Senior Consultant for Data Warehouse and Business Intelligence projects and Managing Director of aditerna GmbH. Tamme is an Oracle Database SQL Certified Expert, and has developed requirements engineering methods to establish a continuous process throughout the lifecycle of a system, enabling the further development of complex systems.

Mark Burgess is a Commercial Services Developer for Prevailance. Mark served 20 years in the US Navy as a Naval Aviator. He deployed for three combat cruises and served as aviation maintenance department head in an operational F-14 squadron. Prior to Prevailance, he provided contract support to OPNAV N98 in the Aviation Warfare Training Division. He also currently serves as the Chief Instructor Pilot for Prevailance Aerospace.

Dr. Krzysztof Rehowicz is a research assistant professor at the Virginia Modeling, Analysis and Simulation Center (VMASC) at Old Dominion University (ODU). His research interests focus on making the world more inclusive through sensory and reality augmentation. He is currently the Digital Senses Lab lead. Krzysztof is also an IEEE Senior Member and a member of the Society for Modeling & Simulation International.