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<td>1330-1400</td>
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<td>LCC Cost Model Connections to Engineering Models</td>
<td>Drew Kelley</td>
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<td>Diane Alvarez</td>
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<td>Cynthia Forgie</td>
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<td>Craig Andres</td>
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<td>MAJ William Viegas</td>
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<td>Matthew Banta</td>
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Statistical Analysis & Modeling of Historical Acquisition Data

Colleen Pleasanton
AMSAA
colleen.f.pleasanton.civ@mail.mil
1300 to 1330
Room 3
Working Group 6b

Statistical Analysis & Modeling of Historical Acquisition Data: AMSAA developed a statistical schedule model to create a distribution of historical program acquisition times that reflect possible time outcomes for a new acquisition program, phase or event. A stepwise linear regression model was the initial basis for the model. Various techniques were used to build a distribution around the time prediction from the regression model for a new acquisition program. The current tool integrates many different types of machine learning models. The tool includes multiple methods to help analysts choose which model is the best for the acquisition program under evaluation. The tool is currently coded in R.

LCC Cost Model Connections to Engineering Models

Drew Kelley
USACE ERDC
drew.e.kelley@erdc.dren.mil
Co-Authors: James Richards
1330 to 1400
Room 3
Working Group 6b

Implementing model-based engineering (MBE) in conjunction with physics-based design computational models early in the design process can provide large tradespaces for analysis of alternatives (AoA). Previous Engineered Resilience Systems (ERS) Life Cycle Cost (LCC) research efforts to translate excel-based cost models that were executable within a physics-based tradespace analysis tool resulted in extensive programming efforts. Current research leverages an open source python package to automate the model integration process. The improved workflow process can lower the
barrier for integrating cost analysis with other tradespace domains. This presentation explores the analysis and implementation of the aforementioned method and the application and use within ERS tradespace tools.

**Modeling and Operational Effectiveness Assessment of Manned Unmanned Teaming (MUM-T) in an Armored Brigade Combat Team (ABCT)**

Hector Aguirre  
TRAC-WSMR  
hector.j.aguirre.civ@mail.mil  
1400 to 1430  
Room 3  
Working Group 6b

The extent to which MUM-T concepts can provide operational benefit to combat fighting units is not well understood. In 2018, the Army Science Board (ASB) asked the Training and Doctrine Command (TRADOC) Analysis Center (TRAC) to conduct an analysis with force-on-force modeling and simulation to answer the question: What is the impact of alternative MUM-T concepts on the operational effectiveness of an ABCT Combined Arms Battalion? Leveraging an autonomy framework, the study team defined each alternative based on the ratio of human operators to robotic combat vehicles; force structure and maneuver differences; human and robot responsibilities for "sense, plan, or act" during operations; their interactions; and enabling capabilities based on science and technology community assumptions. Working with subject matter experts, the study team applied the initial definitions to further develop the MUM-T alternatives, using a mapping exercise to produce the concept of operations, and tactics, techniques, and procedures (TTP). The TTPs specified contingencies for MUM-T points of failure, including those elicited by electronic warfare. Each MUM-T alternative had the following distinct input differences: force structure changes (increased number of robotic combat vehicles (RCV)/manned combat vehicles (MCV)), variation in maneuver speeds, and scheme of maneuver routes, formation spacing, as well as communication linkage ranges (MCV to RCV in terms of maximum ranges). In addition, the study team conducted an analysis of the reaction time architecture for direct fire engagements. In all, the MUM-T alternative development produced distinct inputs to the closed-form One Semi-Automated Forces (OneSAF) model.

The presentation will address alternatives development, integration of scenario details into the model, and analytic results.
Future Vertical Lift (FVL) is the program of record for the Department of Defense's next generation of military rotary wing aviation. With goals for performance, reliability, and availability that far outpace the current fleet, FVL is envisioned as a giant technological leap ahead. The support concept for this new aircraft should therefore take into account advances across the board, rather than continue maintained and sustainment in the same manner as DoD has accomplished for the last five decades. One such new maintenance theory is the notion of a Maintenance Free Operating Period (MFOP), where the aircraft and sustainment concepts are designed to allow for long run operations without any maintenance action required, either corrective action due to failure or routine preventive services. An MFOP maintenance strategy is a departure in thinking and "business as usual" from the current sustainment concept, even with advances such as Conditions Based Maintenance, and requires planning early in the acquisition lifecycle. This study considered an MFOP strategy in order to better understand the theory, design, implementation, and implications to future operations. It involved the construction of a discrete event simulation of a notional assault battalion conducting flight operations for at least one year. Variables and output measures tracked the results of each simulation scenario in order to determine the possible effects of varying the maintenance paradigm and sustainment concept. Ultimately, MFOP presents a way forward for FVL that could provide units with greater availability and an increased probability to achieve longer windows of operation, while decreasing the operational and sustainment costs.
This project uses the planning phase of network operations as a model to develop measurement systems to predict effectiveness of weapons systems. Measurement systems for test and evaluation are often designed to measure a system against an established requirement. This approach is reactive, hindering the predictive nature that is desired for weapons system evaluation for an undetermined future. Prediction models are not new, but creation of useful models have been challenging. Success is dependent on collecting and retaining needed data. Determining the proper data requires a focus beyond the requirement for the weapons system. This focus needs to consider the cyclic operational process. The military decision making process (MDMP) demands data collection that enables the analysis phase of operation. Network planning utilizes a model that computes placement of assets based on known signal propagation limitations and battle space physical characteristics. In a similar way use of test and evaluation data could be used to improve battle predictions given a model that leverages military operation design.

The Future of Army Systems Performance Data

Jerod Bernicky
AMSAA
jerod.m.bernicky.civ@mail.mil
Co-Authors: Scott Pridgeon
1545 to 1615
Room 3
Working Group 6b

The U.S. Army routinely conducts force-on-force modeling in support of Army acquisition related decisions. These models and associated analyses require a significant amount of characteristics and performance data which AMSAA develops and provides in support of these efforts. AMSAA is continually identifying, developing and implementing metrics and process improvements with the potential to improve the overall efficiency of data delivery and quality of data provided.

This presentation will provide an overview of the Army data mission and describe initiatives to shorten data delivery time-lines and improve overall data quality. This presentation will also provide an overview of all primary process improvement efforts along with efforts to ease the burden on the data stakeholders requesting data and where we see the Army data mission in the future.
Migrating Logistics Battle Command to the Cloud

Jonathan Shockley
TRAC-LEE
jonathan.d.shockley.civ@mail.mil
1615 to 1645
Room 3
Working Group 6b

Developed by the Army's Training and Doctrine Command Analysis Center, the Logistics Battle Command (LBC) model is a discrete event simulation written in Java that uses the Naval Postgraduate School's Simkit Application Programming Interface (API). Currently LBC is used by analysts primarily to support Analyses of Alternatives (AoA), i.e., comparative assessments of weapon systems, vehicles or concepts of support, with respect to their impact on military logistics and operational energy (OE). Over the past year, LBC has been completely redesigned into an API for modeling sustainment. This effort, along with the development of a new web-based decision support tool, has allowed LBC to be successfully migrated to a Web Service computing environment managed by the Naval Post Graduate School. This application takes advantage of the tremendous computing power available in an AWS data center, providing a robust data-centric approach to analyzing sustainment, and brings the full power of LBC to logisticians and planners deployed throughout the world.

Maneuver Battle Lab (MBL) Analysis Surveying Tool (MAST)

Cynthia Forgie
Maneuver Center of Excellence
cynthia.c.forgie.civ@mail.mil
Co-Authors: James Gentry
1245 to 1315
Room 3
Working Group 6b

The Maneuver Battle Lab (MBL) Analysis Survey Tool (MAST) is a Microsoft Excel Workbook that employs user forms, created with Visual Basic for Applications (VBA), to assist with data harvesting and analytics. MAST is a menu based spreadsheet application that supports a variety of common data collection and analysis requirements. Basic functionality includes survey design, administration, data collection, data reduction and multiple reporting features. MAST was originally developed to establish a standard for
data harvesting and expedite experiment findings within the Army Expeditionary
Warrior Experiment (AEWE) line of effort. MAST is not a standalone analytical program
and was never intended to function independently outside of AEWE. However, the
functioning application can easily be manipulated to meet different experiment needs.
Multiple organizations including the United Kingdom Army Warrior Experiment team,
Australian Army and Marine Corps Warfighting Laboratory (MCWL) have expressed
interest in the tool as a cost effective alternative to more complex software tools. This
presentation will provide an overview and a demonstration of the tool, followed by a
discussion of real world applications and efficiencies.

Day 2: 17 October 2018

Verification of Truncated Random Data: Challenges and Recommendations
for Modeling Behind Armor Debris

Craig Andres
RDECOM/SLAD
craig.d.andres.civ@mail.mil
1315 to 1345
Room 3
Working Group 6b

VERIFICATION OF TRUNCATED RANDOM DATA: CHALLENGES AND
RECOMMENDATIONS FOR MODELING BEHIND ARMOR DEBRIS
Craig D. Andres, RDECOM/SLAD
Abstract. MUVES generates Behind Armor Debris (BAD) based on probability
distributions fit to observed test data. Truncated Log Normal data is generated for both
shape factor and presented area for each fragment, and Truncated Weibull data for the
cone angle. As part of the Verification effort for MUVES, it is necessary to check that the
data generated is distributed as expected. This presentation will discuss the
assumptions, limitations, and results surrounding the creation and manipulation of this
data. Further considerations will also be discussed with respect to the advantages and
disadvantages to using a probability distribution with a closed support such as the Beta
distribution.
Simulation Comparison between the Infantry Warrior Simulation (IWARS) and the One Semi-Automated Automated Forces Simulation (OneSAF)

Dean Muscietta
AMSAA
dean.c.muscietta.civ@mail.mil
1345 to 1415
Room 3
Working Group 6b

One Semi-Automated Forces Simulation (OneSAF) and the Infantry Warrior Simulation (IWARS) are two simulations that can be used to examine the impact of system or item-level performance on mission success in an operational environment. OneSAF is an entity-level composable Computer Generated Forces (CGF)/Semi-Automated Force (SAF) simulation designed to model brigade and below, combat and non-combat operations. IWARS is analysis driven, entity-based, multi-sided force on force combat simulation focused on individual and small-unit dismounted combatants and their equipment. IWARS was developed for use as a Modeling & Simulation (M&S) tool focusing only on analysis use cases.

In order to support selection of the most appropriate simulation for use in answering specific study questions, AMSAA conducted a comparative study between OneSAF and IWARS. The comparative study was conducted using two basic scenarios - a meeting engagement scenario with open flat terrain and a building clearing scenario. These two scenarios were executed in both OneSAF and IWARS employing similar terrain databases. The scenarios were selected to exercise methodologies that differ between the two simulations in order to examine the impact of these differences on the results. In addition to comparing the results generated from both scenarios, several other areas such as scenario generation, loading of AMSAA weapon system performance data and data collection were examined for a comparison of usability.

Infantry Warrior Simulation (IWARS) Methodology Development to Support the USMC Personal Protective Equipment (PPE) Study

Jeremy Collins
AMSAA
jeremy.a.collins.civ@mail.mil
1415 to 1545
Room 3
Working Group 6b
The Infantry Warrior Simulation (IWARS) has been modified in support of a U.S. Marine Corps Combat Development Center (MCCDC) study to determine the amount of PPE that should be worn to maximize mobility and retain survivability. This study helped to inform requirements for future PPE worn by individual Marines in various threat environments. The MCCDC Fires and Maneuver Integration Division requested IWARS Modeling and Simulation support to help answer a portion of the PPE study questions. IWARS is an analysis driven, entity-based, multi-sided simulation focused on individual and small-unit dismounted combatants & their equipment.

In support of the study, additional IWARS methodology was developed and incorporated in IWARS v5.1. The methodology and associated data made it possible to determine how the movement speed under various loads carried by Marines affected mobility and firepower. It also helped to determine the usefulness of Side-Small Arms Protective Insert (SAPI) plates worn during a direct-fire engagement in an operational environment. In addition the methodology also captured the number of hits on the side-SAPI plates. The new methodologies in IWARS will support examining the trades between protection provided by side-SAPI plates and the impact of added weight.

"The world is changing rapidly, and the operating environment is becoming more contested, more lethal, and more complex." - Multi-Domain Battle: Evolution of Combined Arms for the 21st Century

Army studies require Models and Simulations (M&S) to represent Multi-Domain Operations (MDO) and cross-domain effects, but great uncertainty exists across the Army as to what MDO is, and how to adequately represent it. The TRADOC Analysis Center (TRAC) recognized this requirement and executed an effort from February to June of 2018 to examine MDO concepts and instantiate a representation of MDO in a dynamic scenario using the Advanced Warfighting Simulation (AWARS). The ARCIC MDO Campaign of Learning Playbook was used as a guide to develop a multi-domain operation for instantiation in a dynamic scenario. Plays from the playbook were selected that fit the conditions and addressed the predominant problems of a
chosen dynamic scenario. The selected plays informed the development of a multi-domain operation.

The team was challenged to identify necessary assumptions about the capability, limitation and concept of employment for technologies that do not have reliable performance data, accepted surrogate data, or perhaps even a well-defined system architecture. These assumptions were critical to developing an abbreviated decision support matrix to drive the multi-domain operation.

This presentation will share insights from TRAC's examination of MDO, the approach used to develop a multi-domain operation for instantiation, the model and simulation capabilities used, and examples of future efforts.

**LiDAR Target Acquisition Prediction Model**

Matthew Banta  
AMSAA  
matthew.d.banta.civ@mail.mil  
1530 to 1600  
Room 3  
Working Group 6b

AMSAA requires a model that can predict the probability that a given LiDAR system will be able to perform target acquisition on a given target as a function of both target and LiDAR system parameters. Such a model can be used to represent LiDAR sensors for Army studies within combat simulations and can lead to improved item level performance representation of LiDAR sensors within Army M&S. AMSAA has performed an experiment using partial simulated LiDAR images. By asking volunteers if they can see the targets in the images, we created an empirical measurement of the Probability of Detection (PD) as a function of LiDAR and target parameters. We were then able to fit these measurements to a model to estimate the PD. This PD model was used to create a preliminary Image Quality Equation (IQE) for LiDAR systems. We can use an IQE to estimate the Probability of Detection, Classification, and Recognition for LiDAR systems.