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Welcome Letter

Welcome to the “Bigger, Better, Stronger” 56th Annual Army Operations Research Symposium! The United States Army Materiel Systems Analysis Activity is proud to host this year’s symposium. This year we are focused on improvements to three broad areas for the Operations Research community:

**Bigger Data:** As data science becomes a formal discipline and institutions are wrestling with big data problems, we are on the precipice of a new era of analysis. Is data science a new discipline or just an extension of Operations Research? With large, complex data sets becoming more common, how can we utilize tools, techniques, analysis, visualization, etc. to enable Army decision making?

**Better Acquisition:** With Army senior leader emphasis on a more efficient and more effective acquisition process, we have a unique opportunity to identify areas for improvement in the future force modernization enterprise. What are those areas and how can we ensure the right equipment is getting into the hands of the Soldiers when they need it? How does our partnership with industry and academia evolve to enable this?

**Stronger Bonds in the Analytical Community:** Operations Research Systems Analysts (ORSAs) are spread throughout Army organizations and provide pivotal insights to Senior Leaders. As the Army’s organizational structure changes, how do individual organizations, organizational networks and processes evolve to allow the whole community to address Army top priorities?

The purpose of the Army Operations Research Symposium (AORS) is to provide the analytical community an opportunity for collaboration with peers by presenting their best work, and exchanging professional knowledge, experiences, and insights. The conference offers a forum to leverage knowledge and breakthroughs from recent analytical studies and identify areas for continued improvement.

Take advantage of the opportunity to attend many of the over 100 briefings that are scheduled within our seven working groups: Current Operations; Future Capabilities; Sustainment; Advances in OR and Technology; Manpower, Personnel and Training Analysis; Modeling and Simulation; and Cyber Electro Magnetic Activities Analysis. You can even continue the pursuit of knowledge during lunch by attending the FA 49 Overview session on Tuesday and the Lunch with Senior Leaders on Wednesday.

The ORSA Hall of Fame Banquet is Tuesday evening at the Water’s Edge Events Center. This year’s inductee is Mr. David Shaffer, who held numerous critical positions in his career of more than 30 years, including serving as the Director of AMSAA. There is also a Night Owls Social on Wednesday evening at the Top of the Bay to extend the topics and discussion from the symposium into a more casual environment.

We want to thank all those who have contributed to making this year’s event a success and for taking time to help make our community stronger. Enjoy the symposium and please provide the planning team any suggestions or recommendations for the future!

Sincerely,

[Signature]

JAMES AMATO
Director
US Army Materiel Systems Analysis Activity
# Program Agenda

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Start</th>
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<th>Events</th>
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<tr>
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<td>Lunch – <strong>FA-49 Overview and Meet &amp; Greet</strong></td>
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<td>Working Groups (4)</td>
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<td><strong>ORSA HoF Banquet – Water’s Edge, Belcamp, MD</strong></td>
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<td>Day 3</td>
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LTG Wesley was commissioned as an Armor Officer from the United States Military Academy in 1986. He began his career as a Tank Platoon Leader, Scout Platoon Leader, and Battalion Logistics Officer in 2nd Battalion, 70th Armor Regiment, of the 1st Armored Division in Germany. In May 1991, he was assigned to the 1st Infantry Division at Fort Riley, Kansas where he commanded a tank company in 1st Battalion, 34th Armor, until Dec 1993. He then spent three and a half years with the United States Army Special Operations Command during which he deployed in support of OPERATION JOINT GUARD/ENDEAVOR in Bosnia-Herzegovina.

In June of 1998, he was assigned to the 2nd Brigade of the 3rd Infantry Division at Fort Stewart, Georgia, where he served as a Battalion and Brigade Operations Officer and the Brigade Executive Officer. In September 2002, he deployed with 2nd Brigade to OPERATION DESERT SPRING in Kuwait, followed by OPERATION IRAQI FREEDOM (OIF) where 2nd Brigade led the 3rd Infantry Division’s attack into Baghdad. Upon redeployment, he led the staff effort to move the division to a modular organization.

LTG Wesley returned to Fort Riley in June 2004 and assumed command of a tank battalion, the 1st Battalion, 13th Armor. He deployed the “13th Tank” back to Iraq conducting combat operations in Baghdad in support of OIF from January 2005 to January 2006. Upon relinquishing command, he remained at Fort Riley serving as the Operations Officer of the 1st Infantry Division until June 2007. One year later, he returned to the “Big Red One” and assumed command of the 1st Brigade Combat Team, 1st Infantry Division. After command, he deployed to Kabul, Afghanistan serving as Chief of Current Plans for the International Security Assistance Force (ISAF) in support of OPERATION ENDURING FREEDOM. He then served for two years in the White House on the National Security Council as the Director for Afghanistan-Pakistan Policy. He later returned to Afghanistan where he was the Director for Future Plans for ISAF Joint Command in Afghanistan. He then served as the Deputy Commanding General (Support) for the 1st Infantry Division followed by duty on the Army Staff as the Deputy Director for Program Analysis and Evaluation (PAE) for the Army G8. Most recently LTG Wesley served as the Commanding General, U.S. Army Maneuver Center of Excellence and Fort Benning, Georgia.

LTG Wesley’s military education includes the Armor Officer Basic Course, the Armor Officer Advanced Course, and the U.S. Army Command and General Staff College. He is a graduate of the National War College, earning a Master’s Degree in National Security and Strategic Studies. LTG Wesley also holds a Master’s Degree in International Relations from Troy State University.

His awards and decorations include the Legion of Merit, the Bronze Star Medal for Valor, the Bronze Star Medal, the Meritorious Service Medal, and the Joint Service Commendation Medal. He has also earned the Combat Action Badge, the Parachutist Badge, and the Ranger Tab.

LTG Wesley and his wife Cynthia have three children: Tyler, Austin and Meredith.
U.S. Army Analysis Awards

Dr. Wilbur B. Payne Award for Excellence in Analysis. Dr. Wilbur B. Payne was a pioneer in Army Operations Research and the preeminent leader in the field for three decades. Through his career, Dr. Payne was an enthusiastic advocate for applying methods of science to practical defense decision-making, enforcing the highest standards of professionalism, and nurturing and mentoring operations research analysts. In 1990, the Department of the Army Systems Analysis Award became the Dr. Wilbur B. Payne Memorial Award for Excellence in Analysis in order to honor the memory and contributions of Dr. Payne to the operations research field.

The analysis awards were expanded in 2017 to recognize high quality operational analyses, superior junior military and civilian analysts, and the best AORS paper from the preceding year. All studies nominated for these awards were reflective of the diversity of issues to which operations research/systems analysis and analysts are making major contributions to the United States Army. The papers submitted reflect innovative and traditional applications that assist in major decision-makers and lay the foundation for future analysts’ work.

2018 Dr. Wilbur B. Payne Payne Award Winners

Mid-tier Networking Vehicular (MNVR) Analysis of Alternatives
U.S. Army Materiel Systems Analysis Activity

Study Participants:

John W. Wray
Dominic H. Chan
Vernon J. Marine
Dr. Jesus M. Batista
Calvin T. Nguyen
Tony X. Harris
Steven T. Chizmar
Konstantinos N. Amouris
Kenneth A. Duvall

SUMMARY: As a result of the MNVR Milestone C Full Rate Production decision meeting, the Under Secretary of Defense for Acquisition, Technology and Logistics (USDATL) directed the Army to conduct an AoA of the Army Mid-Tier network radio prior to supporting a full scale production decision. The purpose of the MNVR AoA was to identify and assess suitable alternatives to the MNVR radio using the Wideband Networking Waveform (WNW) that included government and commercial waveforms. Headquarters (HQ) Department of the Army (DA) G-8 directed the Army Materiel Systems Analysis Activity (AMSAA) to lead the study. The AoA study team assessed all reasonable alternatives and provided comparative assessments of all alternatives over a wide array of measures including network end-to-end connectivity and performance, vulnerability to threat electronic attack, technical risk, schedule risk, and cost effectiveness.

Army Follow-on Wideband Satellite Communications (SATCOM) Bandwidth Study
U.S. Training and Doctrine Command Analysis Center

Study Participants:

Ms. Melissa M. Barrette
Mr. Todd M. Gesling
Mr. Timothy D. Luna
Ms. Jaime L. McLellan
Mr. William R. Pace
MAJ Michael E. Premont
MAJ Doug K. Serota
Ms. Melissa A. Stafford
Ms. Sara L. Tisdel
Mr. Michael R. Waskowski
MAJ Daniel L. Weiss

SUMMARY: The Army Follow-On Wideband Satellite Communications (SATCOM) Bandwidth Study represents a comprehensive examination of wideband SATCOM throughput requirements for Army forces conducting expeditionary maneuver against a near-peer adversary in a SATCOM-degraded environment. These requirements formed the basis for the Army’s input to the Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics Wideband Communication Services Analysis of Alternatives, which is evaluating suitable alternatives for wideband SATCOM replacement. The analysis produced a sound, transparent, and repeatable methodology that significantly contributed to the Army’s understanding of required SATCOM and improved Army credibility in Joint forums.
Operational Analysis Award Winner

Understanding Uncertainty Through Risk Likelihood Estimates
Operational Analysis Branch, HQ Allied Rapid Reaction Corps

Study Participants:
MAJ Andrew Seth Pruett, U.S. Army
Lt Col Loic Wierzbinski, French Army
MAJ Jens C. Petersen, Danish Army
Andrew Heaton, Defence Science and Technology Laboratory
Martin Macdonald, GBR Defence Science and Technology

SUMMARY: During exercise ARRCADE Fusion 2015, multiple staff sections presented impactful issues that could undermine the Commander’s, Allied Rapid Reaction Corps (ARRC), ability to conduct operations. Issues included medical resource limitations, logistics constraints and unforeseen threat activities. The evaluation team attributed this to the lack of integration between the risk management process and the decision making process. The ARRC requested the Operational Analysis and Research Branch (OARB) examine the problem and develop solutions to better incorporate risk management processes with ARRC senior leader decision making. This study focuses on how OARB used group sourcing and probability theory to provide the Commander with risk likelihood estimates informed by broad input solicited from across the headquarters and based on the most up to date and relevant information to enable proactive decision making.

U.S. Army Junior Analyst Award Winners

Civilian
Mr. Craig J. Flewelling, Center for Army Analysis
Ms. Jill Dickerson, U.S. Training and Doctrine Command Analysis Center

Military
MAJ Neil E. Kester, Center for Army Analysis

55th AORS Best Presentation Award Winner

Approach to Estimating Army Communication Requirements
Author: Ms. Sara L. Tisdel (DTRA-JIDO, formerly TRAC)

SUMMARY: Headquarters, Department of the Army G-8 initiated the Army Wideband SATCOM Bandwidth Study, and tasked the TRADOC Analysis Center to determine Army wideband SATCOM throughput requirements to support deployed forces conducting expeditionary maneuver in the 2030 timeframe. The study team combined an extensive literature review, network connectivity analysis, and operational assessment to develop the Army communication requirements in terms of throughput by warfighting function and echelon. With these requirements established, it was necessary to estimate the size of each type of communication by echelon in order to determine the total Army throughput estimate. To determine the Army wideband SATCOM throughput requirement, the study team coordinated across the community of interest to identify the operationally relevant sizes associated with each method of communicating across each echelon. This analysis significantly enhanced the quality and thoroughness of the data.
Army Analysis Awards

Dr. Wilbur B. Payne Award
For Excellence in Analysis

Eligibility: The award recognizes the highest quality of Department of the Army ORSA work. Eligibility includes all Department of the Army analysts, technicians, scientists, or groups whose contributions were made during the period 1 Mar - 28 Feb and meet the criteria. Submissions are scored on operations research quality, impact, and presentation.

Nomination: Analysts must submit their study, not more than forty pages with a completed nomination summary, agency endorsement, and sponsor endorsement.

Operational Analysis Award

Eligibility: Includes all Department of the Army analysts, technicians, scientists, or groups whose contributions were made during the period 1 Mar - 28 Feb and meet the criteria below. Submissions are scored on operations research quality, impact, and presentation.

1. Performed in support of operational commanders planning and/or conducting current operations, security cooperation activities, or major exercises.

2. Performed by analysts assigned to operational headquarters, Brigade/Division/Corps staffs, or Army Service Component Commands. Analytic agencies are not eligible.

3. Majority of study team must be Army, inclusive of study team members from allied nations, with significant contribution from at least one US Army military or civilian analyst.

Nomination: Analysts must submit their study, not more than forty pages with a completed nomination summary, agency endorsement, and sponsor endorsement.

POC: Sheri Palmer 703-785-0076 ♦ sheril.palmer4.civ@mail.mil
U.S. Army Junior Analyst Award
Civilian and Military

**Eligibility:** Must be 40 years old or less with a maximum of ten years' experience and be nominated by mid-March of the given year. The nominator must have a mentor-protégé relationship with the individual and can describe the junior analyst's quality and breadth of the work. Submissions are scored based on the strength and quality of the contributions, and should have one or more of the following accomplishments:

1. Outstanding publication
2. Development of a significant new analysis
3. Use of research results in the solution of a military problem

**Nomination:** The Army Mentor must document and submit the relevant information in no more than two pages on the candidate. Along with the documentation, the Army Mentor will provide a cover letter from their agency endorsing this candidate for nomination.

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**AORS Best Presentation Award**

**Eligibility:** All studies presented in AORS Working Groups are eligible

**Nomination:**

1. Working Group Co-Chairs nominate the author(s) of the best study in their group.
2. Nominated authors are invited to submit a written 2-40 page report (including graphics) of their work to the AORS lead agency.
3. The Prize Evaluation Committee will make its recommendation of the best paper to the Senior Army Analytical Board through the Payne Awards Committee.

POC: Sheri Palmer 703-785-0076 ♦ sheril.palmer4.civ@mail.mil
Panel Discussions

Three separate panel discussions will take place to allow Subject Matter Experts (SMEs) from Military, Academia, and the Private Sector to discuss pertinent topics surrounding the Operations Research community.

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Bigger Data Panel

As data science becomes a formal discipline and institutions are wrestling with big data problems, we are on the precipice of a new era of analysis. Is data science a new discipline or just an extension of Operations Research? With large, complex data sets becoming more common, how can we utilize tools, techniques, analysis, visualization, etc. to enable Army decision making?

16 Oct, 1030 – 1200
Auditorium

Facilitator: Amber Ferguson, AMSAA

Invited Members

Dr. Alexander Wissner-Gross
Award-winning scientist, engineer, entrepreneur, investor, and author. President and Chief Scientist of Gemedy and holds academic appointments at Harvard and MIT.

Dr. Kirk Borne
Data scientist, public speaker, consultant, astrophysicist, and space scientist. Principal Data Scientist and Executive Advisor at Booz Allen Hamilton.

Dr. Manuel Vindiola Jr.
Cognitive Scientist in the Computational and Information Sciences Division of the U.S. Army Research Lab. Research interests in modeling of cognitive processes using high performance computing, hardware accelerators, and neuromorphic and other emerging computational architectures.

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Better Acquisition Panel

With Army senior leader emphasis on a more efficient and more effective acquisition process, we have a unique opportunity to identify areas for improvement in the future force modernization enterprise. What are those areas and how can we ensure the right equipment is getting into the hands of the Soldiers when they need it? How does our partnership with industry and academia evolve to enable this?

17 Oct, 1045 – 1145
Auditorium

Facilitator: Jennifer Adair, AMSAA

Invited Members

MG Joel Tyler
Commanding General, Army Test and Evaluation Command. Previous assignments include Commanding General, United States Army Joint Modernization Command, Deputy Commanding General of 1st Armored Division, and J-3 for Combined/Joint Task Force – Operation Inherent Resolve.
Mr. Stephen G. Barth  
Deputy Assistant Secretary of the Army (Cost and Economics), responsible for Army policy and technical direction of all cost and economic activities.

COL Robert Ryan  
Deputy Director for the Network Cross Functional Team. Previous assignments include Commander of the 3rd Brigade Combat Team 25th Infantry Division.

Dr. Dale Henderson  

Stronger Bonds Panel  
Operations Research Systems Analysts (ORSAs) are spread throughout Army organizations and provide pivotal insights to Senior Leaders. As the Army’s organizational structure changes, how do individual organizations, organizational networks and processes evolve to allow the whole community to address Army top priorities?

18 Oct, 0845 – 1000  
Auditorium  
Facilitator: Kristopher Weygant, AMSAA

Invited Members

BG(P) Karl Gingrich  
Director, Capability and Resource Integration, J-8. Previous assignments include Assistant Program Executive Officer for Operations, Readiness, and Fielding, Office of the Program Executive Officer, Command, Control and Communication (Tactical), and Director for Resource Management, Installation Management Command.

Mr. Paul Page  
Director of the Decision Support Directorate in the Space and Missile Defense Command Future Warfare Center and Operations Research Analyst. Previous assignments include Chief of the Studies and Analysis Division overseeing the execution of critical Joint and Army studies to include the Tactical Space Protection Study and the Ballistic Missile Defense Planning Order executed for the Vice Chairman of the Joint Chiefs of Staff.

Ms. Deirdre Sumpter  
Technical Director for the U.S. Army Evaluation Center, responsible for overseeing military programs as part of the acquisition life cycle to keep up with the program/capability/technology changes that may occur along the way and to ensure that decision makers are equipped with the latest information to make an informed decision.
Special Sessions

Functional Area (FA) 49 Overview / Meet & Greet

FA 49 Proponent will provide an overview of the functional area as well as answer questions from the community.

MAJ Nathan Riedel (FA 49 Assignment Officer)
16 Oct, 1200 - 1300
Room 10B

Career Program (CP) 36 Update

Overview and updates of the Civilian Program for Analysis, Modeling and Simulation.

Mr. Michael Truelove (CAA)
17 Oct, 0845 - 0915
Auditorium

Lunch with Senior Leaders

Provides an opportunity to network with Senior Leaders and an open forum for discussion.

17 Oct, 1145 - 1245
Room 10B
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**Notes:**
- N/A indicates information not available or applicable.
- Room numbers indicate the location of the meeting.
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<th>Room</th>
<th>Future Capabilities Room 9</th>
<th>Sustainment Room 13</th>
<th>Advances in OP &amp; Technology Room 5</th>
<th>Manpower, Personnel &amp; Training Analysis Room 14</th>
<th>Modeling and Simulation Room 10B</th>
<th>Modeling and Simulation Room 3</th>
<th>Cyber Electromagnetic Ambiance (CEMA) Analysis Room 13</th>
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<td>1415</td>
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<td>Assessing the Value of Engagement Networks (AVEN)</td>
<td>Unraveling Uncertainty in Multi-Attribute Value Models</td>
<td>War In Time Geospatial Analytics</td>
<td>Just In Time Geospatial Analytics</td>
<td>Component Analysis for Rate</td>
<td>Modeling the Effects of Gravity on Casualty</td>
<td>Verification of Nonlinear Random Dynamic Challenges</td>
<td>Tactical Assessment of Cyber Ambiance</td>
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<td>Assessing the Value of Embedding OFAs in Theater</td>
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<td>Unraveling Uncertainty in Geospatial Analytics</td>
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<td>Novel Geospatial Methodology to Evaluate Aircrafts in Combat</td>
<td>Multi-Attribute Modeling to Address Analytical and Visualization Gaps in Sustainment and Network Communications Analysis</td>
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**Suggestions**

- Consider grouping similar topics together to improve readability and understanding.
- Use bullet points or subheadings to distinguish different sections or categories within the schedule.
- Ensure a clear and logical flow from one topic to the next to maintain coherence.

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**Technical Details**

- Use of tables and lists can help organize information effectively.
- Ensure that all necessary information is included, such as dates, times, locations, and presenters.

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**Visual Aids**

- If possible, include graphs or diagrams to visually represent the schedule or data.
- Use color coding or icons to highlight important points or sections.

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**Accessibility**

- Make sure that the document is accessible to all readers, including those with disabilities.
- Use clear and concise language to avoid jargon or overcomplexity.
Building Map
Mallette Training Facility
Bldg. 6008

MALLETTE TRAINING FACILITY
1st FLOOR

KEY:

**Working Groups:**
- Rm 12 - WG 1: Current Operations
- Rm 4 - WG 2: Future Capabilities
- Rm 13 - WG 3: Sustainment
- Rm 5 - WG 4: Advances in OR and Technology
- Rm 14 - WG 5: Manpower, Personnel & Training Analysis
- Rm 10B - WG 6a: Modeling and Simulation
- Rm 3 - WG 6b: Modeling and Simulation
- Rm 15 - WG 7: Cyber Electro Magnetic Activities (CEMA) Analysis

**Additional Rooms**
- Rm 10A - Registration / Refreshments
- Rm 7 - VIP Room

*Additional Meeting Rooms Available upon Request*
KEY:

**Working Groups:**
- Rm 12 - WG 1: Current Operations
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- Rm 10B - WG 6a: Modeling and Simulation
- Rm 3 - WG 6b: Modeling and Simulation
- Rm 15 - WG 7: Cyber Electro Magnetic Activities (CEMA) Analysis

**Additional Rooms**
- Rm 10A - Registration / Refreshments
- Rm 7 - VIP Room

*Additional Meeting Rooms Available upon Request*
Joint operations involve coordination between services to accomplish the mission while keeping non-combatants and friendly forces safe. AMSAA received a request from a Fighter Squadron to provide Army artillery munition fragmentation altitude, radius, and time of travel estimates to support their mission planning. Estimations aid Fighter Pilots with operational timeline to allow them to safely approach target areas after deployment of an artillery fire mission. AMSAA modified the Fragment Fly-out Program to output altitude, radius, and time parameters and validated the program change using an Air Force weapon test case. AMSAA provided fragment maximum altitude, radius, and time results for common mortar, cannon, rocket, and missile munitions. Product was incorporated into current Warfighter planning operations for Air to Ground integration and disseminated to the Air Force, Air National Guard, and Reserve units.

Historical research is a valuable tool to inform the conduct of a study and requirements analysis by informing the selection of key system attributes. During the initial phase of the Maneuver-Short Range Air Defense (M-SHORAD) Analysis of Alternatives (AoA), historical research presented an opportunity to view the potential future requirements of an air defense system through the lens of the past. TRAC conducted this research effort by identifying evidence repositories and experts both internally and externally to facilitate the development of historical insights from World War I to present day. This research provided historical context to those potential system requirements through a detailed review of air defense artillery (ADA) branch development and structure, the evolution of ADA, historical support to operations, and a discussion of key attributes identified during the research process.

This presentation describes why historical research is important to the conduct of a study, where it fits into a study plan, what resources are required in its execution, and TRAC’s role in the research process. In addition, this presentation describes the process followed to conduct historical research supporting an AoA, including understanding the supported study purpose, objectives and themes; selecting a primary research focus; determining the time period within which to conduct research; outlining historical research topics; analyzing source material; and developing findings based on the analysis.
The Army currently lacks the capability to effectively and efficiently manage software from fiscal, contractual, legal and cybersecurity frameworks. A Software Asset Management (SAM) capability combined with well-defined and data-centric software management processes will produce cost savings, comply with audit and legal standards and meet Congressional direction. At the request of HQDA Chief Information Officer (CIO) G-6, AMSAA performed analysis and research to quantify the expected return on investment (ROI) for this effort, as well as laying out prioritization and a roadmap to ease implementation and generate quick returns.

AMSAA modeled the benefits of license-sharing through simulating availability of software for users generated with usage profiles. This modeling showed that for a robust variety of organization sizes, usage profiles and number of seats, sharing would diminish total required licenses while also positively impacting availability. AMSAA also used data on software license usage and price savings from Enterprise License Agreements over Blanket Purchase Agreements, along with data from the Army Corps of Engineer SAM effort, to both capture where costs savings are generated and the potential ROI of the effort, potentially reducing Army-wide software costs by 10%. Prioritizing new and renewing licenses, non-classified systems and high volume software will make implementing a SAM capability more manageable as the capability progresses through a three-step process, realizing significant gains at each stage of maturation.

**Bayesian Validation of Aerosol Chamber Homogeneity**

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WG 4: Advances in OR & Technology | Room 5

To ensure their adequacy for test and evaluation purposes, test chamber capabilities require a formal validation. An example of this requirement is the need to produce concentration homogeneity throughout the interior of a test chamber to be used for testing aerosol detectors. Based on the approach used for a recently validated chamber, we use simulated data to illustrate a test method and statistical model for such a validation.

The test method involves multiple phases with Bayesian updating of model parameters. During each phase, aerosol samplers are used to measure concentration at specified locations. Based on the collected test data and Bayesian "priors", a statistical model is fitted to account for the different factors and sources of error that contribute to concentration variability. "Nuisance" variability (such as that obtained from sampler measurement error) is then removed from total variability such that an estimate of the magnitude of only the relevant sources of variability remains. This variability is directly used to determine the extent of actual homogeneity within the chamber.

By incorporating all trials into a single model and appropriately accounting for all important sources of variability, the described method provides a single, statistically defensible conclusion regarding chamber homogeneity.

**Stress and Fatigue Analysis Toolkit to Dynamically Represent Soldier and Small Unit (SSU) Performance and Decision-making in Constructive Simulations**

Dean-Michael Sutherland | NSRDEC
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WG 5: Manpower, Personnel & Training Analysis | Room 14

There is a need for improved cognitive and decision-making-models in constructive simulation, allowing more realistic representations of Soldier behaviors and the impact of common operational factors on Soldier cognitive function and alertness. Providing this capability will support the Research, Development and Acquisition (RDA) community in assessing and evaluating the impact of new materiel for the SSU. The study of Soldier and Small Unit (SSU) performance requires understanding the
degree to which Soldiers' skills and abilities are implemented for a particular task or set of tasks in a military operational environment. The Army and other agencies have invested in several projects to study the human factors aspects of Soldier performance as they pertain to physical performance. There is a gap in the understanding of how characterizing factors impact SSU cognitive performance and the interrelationship between these factors (e.g., understanding of how individual Soldier differences combine to affect SSU performance). Examples of characterizing factors include SSU knowledge and experience, environmental factors including the complexity of the battlespace and the weather, and internal states of cognitive workload and physiological stress. A toolkit, Dynamic Representation for Evaluating the Effect of Moderators and Stress on Performance (DREEMS), is an effort to address this gap in human behavior and decision modeling. DREEMS will consist of a suite of tools to include: a Fatigue and Stressor Ontology, a SSU Performance Ontology, and Cause and Effect Methodology.

**Measuring the Effectiveness of Short-Range Air Defense (SHORAD) Against Fixed Wing Using Dynamic Rulesets in the Advanced Framework for Simulation, Integration and Modeling (AFSIM)**

Steve Heinlein | CAA-CA  
steven.e.heinlein.civ@mail.mil  
Co-Author: Paul Chang  
WG 6a: Modeling and Simulation | Room 10B

This presentation addresses the complexity of the SHORAD ruleset in an evolving environment. Accurate modeling requires the use of the Advanced Framework for Simulation, Integration, and Modeling (AFSIM) system which allows complex and dynamic rulesets. Currently, Air Missile Defense models like EADSIM force the user to 'script' what the SHORAD will do against airborne threats thus in essence predetermining the outcome. This does not allow the complex interchange between the attacker and defender to include realistic modeling of electronic warfare (jamming and decoys), deployment of multiple sensor types, altitude changes, operating in pairs, movement of both Maneuver SHORAD (M-SHORAD) systems as well as other major weapon systems, etc. The study developed multiple cases of fixed-wing aircraft versus ground systems using AFSIM to determine how effective (or ineffective) the airborne systems are in conducting SEADS/DEADS (suppression/destruction of enemy air defense) missions against M-SHORAD systems. The results of this study will be used to enhance follow-on air defense modeling cases.

**Statistical Analysis & Modeling of Historical Acquisition Data**

Colleen Pleasanton | AMSAA  
colleen.f.pleasanton.civ@mail.mil  
WG 6b: Modeling and Simulation | Room 3

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.

**Cyber Modeling in Extended Air Defense Simulation Version 18.5**

Leonard Adams | SMDC/ARSTRAT  
leonard.l.adams.civ@mail.mil  
WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15

The Extended Air Defense Simulation (EADSIM) is a many-on-many simulation of air, space, and missile warfare. EADSIM provides analysis, training, and operational planning to the warfighter in a single modeling and simulation package. The mission and functional area modeling is supported by a number of physical models including: flight and movement; communications (including networks);
sensors; jammers; weapons; and constructs such as air space control.

EADSIM movement models include ballistic missiles, fixed and rotary wing aircraft, cruise missiles, air-to-surface weapons, surface-to-air missiles, satellites, and surface platforms. The simulation models space, air, and ground weapons and targets. Natural environments modeled include terrain, atmosphere, and weather within that atmosphere. EADSIM is currently used by more than 220 agencies worldwide. EADSIM is managed by the US Army Space and Missile Defense Command, as the Executive Agent for the Missile Defense Agency. Virtually all improvements and enhancements of the model are requested and funded by the EADSIM user community. This presentation will provide an overview of the EADSIM program, focused on EADSIM cyber modeling.

16 October 2018
1330 – 1400

Quick-turn Analysis to Inform National Policy Decision
Danielle Aldrich | TRAC-WSMR
danielle.m.aldrich.civ@mail.mil
WG 1: Current Operations | Room 12

From January to May 2018, the U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) led the 2018 Anti-Personnel Landmine (APL)/Cluster Munitions (CM) Study to inform policy recommendations to the Secretary of Defense (SECDEF) by assessing the military utility of APL and CM in a near-peer Threat environment. This robust 5-month study was achieved by employing an innovative study approach, leveraging on-going analytical activities from partner agencies, and conducting several multi-layered lines of effort (LOE) in parallel. These LOEs included combat modeling, sustainment analysis, a map exercise (MAPEX), and a Service Component Command Seminar Wargame. The study was supported by partner agencies that included Army Materiel Systems Analysis Activity (AMSAA), Center for Army Analysis (CAA), and TRADOC G-2. Additional support from the Fires Center of Excellence (FCoE), Maneuver Center of Excellence (MCoE), Maneuver Support Center of Excellence (MSCoE), National Training Center (NTC), and Service Component Commands were especially critical for providing strategical, operational, logistical, and political insights. The accelerated timeline required innovative integration of analytic methods and can serve as a basis for future quick-turn analytic support to decision-making.

This presentation will discuss the innovative study approach and the importance of building strong partnerships throughout the analytical community to successfully incorporate parallel LOEs to obtain study results.

Business Intelligence Integration Into Division Level Operations
CPT Marc Eskew | 10th MTN DIV (LI)
marc.a.eskew.mil@mail.mil
WG 2: Future Capabilities | Room 4

Adoption of new technology, techniques, and practices are some of the defining characteristics of the US Army. Unfortunately, Army operations in the Information Age still rely on staff utilizing cumbersome processes to analyze and distribute vital mission information. These processes largely require the manual movement of information between different mediums where a staff will gather their data, input and analyze the data in a spreadsheet, present the results on slides, create their reports in a word processor, and transmit the processed information via email to the next echelon to repeat the process. Meanwhile, commanders and staffs must make decisions at an ever increasing pace. As this happens, the current processes of collection, analysis, and presentation of critical data cannot fully satisfy operational requirements. Greater efficiency, accuracy, and dissemination of critical information at an
operational unit level can be achieved through implementation of Business Intelligence (BI) processes.

Even at Division level, the lowest echelon Army ORSAs reside, BI can be implemented by providing thorough analysis through an easy to use interface. A practical way to accomplish BI implementation is through development of Shiny applications. Shiny apps are web-based interfaces that provides powerful statistical analysis utilizing R and highly customizable HTML presentations. ORSAs can create programs that can dynamically read, process, analyze, and present information in easy to access dashboard or report format.

This concept was validated during the execution of a FORSCOM level Emergency Deployment Readiness Exercise at the 10th Mountain Division, where an Infantry Combat Brigade and enablers were rapidly deployed from Fort Drum, New York to Fort Polk, Louisiana. To enhance the Division Main Command Post during the exercise, a Shiny app was developed to support mission requirements. The app dynamically read multiple sources of data to provide near real time equipment status, forecasts of deployment processes, mapping of geolocation data, and manipulation of SharePoint list data. Broadcasting the app on the local network achieved a real-time flattened information hierarchy, which greatly reduced data processing times and allowed the command to make immediate, informed decisions.

The success of the process during the exercise has prompted the development of additional projects for functions across the division. With the initial success of the BI process development within the 10th Mountain Division; the potential for development and expansion of both 'tactical' apps in support of Current Operations and persistent apps for unit and organization analytics is boundless. Operational level units are alarmingly lacking in their overall capability to analyze their data. With minimal training, an established secure online environment for deployment of applications, and community support; the development of BI processes would further solidify the role of the ORSA in operational units by bringing the capabilities of their organizations into the future.

The Joint Logistics Wargaming Analysis Model (LOGJAM)
MAJ Eric Schmitz | CAA
eric.j.schmitz.mil@mail.mil
Co-Authors: Andrew Cyckowski, Mandi Elliott-Bird
WG 3: Sustainment | Room 13

The Center for Army Analysis (CAA) provides wargaming support for the Headquarters, Department of the Army (HQDA); Component Commands; and Combatant Commands through the use of the Joint Wargaming Analysis Model (JWAM). Commanders and Planners glean qualitative insights on operational sequencing as JWAM highlights gross capability gaps, critical enabling assumptions, and enables general feasibility assessment of warplans. However, JWAM lacked a complete and robust method to represent the Sustainment Warfighting Function. The Joint Logistics Wargaming Analysis Model (LOGJAM) is designed to fulfill this capability gap. LOGJAM supports current CAA wargaming models, such as JWAM, through the development of qualitative insights on the interdependence of Sustainment, Movement, and Maneuver, and identifies associated risks to mission at the operational level of war. Currently designed to represent the aspects of Distribution, Transportation, and Supply directly, LOGJAM can be tailored to support a sponsor's study objective(s). LOGJAM has been tested to support wargames that focus on Phase 2 and 3 Operations with the ability to model Phase 1 through 4.

Novel Theory to Include Hyper Acute GPS Information Into Coriolis Error Compensation
Jennifer Forsythe | AMSAA
Jennifer.L.Forsythe2.Civ@mail.mil
WG 4: Advances in OR & Technology | Room 5

Compensating for the earth's rotation has generally been seen as a minor error that does not impact
the results greatly for large caliber munitions. The effect of the earth’s rotation is dependent on wind velocity and important as the armor force presses for ever greater ranges to engage the enemy. At greater ranges the effect is expected to increase. The rotation of the earth is seen in weather phenomenon such as the spin direction of hurricanes and is defined as the Coriolis force. The Coriolis effect is variable dependent on the direction firing, hemisphere, and latitude on earth. A rule of thumb is that at 1000 meters it may be 0.07 meters off from the center of the target in Sacramento, CA. Modern tanks have sophisticated hyper acute Global Positioning System sensors as well as embedded calculations to determine the direction the turret is pointing. This novel theory promotes the inclusion of an equation to make use of information already embedded in modern tanks to increase the accuracy of large caliber munitions. The impact of the equation will be presented so decision makers can understand the return on investment.

**Staffing Metrics for Simulation and Training Events**
Derrick Robinson | National Simulation Center
derrick.c.robinson.civ@mail.mil
Co-Author: Robert Albright, James Erin
WG 5: Manpower, Personnel & Training Analysis | Room 14

Significant benefits come with measuring personnel workload for simulation and training events. The NSC has a task from higher headquarters to verify and validate staffing metrics for events and activities that occur at Mission Training Complexes. The presentation addresses the data collection and analysis of event workload data from CONUS and OCONUS Mission Training Complexes. A challenge is establishing metrics that represent a customer service center population operating and offering the same types of services, but with the freedom to execute those services differently than the other Mission Training Complexes. The objectives includes establishing the right amount and mix of personnel to provide an environment for Soldiers to execute collective training on a variety of missions. The objectives also includes maintaining conditions for balance on fluctuating missions. Ultimately, the aim is to provide training that save lives and that fosters combat overmatch with Soldier readiness.

Steve Heinlein | CAA
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Co-Author: Paul Chang, Lisa Kim
WG 6a: Modeling and Simulation | Room 10B

The traditional models used for air-to-ground modeling like Extended Air Defense Simulation (EADSIM) and ground combat model like Combat Sample Generator (COSAGE) do not allow a realistic representation of the ground system to air system interaction. These models are static (scripted) and can entail predetermined outcomes. This is especially true when modeling how attack helicopters engage against ground systems like short-range air defense (SHORAD) systems. In this study, ground systems including tanks, self-propelled artillery, trucks as well as the SHORAD systems were modeled in the Advanced Framework for Simulation, Integration, and Modeling (AFSIM) system. Also, the movement and reaction to the helicopter attack were modeled. Subsequently, the reaction of the attack helicopter to the presence of ground targets as well as the SHORAD system's counter-attack were modeled. In the vignette modeling, the reaction time, degradation in the probability of kill (Pk) due to movement, lasing of the targets, and difference in Pk due to helicopter's change in altitude were all modeled. In addition, the use of electronic countermeasure by the attack helicopter in reaction to surface-to-air missiles was modeled along with the evasive maneuver. This study represented terrain with elevation changes from a potential area of interest location defined in a previous wargame and theater campaign model.
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.

An Overview of the Cyberspace Domain and the Cyberspace Analysis - Focus Areas of the Space and Missile Defense Command

Cyberspace is a Domain -- man made, virtual, constantly expanding, and unique. It is not geographically constrained and can impact anyone anywhere within seconds. Land was once the dominant domain in ancient warfare and ancient armies fought for years to determine the outcomes. Today the Cyberspace Domain is causing a Revolution in Military Affairs (RMA). Military forces dependent on efficiencies gained by unprecedented C4I and smart weapons are at great risk. Those very efficiencies can be nullified very quickly and the Calculus of Warfare will change. Cyberspace will change warfare and the unprecedented rate of technological advance will make this domain more challenging to grasp than all the other domains and changes throughout the history of warfare.

The ground Warfighter is becoming increasingly reliant on the Cyberspace domain to win at the Strategic, Operational and Tactical levels of War. The analysis examines Cyberspace operational components and quantifies the operational impacts to the current and future Warfighter during Unified Land Operations. This analysis further seeks to determine the aspects of the cyberspace domain that impact the current and future ground Warfighter; to understand the impacts and effects of cyber operations; and to identify Cyberspace key terrain that require protection against Cyber Attacks.

A study methodology has been to identify the first, second, and third order of cyberspace effects as determined by the ability to deceive, deny, degrade, disrupt, and destroy capabilities through the conduct of cyberspace operations in support of tactical operations. The specific focus is in the area of the overall impacts to combat operations through the utilization of constructive analysis capabilities to explicitly and implicitly model cyberspace operations.

This will overview the SMDC FWC cyberspace domain analysis; identify some of the challenges inherent in the cyberspace operations analysis; and present a way ahead to set the conditions for future analysis.
Pepsi, Peter Lynch, and PowerPoint: The Importance of Design in Impacting Senior Leaders with your Analyses
Michael Lee | CAA
michael.n.lee10.mil@mail.mil
WG 1: Current Operations | Room 12

This presentation addresses the applicability of the design thinking processes of empathizing, defining, ideating, prototyping, and testing to Operations Research related projects. The case study for this presentation is a Center for Army Analysis visualization project for the Chief of Staff of the Army (CSA). The focus of the project was on creating a tool to assist senior leaders in visualizing the force flow of an operation. After the CSA saw the tool, he directed his staff to place it on his and the Vice CSA's personal desktop. The tool was solely created on PowerPoint, which demonstrates how impact is not always correlated to the data science tool du jour or complex algorithms.

R Shiny web app of The Soldier Survey data
MAJ Joseph Pedersen | MCOE CDID
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WG 2: Future Capabilities | Room 4

The original intent of The Soldier Survey, prepared by analysts at the Maneuver Center of Excellence (MCOE) Capabilities Development and Integration Directorate (CDID), was to capture the immediate feedback of Soldiers returning from combat. In 2003, the first surveys were collected using pencil and paper with returning units. As more data was collected, capability and materiel developers were able to quickly identify gaps and implement enhancements or new equipment to improve the Army's support to the Soldier. Over time, the survey has expanded to include questions covering the entire DOTMLPF-P domain and assisted internal/external organizations with their respective missions. We currently survey Brigade Combat Teams, the US Army Sergeant Major Academy (USASMA), and Professional Military Education (PME) courses at the MCOE. To date we have surveyed more than 29,000 Soldiers.

This presentation will be an interactive exploration of the recent data in the Soldier Survey using an R Shiny web app. Our aim is to have this web app on a CAC enabled website in the near future for the widest dissemination of survey results.

C3PO: Class IIIP Optimizer
Colleen Pleasanton | AMSAA
coleen.f.pleasanton.civ@mail.mil
WG 3: Sustainment | Room 13

HQ AMC G-3/4 requested a tool to aid Soldiers in ordering Class IIIP stockage, based on equipment type and the time-frame in which the Class IIIP is needed. A tool was developed in both Excel and R separately. Users can input multiple units, LINs and their quantities, a percent buffer if desired, along with the days, weeks, or months the unit(s) require Class IIIP stockage. The tool optimizes the volumes ordered between 55 gallon drums, 5 gallon, and 1 quart containers based on prices from FEDLOG. Outputs include gallons needed for each Class IIIP fluid type by container size, cost breakdowns, and the square feet needed to house the fluids. Possible extensions of the tool include adding determination of potential shipping methods and the associated shipping cost.
The demand for ground vehicle electrical power on the Battlefield continues to grow as Soldiers are equipped with newer technologies and capabilities. Previous attempts to predict operationally relevant power demands in support of major Army acquisition studies have been limited by low fidelity/resolution models due to the lack of power profiles. As a result, those studies were unable to substantially inform decision makers. This briefing discusses a new approach of leveraging existing surrogate data as well as capturing new operationally relevant power loads to serve as inputs into a power prediction Modeling and Simulation (M&S) tool. The power prediction tool will provide simulation-based test bed to analyze a range of vehicles/configurations within operationally relevant scenarios. The modeling capability developed will support decisions throughout the acquisition life cycle.

**FORSCOM Emergency Deployment Readiness Exercise Assessment**

LTC Robert Spivey | HQ, FORSCOM
robert.j.spivey2.mil@mail.mil
Co-Author: Steven Sawicki
WG 5: Manpower, Personnel & Training Analysis | Room 14
**NOTE: Not Open to Foreign Nationals**

Analysis of a unit's Emergency Deployment Readiness Exercise showed the time to process through an equipment issue node averaged 1 hour, 52 minutes, which exceeded the planned 1 hour, 30 minutes to process the equipment issue node. FORSCOM's Process Improvement Team made three general observations that caused time delays in throughput: 1) sequential processing; 2) lack of command and control; and 3) equipment issue node layout.

Implementing better designs resulted in simultaneous processing, better command and control techniques, and a more efficient layout, which ultimately reduced the average processing time at the equipment issue node to 48 minutes. These changes also resulted in average equipment issue waiting times reducing from 34 minutes to 3 minutes and average foot movement decreasing from 672 yards to 330 yards. Further analysis found that the better utilization of equipment issue node facilities and support personnel could reduce the unit's block time at the equipment issue node by over two hours.

**Detailed Modeling of Unmanned Aerial Vehicles (UAV) Being Used as Aerial Forward Observer against Ground Units**

Steve Heinlein | CAA
steven.e.heinlein.civ@mail.mil
Co-Author: Paul Chang, Lisa Kim
WG 6a: Modeling and Simulation | Room 10B

The traditional ground combat models like Combat Sample Generator (COSAGE) cannot accurately model aerial systems and their different roles in a battle such as acting as a forward observer for indirect fire batteries. The Advanced Framework for Simulation, Integration and Modeling (AFSIM) allows realistic representations of both ground and aerial systems including detailed modeling of sensors, communication between the UAV and indirect batteries, and movement by the ground units when subjected to indirect fire. In this study, the vignette was built using a battlefield defined in several wargames and subsequent theater campaign modeling; this battlefield was represented with terrain and elevation changes. The different cases conducted for this study represented the three different postures traditionally used in ground combat modeling: static, blue defend and red attack, blue attacking and red defending. The major ground weapon systems such as tanks, self-propelled artillery, armored personnel carrier and trucks were modeled in both static and dynamic (moving) states. The delivery of
indirect munition on the ground units was modeled using weaponeering methods. Also included in the vignette were embedded short-range air defense (SHORAD) in the ground maneuver unit that would detect and engage the UAV; in addition, the use of attack helicopters to defeat the UAV. This study provided valuable insights into the effect that unarmed UAVs, acting as a cueing forward observer for indirect fire, would have on the modern battlefield, as well as Blue ground and aerial systems ability to detect and neutralize these aerial threats.

**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

WG 6b: Modeling and Simulation | Room 3

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.

**Denied Positioning, Navigation, and Timing Studies**

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WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15

The Army depends on Global Positioning System (GPS) for its operations. As such, adversaries are aware of the Army's dependence and have created ways to impede the use of space-reliant assets. To evaluate the impact of denied Position, Navigation, and Timing (PNT), the US Army Space & Missile Defense Command/Army Forces Strategic Command has been conducting denied PNT studies for over 8 years. While there are many available simulations/tools to model PNT accuracy that recreate RF propagation and the electromagnetic environment for technical PNT representations, there is a gap in incorporating these PNT representations into realistic combat models for Force-on-Force evaluation. With the use of Air Force tools-System Effectiveness Analysis Simulation (SEAS) and Global Positioning System (GPS) Interference and Navigation Tool (GIANT), these PNT studies have assessed the denied PNT impact on our military's ability in detecting, attributing, and mitigating Electronic Warfare effects, pointing to solutions to ensure mission success.
Optimization of the Canadian Armed Forces Disaster Relief Supply Chain
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WG 1: Current Operations | Room 12

Canadian Armed Forces is a major contributor to domestic and international disaster relief missions characterizing complex operations demanding significant resources, including equipment, medical supplies, and food. For these operations to be successful, ensuring cost-effective and timely resource utilization and support is crucial. This study describes the development of models and algorithms to improve distribution and inventory management of resources for disaster missions. A military three-echelon Supply Chain Network problem is specifically targeted. Challenges addressed and novelties of the models include: (a) integration of inventory management and distribution management, (b) simultaneously addressing several realistic features of supply chain management within one problem, (c) having an extended network that includes the different scales for transportation times, and (d) the intrinsic complexities of multi-echelon, multi-period discrete optimization problems. Both deterministic and stochastic problems dimensions are addressed. This work is intended to provide advanced decision support tools to support disaster relief logistics military leaders. It is aimed at optimizing supply chain management resources utilization while reducing time and costs to achieve efficient supply delivery such as food, water, medicine and equipment.

OneSAF Modeling Informing Trades Analysis Support to Tank Automotive Research, Development, and Engineering (TARDEC) Pre-Next Generation Combat Vehicle (NGCV) Cross-Functional Team (CFT) Prototype Development
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WG 2: Future Capabilities | Room 4

In fiscal year (FY) 2017, TARDEC was tasked to support the Secretary of the Army's next ground combat vehicle plan submission to Congressional Defense Committees. TARDEC requested support from TRADOC Analysis Center (TRAC) to help identify the operational benefit provided by select key technologies integrated on a near-term experimental prototype.

Given the constrained timeline, TRAC's study team chose the One Semi-Automated Forces (OneSAF) model to conduct the operational assessment because scenarios in OneSAF can be integrated with a short turnaround in comparison to other stochastic combat models. Tailoring the OneSAF scenario to stress key trades was crucial to determining relevant operational benefits and creating measurement space that met the study's goals. Measurement space was developed by leveraging OneSAF's human-in-the-loop capability for scenario integration and OneSAF's closed-form capability to execute a high number of replications for ~40 cases to examine operational impacts. The study team developed a modified design of experiments and custom developed post processing tools developed in R and Python to assess the operational impact of technology trades within two scenarios. The operational metrics considered in the experimental design were vetted through study leadership, stakeholders, and military subject matter experts to ensure the analysis was in line with study goals. This analysis will inform key portions of TARDEC input to the experimental prototype design. This presentation will discuss study methodology and review the limitations, various challenges, and lessons learned.
Improving Munitions Readiness through ORSA Capabilities within an ACWF Organization
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WG 3: Sustainment | Room 13

Army readiness is our number one priority, which requires that we strengthen our sustainment capability to procure and manufacture them when and where we need munitions. General Gustave Perna, commander of Army Materiel Command (AMC), says he will do this by aligning "workload in our depots, arsenals and ammunition plants to unit readiness, rapidly acquiring capabilities to meet materiel and sustainment needs while divesting those systems no longer required.” Munitions manufacturing, storage, care of stocks in storage (COSiS), surveillance, distribution, and demilitarization are important for this readiness. For this reason in 2018, Crane Army Ammunition Activity (CAAA) senior leaders began an aggressive effort to enhance its capabilities to support the munitions sustainment readiness to our warfighters. Avoiding the easy push to use smooth-talking gurus, slogans du jour, and obscure black box calculations, CAAA created an operations research/systems analysis (ORSA) cell to assist its leaders in solving complex problems involving sustainment readiness. It did this while reorganizing its offices to align with AMC, Joint Munitions Command (JMC) and other Army Working Capital Fund (AWCF) organizations. This briefing describes these reorganizational efforts and initial actions for improving analyses for CAAA processes. With millions of time-stamped data points within its Logistics Modernization Program (LMP), this ORSA cell will apply data science to assess this big data. Along with understanding the human factors of its processes, this includes development of stochastic systems for queuing and batch processes. For munitions manufacturing, tools will be developed to improve performance and enhance controls using metrics such as capacity, lead time, rate, cycle time, reliability, and economic results. For production line decisions, models will be developed to performance of series, parallel, bypassing, backtracking, and jobshop configurations. And, for multi-stage process systems, analyses will be formulated to assess surplus-based, time-based, token-based, constant work-in-process (CONWIP), Kanban, first-in first-out (FIFO), earliest due date, shortest remaining processing time, critical ratio, and least slack scheduling methods.

AMSAA Probability of Hit and Kill Simulation (APHAKS) Armor Tile Methodology
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WG 4: Advances in OR & Technology | Room 5

The AMSAA Probability of Hit and Kill Simulation (APHAKS) is an Item-level effectiveness model developed with the intent to make it more-readily adaptable to address new analytical questions. Like other effectiveness models, APHAKS assumes that a target is undamaged each time a threat impacts the target. This assumption is reasonably sound for homogeneous metallic armors, but it does not hold for modern ceramic armors. These armors are much less ductile and tend to fracture rather than deform when struck by a threat. As such, ceramic armors are typically applied as armor tiles that can be replaced when damaged by either a direct hit, or following a hit to a nearby tile.

In order to model hits and damage to armor tiles, an optional behavior was added to APHAKS that allows the model to generate an array of hexagonal armor tiles overlaid on a cell-by-cell target. Hits to the armor tiles are tracked during the simulated engagement. Being hit during the engagement puts an armor tile and a user-defined number of adjacent armor tiles into a damaged state; hits to damaged tiles and number of tiles damaged are also tracked. This methodology was developed to support the Army Studies Program studies "Impact on Crew Protection - Vehicle Survivability due to Armor Multi-Hit Performance" in FY16 and FY17 based on test data from armor certification testing.
Bayonet Warrior Athlete Program Assessment
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WG 5: Manpower, Personnel & Training Analysis | Room 14

Launched in November 2016, the Bayonet Warrior Athlete Program (BWAP) is a 7th Infantry Division (7th ID) commander initiative aimed at reducing injuries and building functional fitness throughout the formation. BWAP involves both educating PRT leaders on the aspects of personal fitness using a 40-hour Program of Instruction and implementing a comprehensive fitness and wellness program. Additionally, each company/battery/troop is issued an expeditionary fitness container designed to utilize while training in both garrison or deployed environments. In order to assess the effectiveness of the program, the 7th ID Surgeon cell and data analysts, were tasked to create a periodic assessment to determine if the average Soldier is improving holistically as a result of the BWAP. This presentation will discuss the methodology and measures of performance used for the assessment as well as the challenges in collecting the information, cleaning the data, and analyzing the results.

Exploratory Analysis of Aircraft Susceptibility Parameters
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WG 6a: Modeling and Simulation | Room 10B

The Future Vertical Lift Capability Set 3 Analysis of Alternatives (FVL CS3 AoA) examines the Joint Services' requirements for a multi-role, medium-lift aircraft. Several conceptual, pre-Milestone A alternatives have been developed. A decade-long planning horizon introduces considerable uncertainty regarding these alternatives' actual performance, as well as their methods of employment versus unknown threats in unknown locations. These uncertainties could potentially offset the value of added performance characteristics when susceptibility is considered. The Analytic Probability Model for Aircraft Susceptibility, with Probability of a Hit Evaluated in a Response-surface Experiment (APMASPHERE) is a simple, yet agile simulation model designed to offer low-resolution insights into just such a large possibility space. It takes as inputs Area of Operations (AO) dimensions, parametric threat data, AO terrain "in-view" distributions, and an experimental run matrix that varies several operational factors of interest. APMASPHERE relates factor settings in the run matrix to the other inputs through an analytic kill-chain calculation, using threat-aircraft engagement geometry as its motivating idea. Its primary output is the expected probability of a hit. Regression modeling of the outputs and a statistical design of the inputs facilitate sensitivity analyses of important variable interactions, in order to highlight relative importance of requirements for conceptual-stage program.

Analysis of a Maintenance Free Operating Period Strategy for the Future Vertical Lift Family of Systems Sustainment Concept
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WG 6b: Modeling and Simulation | Room 3

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.

Training Implications in a Denied, Degraded, and Disrupted Space Operational Environment (D3SOE) based on Multi-Domain Battle (MDB) Concepts
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WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15

The MDB concept is an approach for combat operations against a peer enemy in the 2025-2040 timeframe. The concept entails a more holistic use of the five military domains of air, land, maritime, space, and cyberspace. Future Army forces will integrate and synchronize capabilities as part of a joint team to create temporary windows of superiority across multiple domains and throughout the depth of the battlefield in order to seize, retain, and exploit the initiative; defeat enemies; and achieve military objectives.

This abstract focuses on one aspect of the space domain. In a D3SOE, our ground forces may be challenged if our adversaries contest the space environment. If a peer enemy can deny, degrade, or disrupt our positioning, navigation, and timing (PNT), many of our weapon, communication, ISR, and munition systems and capabilities may be affected. This technology is readily available, and being implemented and integrated into peer military operations.

The U.S. Army must develop better D3SOE training capabilities in live and simulated environments to enhance our MDB abilities. Many Soldiers and Leaders take U.S. space advantages as a fact, assuming they will remain that way. We must train from a point of disadvantage and learn to develop those windows of superiority. USASMD/ARSTRAT is training U.S. Army forces to operate in a D3SOE, and several areas for improvement are being identified at both the collective and individual level to improve readiness.

16 October 2018
1515 – 1545

Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) Target Surrogation
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WG 1: Current Operations | Room 12

The Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) is responsible for providing timely, complete, state-of-the-art joint service authenticated weapons effects data to the Warfighter. To support this mission, JTCG/ME develops Joint Munitions Effectiveness Manuals (JMEMs) that are the sole source for all Joint Service Authenticated non-nuclear weapons effectiveness data for DoD. JMEMs are packaged into an interactive tool called the JMEM Weaponeering System (JWS), it embeds accredited methodologies, certified munition characteristics/delivery accuracy/target vulnerability data, and numerous user aids to predict weapons effectiveness. Resource and intelligence constraints limit the number of full target vulnerability assessments that can be developed. Therefore,
JTCG/ME needs to rely on approved surrogation methods to fill voids and provide Warfighter with the needed capability. This presentation will discuss the state of the JTCG/ME target surrogation process and focus on recent improvements that enable the team to develop surrogations faster without sacrificing quality. Along with streamlining the overall process, all target request will be processed in some way so no target gets left behind.

A Methodological Framework for Developing the Army Futures Command's Data Strategy
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WG 2: Future Capabilities | Room 4

In order to lead the Army's modernization efforts, the new Army Futures Command (AFC) will leverage timely, relevant, and credible analysis that informs and drives the Army's critical modernization strategies, priorities, and decisions. In support of this, the AFC's internal data analytics team coupled with the TRADOC Analysis Center (TRAC) is developing and operationalizing a formal AFC Data Strategy. The AFC data strategy provides a strategic framework for how the AFC will exploit the opportunity provided by the enterprise asset of data. The data strategy serves as an enduring, foundational document for the command as it moves from initial to full operating capability. Given the pre-decisional nature of the AFC, TRAC leveraged systems architecting methods to determine how to build a data strategy for this emerging organization. This presentation details the methodology that enabled the development of the AFC's Data Strategy while also delivering a general framework to guide continuous development and implementation of successive, detailed realizations of the data strategy.

Bridging the Gap Between Real World Data and Army Procurement Decisions
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WG 3: Sustainment | Room 13

Bridging the gap between real world data and Army procurement decisions Headquarters, Department of the Army (HQDA), G-8, uses a reliable and repeatable process to analyze the Army's equipment posture against Defense Planning Guidance scenarios to inform Army leaders on the impact of their equipping decisions. The process can incorporate authoritative equipping data, operational plans, and policies to forecast the equipping status of operational and generating force units. The agent-based simulation, Sustainable Readiness Assessment Model, represents units and the impact of various events, to include equipment procurements, divestments, attrition, and trade as units move through various states such as deployment and reset. Modeling results allow leaders to assess how procurement decisions impact force capability, based on equipment on hand and modernization levels.

Dynamic Visualization Dashboards Using Shiny
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WG 4: Advances in OR & Technology | Room 5

Traditional data analytics and visualization dashboards are tied to specific datasets and can be difficult to construct generalized presentations for varying groups. Shiny, an open-source web application framework, allows individuals to develop graphical, analytical, and statistical-based visualization tools, as well as collaborative dashboards. Shiny web applications make it easy to build interactive toolkits that combine the computational power of the R programming language with the flexibility and interactivity of web technologies. These dashboards apply data filtering and visualization techniques to generate custom dashboards for traditional tradespaces. The dynamic customization of these
dashboards allows users to quickly add filters and see these changes in real-time. We will showcase the ability to import tradespace data, apply filters to the dataset, and demonstrate the potential Shiny offers for data visualization and analytics.

**Predicting First-Term Army Attrition After Initial Entry Training**  
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Co-Author: Jon Alt  
WG 5: Manpower, Personnel & Training Analysis | Room 14

This U.S. Army TRADOC Analysis Center (TRAC) research developed models to (i) identify the demographic factors of Army enlisted personnel with highest probability of failure to implement preventative measures and (ii) estimated total failures during the first enlistment term to set proper recruiting targets. TRAC used predictive and classification data analytic techniques within the Person-event Data Environment (PDE) on millions of records to inform sponsors on attrition trends. The model results were used as inputs to a user-friendly application that displays the predicted probability of success for first term enlistees. These results and application are transportable to other accession and retention related issues within TRADOC as well as other Major Commands within the DoD.

In the presentation, we will explore initial insights gained from the project, demonstrate the R Shiny application, and identify future implementation possibilities.

**Air-to-Ground Expected Kill Data**  
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Co-author: Joseph McCarthy  
WG 6a: Modeling and Simulation | Room 10B

The Army’s Theater Campaign Model (Joint Integrated Contingency Model - JICM) uses a series of Expected Kill (EK) tables to calculate attrition for the air-to-ground campaign. Air-to-ground weapon effectiveness must be translated from weaponeering data to campaign appropriate expected kills. Accordingly, we developed a sustainable EK generation process to extract meaningful data from the USAF Air Armament Center’s Weapon Effects Analysis Probability Software and build over 800 JICM EK tables. Using this Air-to-Ground EK generation process, the Center for Army Analysis can provide repeatable, defensible EK data on a recurring basis or whenever new air-to-ground munitions are fielded.

**The Future of Army Systems Performance Data**  
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WG 6b: Modeling and Simulation | Room 3

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.
For frequencies at mid VHF and above, urban structures are highly reflective and create a complex multi-path environment. Advances in computer languages, distributed processing, and computing hardware enable timely modeling and simulation of this challenging environment. In this presentation, we look at using a modern and integrated approach to simulation that incorporates antenna modeling, structural 3D CAD models, and a multi-path propagation solver to provide an efficient, cost effective, and convenient solution. The method is examined in detail by studying a simulation that models a wide area network of miniature unattended sensors dispersed within an urban district. We cover not only the RF sensing characteristics but the wireless data link to a common network access point.

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Leveraging Real-Time Data for Operational Sustainment Optimization
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WG 1: Current Operations | Room 12

The US Army's adoption of the Global Combat Support System - Army as an enterprise resource planning (ERP) system provides tremendous opportunities to leverage the ERP’s operational data for modeling and analytical efforts. This presentation offers a data-driven approach to forecast the sustainment demand for expeditionary military operations using GCSS-Army data; assess the capacity of sustainment courses of action (COA) to meet the demand associated with the plan; and define the operational risk inherent to a plan from its sustainment requirements.

We will show work completed to date at NCSU, including: demand forecast generation using an end-to-end analysis of expeditionary supply chains, assessment of the sustainment plan for sufficiency, and sustainment risk analysis. These are accomplished through simulation and queuing theory. Current research is focused on modeling the sustainment chain as a network, providing increased fidelity of the model and the risk characterizations, and on expanding the model and tool's capabilities to make it a prescriptive model. Given the operational characteristics and performance thresholds, the model will optimize for the "best" sustainment COA for the commander's consideration.

We will also present the goal of this research moving forward, which is to provide a tool that exploits the real-time logistics data of the ERP to enable planners to more effectively conduct planning, especially for expeditionary operations. The planner will provide model inputs including task organization, mission set, environment, and operational timeline. The modeling and planning tool will generate the forecasted demand based on these factors, query the ERP for the sourcing location for jobs, and optimize the flow of sustainment through the logistics network. A planner could quickly assess different COA's for sufficiency and risk, providing the commander much better understanding of the sustainment impacts of the scheme of maneuver. No other extant logistics planning model exploits ERP data or runs in near-real time, making this tool uniquely relevant for operational planners.

We will illustrate how application of the model to historical operations has validated our results, and demonstrated the utility of the model as a planning tool. Applied to OIF in 2003, for example, the model predicts the bottlenecking and concomitant operational readiness decreases that arose from the sustainment chain, and is easily used to identify capacity increases required to prevent the problems.
Reliability is traditionally defined as "the probability that an item will perform a required function without failure under stated conditions for a stated period of time" (O'Connor, 2012). This definition applies to all levels of a system, to include the smallest part up to the system as a whole. Predicting reliability requires considerable knowledge of the system of interest, thus making prediction difficult. This problem is further complicated by the desire to predict system reliability early in the acquisition lifecycle. Current work seeks to develop a model for the prediction of system reliability early in the system lifecycle. The model uses the following eight factors to achieve this goal: number of system requirements, number of major interfaces, number of operational environments, requirements understanding, technology maturity, manufacturability, company experience, and performance convergence. These factors come together to form a model much like the software engineering and systems engineering models COCOMO (Constructive Cost Model) and COSYSMO (Constructive Systems Engineering Cost Model).

This presentation demonstrates that information available during early system development may be used to predict system reliability. It will compare actual system reliability values determined through testing with early lifecycle model predictions for military ground vehicles. These early prediction demonstrate the ability to forecast reliability rates within 25% of actual recorded values.

Army leaders make important decisions with respect to acquisition and sustainment of the fleet to better enable the Army equipment to best serve our warfighters. Being able to monitor the changes of the past and current availability status of this equipment will enable Army leaders to detect issues before they occur. This leads to better informed decisions. These early warnings could have many possible causes, such as aging, collection or maintenance policies changes, non-garrison percentage changes, etc.

AMSAA has created a methodology to perform this monitoring and it is called “Statistical Monitoring (SM) Methodology for Army Availability”. This SM methodology is composed of a suite of methodologies and an algorithm to compute lower & upper monitoring limits (LML & UML). These methodologies are: 1. Longitudinal Gap; 2. Confidence Interval for Ratio Means (issued U.S. Patent on December 18, 2012); 3. Field Sampling Requirements; 4. Hypothesis Testing for Ratio Means.

This paper will provide a foundation overview of each of the four methodologies, the monitoring limits algorithm, and additional investigative comparative analyses, along with a notional application of the over-arching SM methodology. This methodology was just recently applied to a few of the ground combat systems. This SM framework will also lead to solutions to many other Army problems (i.e. providing guidelines for prescribing future sampling allocations, etc.).
Automating Training Readiness Data Collection and Visualization using R

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WG 4: Advances in OR & Technology | Room 5

In support of the Chief of Staff of the Army Cost of Training Readiness effort, we are supporting fellow Operations Research Analysts at Department of the Army Military Operations - Training (DAMO-TR) in automating the capture, analysis, and visualization of Army training readiness data. Current enterprise software tools for capturing Army training readiness data are limited in what data they capture and are often not intuitive for operational units to enter robust data. We will discuss tools and methods for capturing, analyzing, and visualizing data using online SharePoint InfoPath forms as a CAC enabled collection tool and using R for automated processing and visualization. We will discuss how these tools are then being used to testbed training metrics for future enterprise software tool changes.

The Improvement of Chemical, Biological, Radiological, and Nuclear (CBRN) Test and Evaluation (T&E) through the Test and Evaluation Capabilities and Methodologies Integrated Process Team (TECMIPT)

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WG 5: Manpower, Personnel & Training Analysis | Room 14

The TECMIPT was established by the Assistant Deputy Under Secretary of the Army for Test and Evaluation (DUSA-TE) to develop and improve the Chemical, Biological, Radiological, and Nuclear (CBRN) Test and Evaluation (T&E) standards, methodologies and infrastructure. These improvements work to prevent disparate test results across test agencies by synchronizing testing methodologies and characterizing test infrastructure, which also increases confidence in test data. This can also reduce costly redundant testing and Acquisition Program (AP) schedule slips. The presentation will discuss how the development of T&E standards has supported the verification of infrastructure capabilities, improved the community's trust in T&E data generated during tests, and provided a robust characterization of data used to support the evaluation and approval of CBRN Programs of Record.

Aerial Exposure Metric

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WG 6a: Modeling and Simulation | Room 10B

This U.S. Army TRADOC Analysis Center (TRAC) research developed a method to calculate the level of exposure of each point in the sky in a given terrain box to points on the ground. Understanding exposure informs numerous upcoming and ongoing studies such as Future Vertical Lift, Maneuver-Short Range Air Defense, and Unmanned Aerial Systems. Capability requirements for these systems can be informed by exploring how exposure changes with the interaction of aircraft velocity, flight altitude, and varying terrain. The exposure metric can also be used to determine the optimal routing to minimize exposure in a given area, or to determine the optimal placement of air defense assets to maximize coverage in an area in support of simulation and operational planning. The research also informs the computational costs of scaling these methods up to a larger terrain box and provides insights into future directions. The research team created a proof of principle application to demonstrate applications and formulations of the exposure metric.

The presentation will introduce the concept and formulations of aerial exposure, explore initial insights gained from the project, and demonstrate potential future applications.
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.

Challenge Accepted - A Machine Learning Approach to Automatic Modulation Classification
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WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15

In April of 2018, the Army Rapid Capabilities Office (RCO) launched what it refers to as the "Army Signal Classification Challenge". This is an industry wide challenge meant to promote advanced research in automatic detection and characterization of signals within the Electro-Magnetic Spectrum. In particular, this challenge is meant to flesh out methods that embody Artificial Intelligence (AI) algorithms, and provide a quantitative and meaningful measure of their performance. In this presentation, we look at a Blind Modulation Recognition (BMR) method that incorporates the Support Vector Classifier (SVC). The SVC is a supervised Machine Learning (ML) technique that is versatile and can be effectively deployed using Open-Source software running on modern lap-top computers. We look at the overall structure of the BMR and the standard data set released by the RCO intended for training and test. We conclude with a discussion of both the BMR performance and the cross-validation technique used to measure performance.

16 October 2018
1615 – 1645

Test and Evaluation for the Explosive Destruction System Phase 2
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WG 1: Current Operations | Room 12

The US Army Materiel Systems Analysis Activity (AMSA) completed the Test and Evaluation of the Explosive Destruction System (EDS) Phase 2 Retrofit supporting the start of agent operations at the Pueblo Chemical Agent Destruction Pilot Plant (PCAPP). The EDS was designed, constructed, and Systemized to destroy chemical filled recovered munitions. AMSAA's evaluation conducted during Developmental testing (DT) was provided to the Chemical Demilitarization Test and Evaluation Integrated Product Team, to support a recommendation to begin Agent Operations at PCAPP. At the conclusion of AMSAA's evaluation during DT, the PEO ACWA provided the TIPT's recommendation, along with recommendations from other program stakeholders, to the Undersecretary of Defense for Acquisition, Technology, and Logistics (OUSD AT&L) supporting a milestone decision to begin Operations at PCAPP. Following the decision to begin operation at PCAPP, AMSAA continued its
evaluation during Follow-On Operational Test and Evaluation (FOT&E) where PCAPP disposed of 560 of its most difficult to destroy Chemical Munitions. The results of AMSAA's evaluation during DT and FOT&E have been documented in Test Evaluation Reports.

**Crime Scene Documentation with a 3D Scanner - A MADM Analysis**
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WG 2: Future Capabilities | Room 4

The ORSA Cell at the Maneuver Support Center of Excellence (MSCoE) used Multi-Attribute Decision Making (MADM) to help the Military Police (MP) School decide if they should start using advanced 3D scanners to document crime scenes. A Focused Assessment (FA) was conducted to answer the Issue question: "How does 3D scanning technology compare to traditional methods of Crime Scene Documentation?". The two Alternatives considered were experimented upon by using a state-of-the-art representative technology (the FARO FOCUSs 350), and Certified Instructors from the MP School. Essential Elements of Analysis (EEA) included assessments of how well the Alternatives "Measured", "Recorded", "Processed", and "Analyzed" the Crime Scene. Value Curves were developed by working with Subject Matter Experts (SMEs) to model the rate at which real-world Crime Scene Investigators would assign "value" to the possible degrees of attainment of the various Measures of Merit (MoMs).

**An Application of Discrete Event Simulation to Joint Logistics Over-the-Shore Throughput Operations Modeling and Duration Estimates**
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WG 3: Sustainment | Room 13

Joint Logistics Over-the-Shore (JLOTS) is the method the Army and Navy use to discharge cargo from large seafaring vessels onto a bare beach when an enemy force has denied access to a deep-water port, or when ports have been damaged by natural disasters, terrorist actions, sabotage by military forces, etc. The last large scale, published analytic study on JLOTS was conducted in 1993. Since then, nearly the entire United States Army inventory of wheeled rolling stock has been replaced and tracked systems have increased both in size and weight with the addition of reactive armor tiles and urban survival kits. The most recent estimation tool, the Joint Over-the-Shore Estimator, for determining duration of a JLOTS operation uses average duration values in order to determine total operation length. This research will show the average method consistently overestimates operational throughput while underestimating duration since it fails to capture the ripple effects occurring when a stoppage happens due to an outlying event during discharge. To capture the variability inherent in JLOTS, this research uses discrete event simulation and defines process times using theoretical distributions that best fit the data collected from JLOTS subject matter experts. This dissertational research uses TRADOC Analysis Center - White Sands Missile Range's Innovation Initiative.

This presentation will outline historical JLOTS research, discuss research methodology, present emerging results, and solicit feedback from the community.

**Building Consensus in Analysis**
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WG 4: Advances in OR & Technology | Room 5

Building consensus in analysis for decision making is a creative and dynamic way of reaching a general agreement between all stakeholders. A group of stakeholders building consensus is committed to a common understanding of the problem set and finding a solution set that everyone actively supports, or at the very least, can live with instead of simply voting for an alternative or a sub-set of the group getting their way. This methodology ensures all stakeholders' opinions, ideas and concerns are taken
into account during the analysis. Through active listening, the stakeholders share information about the decisions that will be made, in order to involve all stakeholders in the process and gain buy-in. Building consensus is then used to come up with courses of action (COAs) and recommendations that work for everyone.

This methodology is recommended by business author Patrick Lencioni and used frequently in Japanese business culture. Patrick Lencioni is the author of the best-selling, The Five Dysfunctions of a Team. Lack of Commitment is one of the dysfunctions due to the lack of buy-in and conflict. Building consensus ensures all stakeholders’ options are included in the decision making process through debate. In Japan, ‘Nemawashi,” is the process of building consensus through frank and vigorous debate before the formal decision meeting. This can be done with one-on-one discussion or small subsets of the group to discuss the proposals.

HODA G-8 recently conducted Armored Multi-Purpose Vehicle - Engineer Variant (AMPV-EV) analysis with a diverse group of stakeholders after promoting the use of analytical rigor in future studies. DAPR-FDA chose to use building consensus in their analysis approach as the desired methodology. This supports HQDA G-8 leadership's directive to include analytical rigor in command studies. The analysis team was being included with stakeholders who had limited familiarity of traditional operations research techniques. Through an iterative IPR approach, the study lead used building consensus in analysis to achieve a convergence of opinion on a specific real-world issue. For example, early in the analysis process the stakeholders agreed upon the analytic foundation (Problem Statement, Facts, Assumptions, Constraints and Limitations) to provide a common frame of reference of the issues to realize a common understanding. The author will use AMPV-EV analysis as a case study to demonstrate the benefits of building consensus in analysis.

Analytic After-Action Review Best Practices and Repository
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Co-Author: Stephen Bader
WG 5: Manpower, Personnel & Training Analysis | Room 14
Modeling and Simulation (M&S) Challenges and an Approach for Development of a Relevant Scenario for the Cannon-Delivered Area Effects Munition (C-DAEM) Analysis of Alternatives (AoA)

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WG 6a: Modeling and Simulation | Room 10B

In 2017, the Training and Doctrine Command (TRADOC) was directed to conduct an AoA to assess a range of alternatives for replacing the Army’s dual-purpose improved conventional munition (DPICM). The C-DAEM AoA, executed by the TRADOC Analysis Center (TRAC), provided an analytical comparison of the operational effectiveness, performance, risk, life cycle cost, and development schedules for the alternatives examined. Performance modeling was used to characterize the munitions; goal programming then determined high payoff munition combinations based on performance, cost, and schedule. Finally, the study team used the Combined Arms Analysis Tool for the 21st Century (COMBATXXI) to perform operational effectiveness analysis of these munition combinations.

This presentation will describe the M&S methodology, assumptions, and techniques applied to scope and model a COMBATXXI scenario for the C-DAEM AoA.

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

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WG 6b: Modeling and Simulation | Room 3

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.

Autonomous and Robotic Systems Cyber and Electromagnetic Activities Test and Evaluation Guide

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WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15
**Note: Also scheduled 17 Oct, 1415-1445, Rm 15**

The published guide serves to document an evaluation framework for Cybersecurity and Electromagnetic Activities (CEMA) and develop example inputs for a general U.S. Army Evaluation Center System Evaluation Plan. The evaluation framework aligns phases of the acquisition lifecycle and synchronizes processes such as developmental systems engineering and the Risk Management Framework through clear and concise CEMA Test & Evaluation (T&E) measures.
Robust cyberspace based threats increasingly engage tactical and enterprise systems. Any data exchange, however brief, provides an opportunity for a determined and skilled cyberspace based threat to monitor, interrupt, or damage information and combat systems. Department of Defense acquisition processes must deliver systems that provide secure, resilient capabilities in the expected operational environment. Operationally realistic assessments and measures must assess a system T&E in the presence of a realistic cyber threat early in the acquisition lifecycle.

Electronic Warfare (EW), the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy, consists of three divisions: electronic attack, electronic protection, and EW support. Adversaries are constantly developing and adapting EW threat capabilities, exploiting these technologies, and using them to disseminate attacks against wireless networks, radios, electronics equipment, and computer networks.

17 October 2018
1245 – 1315

Assessing the Value of Engagement Networks (AVEN)
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WG 1: Current Operations | Room 12

Senior Leader Engagements (SLEs) are important assets in any organization. While there are many factors that affect scheduling, coordination, and prioritization of meetings at such high levels, guiding these activities by the unit's overarching strategy and incorporating them into a common operating picture could increase their utility. The leadership and staff at U.S. Africa Command (AFRICOM) recognized this opportunity, especially when it comes to accomplishing the mission. Even though the AFRICOM SLE processes were already quite robust and advanced, they were geared more toward basic, common sense checks and the qualitative archival of engagements. The leadership and staff members needed a better operations research and systems analysis approach. This presentation will cover analyst recommendations to AFRICOM on modifying the SLE data collection and analysis processes to assess SLE coverage and effectiveness against their theater campaign plan.

Unmasking Uncertainty in Multi-Attribute Value Models (Level 1): Exploring Uncertainty on the Frontier
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Co-Author: John Caddell, Matthew Dabkowski, Patrick Driscoll
WG 2: Future Capabilities | Room 4

Multi-Attribute Decision Making (MADM) enables decision makers to objectively evaluate a finite set of alternatives based upon multiple criteria. For simplicity of discussion, traditional methods often reduce the alternatives to a discrete approximation of their predicted cost and value. Practitioners and decision makers alike understand that these predictions contain assumptions and uncertainties that are often ignored in the analysis, lowering the decision maker's trust in the model. Sophisticated methods such as Multi-Attribute Utility Theory enable analysts to capture uncertainty in their models but require complex techniques to compare alternatives that fail to enable an enlightened discussion about the decision maker's best course of action. With this in mind, we propose a stochastic extension of value modeling to provide a more holistic evaluation of uncertain alternatives. In particular, we use Monte Carlo concepts to model the uncertainty inherent in alternative evaluation to reduce the uncertain cost and value tradespace to a conversation concerning comparative dominance. Simulated outcomes are compared to one another, distilling the random frontier into a collection of likelihoods that estimate the
dominance and Pareto-optimality of the alternatives. This approach acknowledges the analysis' underlying assumptions and uncertainties in a compact, digestible way, thereby increasing the decision maker's faith in the model and ultimately facilitating better decisions.

Performance Based Logistics Feasibility Analysis and Metrics
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WG 3: Sustainment | Room 13

The Army is always seeking ways to improve readiness, decrease logistics footprints, and reduce operation and support (O&S) costs. Performance Based Logistics (PBL) has often been suggested as one way to achieve these goals. PBL is an outcome-based product support arrangement designed to improve readiness and deliver warfighter requirements, while incentivizing product support providers to reduce costs through innovation. When implemented appropriately, PBL has a proven track record of increasing materiel availability and has the potential to create significant savings for the Army.

DoDI 5000.02 instructs program managers to employ effective PBL planning, development, implementation, and management in developing a system's product support arrangements. PBL has often been touted as a golden opportunity to save money and improve readiness for the Army; however, not all parts and programs are opportunities for PBL to save money or increase readiness. The study explores opportunities for component-, component bundling-, and system-level PBL arrangements while considering impacts to O&S cost, readiness, and workload. The presented methodology leverages several data sources and utilizes various analytical techniques to develop quick and easy criteria for determining ideal candidates for future PBL contracts.

Just in Time Geospatial Analytics
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WG 4: Advances in OR & Technology | Room 5

Geospatial data sets are rapidly growing in data size, resolution and refresh rate causing analysts to have to make difficult analytic tradeoffs to execute all the data pre-processing steps (i.e. Extract Transform Load) and then computing the analytics via standard desktop processing workflows. These tradeoffs might include only using a subset of the data, artificially limiting the geographical size/resolution of the analysis, and having limited time to iteratively refine the analysis to deliver it in relevant timeframes. This talk will present the results of building a software tool that leverages the Graphical Processing Unit (GPU) on a computer to accelerate typical geospatial analytic workflows. It will describe the results of benchmarking the tool on a typically expensive analysis pipeline for Cross Country Mobility Modeling and discuss the benefits this approach can enable since the speedup is fast enough to move from preprocessing the CCM's as a pre-calculated static input to calculating it on the fly as user's make requests. This can enable significantly more capability in a smaller hardware footprint, exposing analytic capabilities in an offline laptop (with an nVidia GPU) that would typically take a significant number of non-GPU based servers or a cloud environment to enable.

Component Analysis for Rate of Entry (CARE)
Melissa Wickers | CAA
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WG 5: Manpower, Personnel & Training Analysis | Room 14

The U.S Army's Warrior Care and Transition Program (WCTP) ensures recovering wounded, ill, or injured Soldiers receive equitable, consistent, and high quality support services. In order to provide this level of care to Soldiers in the WCTP, the U.S. Army Medical Command (MEDCOM) Deputy Chief of Staff for Warrior Care and Transition (DCS, WCT) must forecast the number of Soldiers with battle
injuries (BI) and disease/non-battle injuries (DNBI) that will enter the WCTP over the next six months. The current manpower model used by MEDCOM - DCS, WCT to project future work load requirements is based on two key inputs: current workload and future deployment and mobilization schedules. However, the model insufficiently forecasts the Reserve Components’ entries into the WCTP. MEDCOM - DCS, WCT has requested the Center for Army Analysis perform additional statistical analysis on the Reserve Components’ WCTP entries. The Component Analysis for Rate of Entry study seeks to give a better depiction of future Reserve Components’ BI and DNBI entries into the WCTP. A key component to this analysis is determining the relationship, if any, between BI/DNBI entries and the total number of Soldiers deployed or mobilized.

Modeling the Effects of Gravity in a Casualty Reduction Model (CASRED)
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WG 6a: Modeling and Simulation | Room 10B

The AMSAA Casualty Reduction (CASRED) model estimates the effects of personal protective equipment, such as body armor, helmets and goggles, in reducing personnel casualties, including injury and incapacitation, from fragmenting munitions. The model considers the effects of terrain shielding, vegetation, and air drag in slowing or stopping fragments on their way to targets. Coverage of body parts, and armor material properties, affect the estimate of incapacitation or injury. CASRED considers fragmentation mass, shape, density and velocity data by nose-to-tail zone, as measured in arena tests. For munitions where such tests are not feasible, a different approach is required, using sets of impact point data. An off-line program uses a point-mass, two-degree-of-freedom model that considers both air drag and gravity and outputs sets of trajectories for individual fragments. A version of CASRED reads these trajectories and calculates the numbers and locations of hits on each target. AMSAA has used this version of CASRED to estimate casualties from a mine, an air-bursting munition, a non-lethal "stingball" munition, and a canister tank round.

Verification of Truncated Random Data: Challenges and Recommendations for Modeling Behind Armor Debris
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WG 6b: Modeling and Simulation | Room 3

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.

The Center for Cyber Analysis Assessment
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WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15
The nature of deployed ORSA support has varied over time, among providers, and from analyst to analyst. Some changes were mandated by changes in mission/command requirements, formally and informally. Deployed units operate in rapidly changing environments, so organizations with a variety of subject-matter expertise have analysts, who are employed in various ways based on their unique experiences and skillsets to meet commanders’ changing needs. What has remained consistent in recent years is a relatively low level of awareness of how commands use the products and services deployed ORSA analysts provide and indications of the impact they have on the commander’s ability to make more informed decisions. This brief gives an overview of the Joint Improvised-Threat Defeat Organization’s investigation into these matters concerning its’ Deployed ORSA Program.

Unmasking Uncertainty in Multi-Attribute Value Models (Level 2): Illuminating the Trades We Expect
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WG 2: Future Capabilities | Room 4
In our previous presentation we introduced a simple way to capture and represent the underlying assumptions and uncertainties of the cost and value tradespace associated with a Multi-Attribute Decision Making (MADM) model. Dubbed "Level 1" analysis, this approach uses Monte Carlo concepts to model the uncertainty inherent in alternative evaluation and reduce the uncertain cost and value tradespace to a conversation concerning comparative dominance. In this talk, we extend our approach by focusing on the set of Pareto optimal alternatives and comparing the relative, random slopes between them to the decision maker's expected trades. This "Level 2" analysis subsequently summarizes these comparisons into a collection of metrics based upon the development of several zones - one of which represents the region where the decision maker would no longer select a given Pareto optimal alternative. Ultimately, by providing the decision maker a more comprehensive assessment of the uncertainty surrounding a problem's most attractive alternatives, we establish realistic expectations and more fully quantify risk.

Using Discrete Event Simulation to Optimize Sparing Concepts within Operational Availability (Ao) Models
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WG 3: Sustainment | Room 13

In an effort to increase readiness and decrease downtime for the warfighter, many pieces of equipment are fielded with spares to address failures that occur. In many cases, these sparing decisions are back of the envelope and without analytic rigor. To address these shortcomings, AMSAA has developed an approach within existing Operational Availability (Ao) modeling efforts, to determine the most effective sparing procedures for various pieces of equipment. Do we have too many spares? Do we have too few? What would our Ao be if we were able to field 10 more spares? These questions and many more can be answered using the methodology developed for this specific use case.

Machine Learning Algorithms for Weaponeering Calculation
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WG 4: Advances in OR & Technology | Room 5

The JTCG/ME develops and distributes the JMEM Weaponeering System which provides combatant commanders a multiplicity of calculation tools to support mission planning, and weaponeering activities. Packaging a large number of complex computer models, the large data sets required to drive these models, and an interface sophisticated enough for an end user to run these models is a resource intensive process. In addition, the warfighter is often working under tight time constraints to develop effective results from their weaponeering tools. Machine Learning (ML) algorithms have the potential to significantly reduce the complexity and data volume required to provide a needed "quick turn" result with real-time response rates. To investigate this potential, the JTCG/ME is developing prototype machine learning tools based on existing weapon effects data sets, and scoring them using several criteria (prediction rates, size, response times).

Emerging Growth Generated Priority List Analytical Tool
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WG 5: Manpower, Personnel & Training Analysis | Room 14

Total Army Analysis (TAA) stakeholders annually submit resourcing requests to the Army to compete for resources for emerging growth requirements. These requests can range from a single person to an entire unit and include both capacity and capability requirements. The broad scope of the requests makes it difficult to establish a common denominator with which to compare them, identify those with the most benefit to the Army, and defend the selection in an easily understandable way. The Army
currently determines which requests to approve by voting on them, but they would like to implement a more analytical, less biased method. Analysts at the Center for Army Analysis (CAA) will use decision analysis methods to compare resourcing requests from stakeholders for emerging growth.

**Operational Requirements Casualty-based Assessment Visualized in Virtual Reality**
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WG 6a: Modeling and Simulation | Room 10B

ORCA-VR is a prototype application being developed to explore methods of displaying Operational Requirements Casualty-based Assessment (ORCA) model output in an immersive and informative virtual reality (VR) environment. This virtual reality prototype aims to assist analysts by displaying a shot-line through the body in an interactive 3D environment, opposed to the current methodology: 2D images accompanied by tabular output. Using a 3D immersive environment give analysts a multi-modal understanding of model results by providing spatial awareness and multiple levels of information in one context. With more information displayed in one context the DoD analyst has a reduced cognitive load while analyzing data, leading to an improved assessment of survivability and lethality at the human system level. This presentation will explain the techniques used to visualize shot-line data, such as injured tissue types and the tissues’ corresponding severity.

**Simulation Comparison between the Infantry Warrior Simulation (IWARS) and the One Semi-Automated Automated Forces Simulation (OneSAF)**
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WG 6b: Modeling and Simulation | Room 3

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.

**Traffic-Based Model for Network System Assessment**
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Co-authors: Christian Murga, Jaime Acosta
WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15
Specific environmental attributes have a great impact on materiel sustainment and network communications; therefore, integration of geospatial data and/or geographic visualization into current analysis methods would greatly increase the ability to efficiently draw insights and conclusions regarding these impacts. Providing these capabilities would allow for realization of geographic trends or environment-specific impacts that could better inform logistics and network communications related readiness and acquisition decisions. Geospatial Analysis is a constantly evolving area that has the potential to address various analytical gaps and needs across the Army and DoD.

The Army Materiel Systems Analysis Activity (AMSAA) has developed prototype, web-based tools that enable efficient and effective analysis and visualization of logistics and network communications data. This proof of concept demonstrates how geospatial data and analysis techniques can provide increased logistics and network communications analysis capabilities to inform readiness and acquisition decisions, and will influence future work in this area. Specifically, web-based geospatial methodologies can enable the user to identify inventory, maintenance labor expenditures, and supply chain issues in support of logistics analysis and decisions, as well as enable identification of network communications connectivity issues associated with geospecific terrains in support of network / communications analyses. Understanding the effects geographic location has on logistics and network communications is an integral part of optimizing mission readiness and effectiveness. Providing geospatial technologies in a web-based environment provides the user with an increased understanding of and the ability to interact with data, supporting better informed readiness and acquisition decisions.
A Method for Repeatable Data Collection and Assessment of Communications Interoperability

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WG 2: Future Capabilities | Room 4

The Center for Army Analysis (CAA) was tasked by the U.S. Army Director of Force Management (DFM) to develop a methodology and tool to evaluate how capable U.S. Army forces are at communications interoperability with our joint and multinational mission partners. This tool's purpose is to collect information from the field as structured data that leaders can use to understand the current capability level with specific mission partners and manage operational knowledge related to Doctrine, Organization, Training, Materiel, Leadership/Education, Personnel, Facilities, and Policy (DOTMLPF-P) elements that limit or enable communications. The data collection methodology is structured by mission partner, echelon, U.S. Army Warfighting Functions (WfF), and U.S. Army Tasks (ART). Standardized definitions of the levels of interoperability (according to NATO AAP-06 and U.S. AR 34-1) for tasks within each WfF provide the framework for objective assessments of interoperability. The structured, repeatable nature of the data allows for quantitative and longitudinal analysis of information that is typically analyzed and assessed subjectively. CAA is currently testing and developing the prototype tool during multinational exercise events.

Using Big Data to Support Test and Evaluation Analyses for Army Vehicles

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WG 3: Sustainment | Room 13

During military vehicle testing, terabytes and even petabytes of data are collected. This massive volume of data, termed big data, can help drive test efficiencies and reduce future risks during the test and evaluation (T&E) process. The challenge is to convert these test data into useable information, which can be used to identify patterns and deviations from those patterns. Unfortunately, big data are so large and complex that it becomes difficult to process using traditional database and software techniques. AMSAA developed a tool to quickly process and analyze test data to provide reliability focused data analyses. These reliability focused data analyses complement existing data sources used during Reliability, Availability, and Maintainability (RAM) evaluations by identifying when the vehicle exceeds threshold limits, compares the performance of the component before and after the fix is implemented, provides justification for fix effectiveness factors, and helps classify test events that can lead to better and faster solutions. In addition, instrumentation/test data can be used to help gain insights into design information, which will be more indicative of vehicle performance than vendor's claims. The test data can support accelerated component and subsystem level testing. By incorporating big data analytics into the T&E process, it can lead to smarter acquisition and T&E decisions and a better product to the Soldier.

Rapid Analytic Development in the DoD: Theory and Case Studies

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WG 4: Advances in OR & Technology | Room 5

As the Department of Defense (DoD) continues to struggle to operationalize data science, one thing that has become clear is that many emerging problems cannot be solved using traditional software acquisition. This presentation advocates for an alternative way forward using a process called Rapid Analytic Development (RAD). Under the RAD concept, data scientists work directly with those who could benefit from analytic solutions (users) in an iterative prototyping model to solve problems quickly and accurately. This presentation will begin with a discussion of the theory of RAD, then present several DoD case studies demonstrating the value of the process.
The "Holy Grail": The Joint Force Activities Dataset (JFAD) and the Historical Deployment Process
Terri Chang | CAA
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WG 5: Manpower, Personnel & Training Analysis | Room 14

An authoritative and complete historical dataset is the Holy Grail for many analysts. On the contrary, the road to analytical insignificance is paved with good intentions, otherwise known as the lack of an authoritative and complete historical dataset. The Joint Force Activities Dataset (JFAD) consists of an integrated set of orders and deployment data and can serve as a starting point for studies that address issues related to defense strategy, planning, and programming. Combatant commander's force requirements are matched with HQDA sourcing assignments. A procedure has been established to provide a historical account of personnel that are trained, equipped and become available to deploy. Analyst use simulation models to inform sourcing recommendations. JFAD can be considered a "demand signal" to represent Army deployments, and can provide boundaries for parameters used within simulation models. The analysis process models Army rotations necessary to support defined mission requirements. The inputs to the simulation models, as well as the simulation outputs can be illustrated in visual display charts. Some sample critical Army units' force generation have been selected, as examples for data used in conducting studies. This dataset is available to all DoD analysts and may prove to be your elusive Holy Grail.

Visualizing and Analyzing Casualty Medical Data and ORCA Simulation Data using Visual Anatomical Injury Descriptor (VisualAID)
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Co-Author: Kathryn Loftis, Ronald Weaver
WG 6a: Modeling and Simulation | Room 10B

Visual Anatomical Injury Descriptor (VisualAID) is a graphical computer tool developed to illustrate injury and severity on an anatomical figure to communicate trauma. The illustrations are created via mapping Abbreviated Injury Severity (AIS) codes to tissue images on top of a template anatomy image. VisualAID is a data visualization and analysis tool for injuries identified in casualty medical records or simulated through modeling and simulation. These standardized illustrations have drastically improved communication and analysis of injury data by providing a medium to compare injuries occurring during traumatic events. This presentation will show visualization of wound ballistic case data. It will also demo how VisualAID uses output from the Operational Requirements-based Casualty Assessment (ORCA) model to illustrate and understand injuries of military personnel. Once individual cases are explained we will show how they can be grouped, filtered and compared in a frequency analysis mode. Lastly, we will briefly discuss collaboration with the National Highway and Traffic Safety Administration and their use of VisualAID tool to store injury and event data.

Infantry Warrior Simulation (IWARS) Methodology Development to Support the USMC Personal Protective Equipment (PPE) Study
Jeremy Collins | AMSAA
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WG 6b: Modeling and Simulation | Room 3

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.

Analysis and Assessment of Autonomous Systems and Human Agent Interaction
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Co-Author: Jeffrey Smith
WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15

Future battlefields will have an increasing number of semi and fully autonomous, intelligent, and adaptive systems working with human warfighters. There are many challenges in developing test methodologies to define and evaluate the performance of AS alone. The challenge is further compounded when the AS is expected to "partner" with a human in a dynamic environment. In this paper, we explore the problem-space and present a framework for an analyst to assess and analyze AS operating alone or with human agents in an unpredictable dynamic environment.

17 October 2018
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Novel Geospatial Methodology to Evaluate Aircraft Susceptibility to Enemy Air Defense Systems to Inform Future Vertical Lift Capability Set 3 Analysis of Alternatives
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WG 1: Current Operations | Room 12

The Future Vertical Lift Capability Set 3 Analysis of Alternatives (FVL CS3 AoA) examines the Joint Services' requirements for a multi-role, medium-lift aircraft. A fundamental component of the FVL CS3 AoA is combat aircraft survivability, which consists of two elements - susceptibility and vulnerability. Susceptibility is the probability that a hostile weapon system acquires and hits a friendly aircraft. To reduce susceptibility to enemy air defenses, it is critical to avoid enemy detection and engagement. Flying faster at various altitudes and leveraging terrain shielding effects are two means to avoid enemy detection and engagement. To properly inform FVL survivability requirements, new geospatial analysis tools and methodologies were required.

The Army Materiel Systems Analysis Activity (AMSAA) developed a novel methodology to evaluate an aircraft's ability to evade enemy air defense systems. Using high resolution terrain data and geospatial analysis techniques, the model generates route agnostic probability distributions of aircraft susceptibility across a spectrum of threat densities, threat system engagement ranges, aircraft altitudes and airspeeds. The results are being incorporated into AMSAA's Analytical Probability Model for Aircraft Susceptibility with Probability of Hit Evaluated in a Response-surface Experiment (APMASPHERE) to inform FVL CS3 AoA Milestone A requirements, shaping design parameters for aircraft airspeed, altitude, threat acquisition range, lock-on range and countermeasures effectiveness. In addition to FVL CS3, future Army aviation studies will benefit from the new insights derived from these groundbreaking tools and methodologies. The tools can be employed to generate geospecific, operationally relevant aircraft susceptibility results for worldwide enemy air defense systems.
AMSAA performed a Mid-Tier networking Vehicular Radio (MNVR) Analysis of Alternatives (AoA) at the direction of the Office of the Secretary of Defense (OSD) Cost Assessment and Program Evaluation (CAPE) to support the full rate production decision for the MNVR program. The objective of the analysis was to assess Mid-Tier waveform requirements to support the Army ground communication needs in a satellite contested environment, both with and without jamming of the mid-tier network.

The AoA study team assessed all reasonable alternatives and provided comparative assessments of all alternatives over a wide array of measures including network end-to-end connectivity and performance, vulnerability to threat electronic attack, technical risk, schedule risk, and cost effectiveness.

The overall analysis was able to clearly show the differences in how the waveform capabilities and characteristics translated into end-to-end message completion rates, message delays, and ability to prosecute artillery and mortar fires missions, the ability of the waveforms to operate in the presence of enemy jamming, the cost differences, schedule risks, spectrum supportability, SWaP, and interoperability. The study allowed leadership to easily compare the performance of the various alternatives, understand the pros and cons of each alternative, explain why one waveform was better than the other, and support the way ahead for the Army's network design.

Using System of Systems M&S to Assess Operational Energy and Inform S&T Investments
Michael Clark | TARDEC - Analytics
michael.g.clark22.civ@mail.mil
Co-Author: Brian Ernst, Dennis Anderson, Francois Bosselut
WG 3: Sustainment | Room 13

The Joint Operational Energy Initiative (JOEI), under the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC), uses system of systems (SoS) modeling and simulation (M&S) to model, analyze, and assess operational energy (OE) impacts to inform Science and Technology (S&T) investments. Using the System of Systems Analysis Toolset (SoSAT), a detailed SoS stochastic M&S tool, in concert with the Fully Burdened Cost Tool (FBCT), the JOEI team developed a library of operational scenario models that are used to analyze the impacts of alternative technologies and operational concepts on OE. Hydrogen fuel cells and vehicle electrification are two recent alternative technologies that have been modeled and analyzed. Operational energy impacts assessed include fuel, water, and other supply class consumption; operational reach without resupply; demand reduction; and identification of second- and third-order effects; along with determination of fully burdened costs. The scenario models were developed in collaboration with and in support of the U.S. Army Operational Energy Analysis Task Force (OEATF) and involve combat and stability operations at brigade, division, and theater levels, with the stability operations scenario involving operations of systems and technologies in base camps. SoSAT is used to model system scenario operations, including reliability, supply consumption, supply generation, sustainment, and detailed convoy operations.

Human in the Loop Entity Resolution with R2D2
LTC Samuel Huddleston | Naval Postgraduate School
shhuddle@nps.edu
Co-Author: Alex Ryan
WG 4: Advances in OR & Technology | Room 5

Entity resolution is "the process of determining whether two references to real-world objects are referring to the same, or to different, objects" and forms a key part of analyst workflow in many
intelligence applications. However, given the massive amounts of data intelligence analysts are required to process, they often struggle to efficiently and accurately resolve entities of interest in bulk data stores. The authors have developed a free, open-source, server-deployed application that provides analysts the ability to perform state-of-the-art bulk record linkage and deduplication through the use of a simple web browser interface. The Resolver Revolver (R2) and Duplicate Detector (D2) tools are now available for download as a single application (R2D2) to all DoD personnel via dscoe.org.

**Sexual Harassment/Assault Response and Prevention Program Review (SHARPPR)**

Sandra Hatch | CAA
sandra.w.hatch.civ@mail.mil
Co-Authors: Renee Carlucci, Melissa Wickers, Gale Collins
WG 5: Manpower, Personnel & Training Analysis | Room 14

The Army's Sexual Harassment/Assault Response and Prevention (SHARP) Program is the Army's integrated, proactive effort to end sexual harassment and sexual assault within its ranks. However, the current Army SHARP program may not be optimally organized and resourced to effectively administer the sexual assault prevention and response program across all Army Components. A February 2017 United States Government Accountability Office (GAO) report to congressional committees stated that better resource management is needed to improve prevention and response in the Army National Guard and Army Reserve. This study was requested by the Secretary of the Army's office to assess the requirements and capabilities of SHARP personnel, to identify strategic choices for personnel realignment, and identify ways to improve the effectiveness and efficiency of the SHARP program. The briefing will cover the study methodology, facts established from our initial analysis and data call, and highlight the many program challenges.

**D-Optimally Based Sequential Test Method for Ballistic Limit testing with a Change in Mechanism**

Leonard Lombardo | Army Test Center
Leonard.C.Lombardo.civ@mail.mil
WG 6a: Modeling and Simulation | Room 10B

Ballistic limit testing of armor is testing in which a kinetic energy threat is shot at armor at varying velocities. The striking velocity and whether the threat completely penetrated or partially penetrated the armor is recorded. The probability of penetration is modeled as a function of velocity using a generalized linear model. The parameters of the model serve as inputs to MUVES which is a Department of Defense software tool used to analyze weapon system vulnerability and munition lethality.

Generally, the probability of penetration is assumed to be monotonically increasing with velocity. However, in cases in which there is a change in penetration mechanism, such as the shatter gap phenomena, the probability of penetration can no longer be assumed to be monotonically increasing and a more complex model is necessary. One such model was developed by Chang and Bodt to model the probability of penetration as a function of velocity over a velocity range in which there are two penetration mechanisms.

This paper proposes a D-optimally based sequential shot selection method to efficiently select threat velocities during testing. Two cases are presented: the case in which the penetration mechanism for each shot is known (via high-speed or post shot x-ray) and the case in which the penetration mechanism is not known. This method may be used to support an improved evaluation of armor performance for cases in which there is a change in penetration mechanism.
The published guide serves to document an evaluation framework for Cybersecurity and Electromagnetic Activities (CEMA) and develop example inputs for a general U.S. Army Evaluation Center System Evaluation Plan. The evaluation framework aligns phases of the acquisition lifecycle and synchronizes processes such as developmental systems engineering and the Risk Management Framework through clear and concise CEMA Test & Evaluation (T&E) measures.

Robust cyberspace based threats increasingly engage tactical and enterprise systems. Any data exchange, however brief, provides an opportunity for a determined and skilled cyberspace based threat to monitor, interrupt, or damage information and combat systems. Department of Defense acquisition processes must deliver systems that provide secure, resilient capabilities in the expected operational environment. Operationally realistic assessments and measures must assess a system T&E in the presence of a realistic cyber threat early in the acquisition lifecycle.

Electronic Warfare (EW), the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy, consists of three divisions: electronic attack, electronic protection, and EW support. Adversaries are constantly developing and adapting EW threat capabilities, exploiting these technologies, and using them to disseminate attacks against wireless networks, radios, electronics equipment, and computer networks.
The Squad Multipurpose Equipment Transport (SMET) provides the small unit with an unmanned cargo transport and resupply capability. SMET both reduces Soldier load burden and provides power generation, directly supporting the expanding needs of Squads in dismounted operations. In April of 2017, Department of the Army approved a Directed Requirement for an SMET Technology Demonstration (TD) to accelerate deliver of an SMET capability to the Infantry Brigade Combat Team (IBCT). Phase II of the TD begins in November of 2018 and will involve 2 IBCTs incorporating 4 different prototypes in their training, to include a rotation at the Joint Readiness Training Center.

This presentation will introduce the Army's SMET Study Plan and focus on data collection and analysis tools used to support the TD and other Study efforts. The Maneuver Center of Excellence and RAND have collaborated to develop the data collection methodology and collection tools. Results and Insights will inform Army directed Study Issues, a Capability Production Document and provide Product Managers a cost-benefit analysis of alternative solutions.
Janet Langley | Natick Soldier RD&E Center
Janet.C.Langley.civ@mail.mil
Co-Author: Joseph Quigley
WG 3: Sustainment | Room 13

Material and non-material capabilities have been developed by the Army to reduce the need for fuel and water resupply, as well as waste backhaul, on austere expeditionary base camps. The aggregate effectiveness of combining these capabilities to reduce sustainment and logistics requirements on these contingency bases is not well understood. As part of the U.S. Army Natick Soldier Research, Development and Engineering Center's Sustainability/Logistics-Basing -Science and Technology Objective - Demonstration, modeling and simulation tools were developed to assess the impact of new material and non-material solutions on sustainment usage at 50, 300, and 1000 PAX expeditionary base camps in equatorial, temperate, and arctic environments. The results identify key capabilities that can reduce sustainment needs in expeditionary base camps. This analysis also captures conclusions, insights, and recommendations to assist the Army Leadership in making informed decisions regarding the implementation of materiel and non-materiel options to save fuel, water, and waste in base camps.

Building Analytics Teams in DoD Organizations
LTC Samuel Huddleston | Naval Postgraduate School
shhuddle@nps.edu
Co-Authors: Ian Kloo
WG 4: Advances in OR & Technology | Room 5

During the 86th MORS Symposium, more than 70 members of analytics teams across the DoD gathered to discuss the state of data science and analytics in the DoD. This presentation will provide an overview of the key "lessons learned" articulated by this group of analysts during the Data Analytics Focus Session. Specific topics of discussion include data infrastructure and technology platforms needed; the education and development of key personnel; the adaption of existing policies to facilitate rapid analytic development; and the development of community spaces for collaboration across organizations.

Cost Comparison Analysis Tool for Stationing (CCATS) Model Enhancement
Sarah Stewart | CAA
sarah.e.stewart38.civ@mail.mil
Co-Author: Nancy Zoller
WG 5: Manpower, Personnel & Training Analysis | Room 14

The Department of Defense (DoD) has used the Cost of Base Realignment Actions (COBRA) model since the first Base Realignment and Closure (BRAC) round in 1988. COBRA is a cost comparison model that allows an analyst to compare competing BRAC scenarios and up until now has not been used outside of BRAC. However, the Military Departments could use the COBRA model's capabilities to provide cost comparisons for day-to-day stationing or inform strategic stationing decisions. COBRA has not been updated since the 2005 BRAC round, when a DoD Joint Process Action Team (JPAT) rewrote multiple algorithms to account for changes in technology and DoD business operations. In
2016, the Office of the Secretary of Defense (OSD) initiated a three-phase effort co-led by CAA and OSD to update the COBRA model. A JPAT with representatives from all Services met monthly to review selected COBRA model topics and developed requirements for an updated model with new analytic capabilities. The JPAT is in the process of building a functioning model based on JPAT requirements and then use the new COBRA model to support current stationing decisions across the Departments. We will discuss the underlying principles of the revised model and how such principles will support future stationing analyses. We will also discuss the key analytic modeling capabilities expected in the new COBRA model and their implications to future strategic studies.

An Overview of FRACTALS: A Framework for Capability-Based Tactical Analysis Libraries and Simulations
Eric Harclerode | AMSAA
eric.s.harclerode.civ@mail.mil
WG 6a: Modeling and Simulation | Room 10B

The U.S. Army Materiel Systems Analysis Activity (AMSAA) is developing the Framework for Capability-based Tactical Analysis Libraries and Simulations (FRACTALS) to allow integration of numerous item-level performance models and simulations. FRACTALS was derived from the underlying architecture of the Fusion Oriented C4ISR Utility Simulation (FOCUS), a simulation used to analyze the performance of ISR assets in tactical vignettes, by separating functional capabilities from the simulation engine. The new framework is centered on an entity and "plug-in" capability relationship controlled by process flows that allow users to define the interactions between and behaviors within the entities and capabilities. For example, in the ISR domain, users have greater flexibility in the definition of the target acquisition timeline, dynamic tasking, and intelligence processing, exploitation, and dissemination. The deconstruction of FOCUS also precipitates the creation of the Tactical ISR Performance Suite (TIPS) that encapsulates ISR performance methodologies into a standalone module capable of use with FRACTALS and other external applications. FRACTALS offers an agile, extensible simulation environment to meet the requirements of both current and future technologies in our fast-paced, ever-changing world.

LiDAR Target Acquisition Prediction Model
Matthew Banta | AMSAA
matthew.d.banta.civ@mail.mil
WG 6b: Modeling and Simulation | Room 3

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.

The Army Blueprint to Become a Force Multiplier Across Domains
MAJ William Cross | USARPAC
william.r.cross.mil@mail.mil
Co-Authors: Nicole Seaman, Michelle Meier
WG 7: Cyber Electromagnetic Activities (CEMA) Analysis | Room 15
**Note: Briefing time is 1500-1600**

The MDTF is a potential solution that could enable the Army to deploy, fight, and win decisively by
utilizing information and intelligence, and kinetic and non-kinetic fires across domains in light of the emerging operational environment. The United States Army Pacific has conducted and planned a series of analytic events, including exercises, simulations, wargames, and workshops to inform Multi-Domain Operations and the Multi-Domain Task Force concept of operations and employment, provided insights into the manner in which the desired capabilities contribute to joint operations, and highlighted multiple capabilities and technologies for further exploration.

17 October 2018

1530 – 1600

Fragment Fly-out Modeling to Support Joint Operations

Zachary Zoller | AMSAA
zachary.p.zoller.civ@mail.mil
Co-Author: Gregory Navaline
WG 1: Current Operations | Room 12
**Note: Also scheduled 16 Oct, 1300-1330, Rm 12**

Joint operations involve coordination between services to accomplish the mission while keeping non-combatants and friendly forces safe. AMSAA received a request from a Fighter Squadron to provide Army artillery munition fragmentation altitude, radius, and time of travel estimates to support their mission planning. Estimations aid Fighter Pilots with operational timeline to allow them to safely approach target areas after deployment of an artillery fire mission. AMSAA modified the Fragment Fly-out Program to output altitude, radius, and time parameters and validated the program change using an Air Force weapon test case. AMSAA provided fragment maximum altitude, radius, and time results for common mortar, cannon, rocket, and missile munitions. Product was incorporated into current Warfighter planning operations for Air to Ground integration and disseminated to the Air Force, Air National Guard, and Reserve units.

Cannon-Delivered Area Effects Munition (C-DAEM) Analysis of Alternatives (AoA) Candidate Munitions Capability Evaluation (CMCE)

Logan Nichols | TRAC-WSMR
logan.s.nichols2.civ@mail.mil
Co-Author: Kirstin Smead
WG 2: Future Capabilities | Room 4

In 2008, the Department of Defense (DOD) signed the Cluster Munitions and Unintended Harm to Civilians Policy, banning any cluster munition with an unexploded ordnance rate exceeding 1 percent from operational employment starting 1 January 2019. As a result, the Army cannot use its current inventory of dual-purpose improved conventional munitions (DPICM). The Fires Center of Excellence, with input from Combatant Commands, assessed the lost capabilities and their impacts without DPICM, and the Army is pursuing a replacement capability under the C-DAEM program. The initial capabilities document (ICD) describes desired requirements against the complete target set.

In February 2017, Headquarters, Department of the Army, G-8 directed the TRADOC Analysis Center (TRAC) to conduct an analysis of alternatives (AoA) to examine alternatives that address the C-DAEM requirements outlined in the ICD. The AoA analyzed a set of alternative munitions to address the C-DAEM target set. During the CMCE line of effort, the study team described, categorized, compared, and screened candidate munitions to reduce the number of munitions for assessment. The set of candidates was reduced further using optimization and Fires Simulation XXI, identifying and prioritizing munitions based on lethality, cost, and schedule attributes. This provided initial insights into candidate munition lethality, cost, schedule, and efficiency while providing recommendations for restricting the scope of the remainder of the AoA.
This presentation describes the methodology, challenges associated with rapid analytic techniques, and considerations for new tools and techniques used to perform quick turn analysis to support Army decisions.

Analysis of Emerging Solar Panel Systems to Improve Sustainment and Readiness of Low-usage Vehicles
Brian Frymiare | AMSAA
brian.e.frymiare.civ@mail.mil
Co-Authors: Kevin Guite, Ernest Luoto
WG 3: Sustainment | Room 13

The Army's vast fleet of tactical wheeled vehicles (TWVs), which make up nearly 65 percent of the Army's total vehicle inventory, is charged with the global sustainment mission and is a critical component needed to transport supplies and equipment to and around the battlefield. However, approximately 75 percent of the TWVs can be characterized as low-usage, or operated fewer than 3,000 miles each year. Without consistent maintenance of these low-usage TWV systems, they have proven to be a big part of the battery failure-and-replacement cycle for the Army. Recent Army Sample Data Collection and Analysis (SDC&A) data shows TWV batteries being replaced every 13 months on average, yet the expected minimal life of the battery is three years, with an expected full life of approximately 6 to 8 years when treated properly. The replacement cycle is an expensive effort for the US Army, which spent on average approximately $26M per year during FY15-FY17 on batteries that power its fleet of TWVs.

Emerging solar panel technology has the potential of providing a cost-efficient solution to the battery failure-and-replacement cycle for these low-usage ground vehicles. The use of a solar charging system is expected to extend vehicle battery life 3 to 5 times its current lifespan. As a result, average yearly TWV battery replacement costs could be reduced to one third of their current level, yielding a yearly cost avoidance of approximately $17M. Saving a single battery on a TWV will quickly recoup the cost for that vehicle's solar charging system.

AMSAA is leading a focused analysis effort to quantify the performance of emerging solar panel technology to ensure the power produced is capable of charging/maintaining multiple batteries aligned in series/parallel configurations in Army ground vehicles. Through a year-long effort initiated in the summer of 2018, analysts are examining solar panel power output, battery voltages, battery states of charge, and ambient temperature readings to produce recommendations for cost-efficient solar panel solutions to benefit low-usage Army TWVs. Emerging results have produced a collection of lessons learned as well as characterizing the speed and efficiency of today's solar panel products. It is expected that at the conclusion of the study, the US Army will benefit from increased fleet readiness rates, decreased maintenance costs, decreased reliance on energy supply lines, and documented market research and data analysis informing vehicle based solar power requirements to support Army sustainment and acquisition communities.

An Update From The Simulation Interoperability Standards Organization (SISO) Exploration of Next Generation Technology Application to Modeling and Simulation (ENGTAM) Standing Study Group
Chris McGroarty | Simulation & Training Technology Center
christopher.j.mcgroarty.civ@mail.mil
Co-Authors: Christopher Metevier, Joseph McDonnell, Lana McGlynn
WG 4: Advances in OR & Technology | Room 5

The core development of our Modeling & Simulation (M&S) and Analysis Tools is driven by need; however, there are times when a reflection on the state-of-the-art in computing can provide insights in to how we might want to evolve. Given the rapid advances in computing technologies occurring
independent of our M&S and analysis tools, an exploration of the tradespace would be prudent to maximize our leveraging potential.

To that end, the Simulation Interoperability Standards Organization (SISO) established the Exploration of Next Generation Technology Applications to Modeling and Simulation (ENGTAM) Standing Study Group (SSG) to research emerging technologies with the goal of understanding how they can be adopted and adapted to support military analysts as they employ M&S as a tool. The ENGTAM SSG focuses on technology adoption, interoperability, and technology areas, such as big data, cloud computing, artificial intelligence, machine learning and mixed reality.

This presentation will discuss relevant findings from the ENGTAM SSG and what they mean to the military analytical and simulation communities.

**Workload Analysis to Support Software Sustainment**

John David DeVido | AMSAA  
Co-Authors: Lisa Carroll, Jason Steve  
WG 5: Manpower, Personnel & Training Analysis | Room 14

Software is prevalent in multiple commodity areas and in many systems across the Army, and its use/dependency is continually increasing. Software, like hardware, must be sustained throughout its life cycle to ensure that it continues to support the operational mission. Software sustainment is provided through various Software Engineering Centers (SEC) through the Post Production Software Support (PPSS) mission, which is a subset of Army depot maintenance. In recent history, the number of systems to sustain in PPSS has increased significantly. However, the total Table of Distribution & Allowances (TDA) for the various SECs has not increased proportionally to account for the influx of systems. The SECs have had to rely on contractor support to maintain the systems in PPSS and ratios of government to contractor personnel will continue to decrease if TDA’s are not re-evaluated. In order to rebalance government to contractor ratios in the SECs, an analysis of the current workforce structure was performed to help determine future PPSS workload requirements to accommodate the additional systems entering into PPSS.

**Terrain Development for Combat Samples in Theater-Level Models**

Stephen McCarty | CAA  
Stephen.g.mccarty.civ@mail.mil  
WG 6a: Modeling and Simulation | Room 10B

Campaign analysis of ground operations across different theaters and time frames requires a model that produces consistent and reproducible combat samples that are in turn used in theater-level models. The Center for Army Analysis (CAA) uses the Combat Sample Generator (COSAGE) model to produce these combat samples.

The combat samples produced by CAA are for use in all Attrition Calibration-based theater-level models (e.g., Joint Integrated Contingency Model, Synthetic Theater Operations Research Model).

The terrain used in COSAGE was developed from an on-the-ground terrain study in West Germany in the 1970s. The measurements from this study were turned into parameters for the COSAGE model. In an effort to update the terrain factors in COSAGE, CAA analysts used a wide range of sources and modern geospatial tools to develop similar statistical terrain factors. This brief will summarize CAA’s efforts to produce a terrain methodology to use in the COSAGE model and highlight the challenges and methods used during the process.
Army operating concepts describe joint combined arms operations on increasingly lethal battlefields. Recent events in the Middle East (Hezbollah in Lebanon, Houthi Rebels in Yemen, and ISIS in Iraq) have demonstrated that non-state actors also have capabilities to defeat the most heavily armored vehicles. The U.S. Army has the opportunity to address combat vehicle needs in order to maintain overmatch against adversaries. Many active and passive protection technologies have reached sufficient maturity, offer protection improvements against a range of threats, and are assessed to have acceptable impacts to the size, weight, power, and cooling (SWaP-C) of combat vehicles.

To better understand the problem and inform combat vehicle modernization, the Army directed the Maneuver Center of Excellence at Fort Benning to lead a 90-day study, assisted by the Program Executive Office for Ground Combat Systems (PEO GCS) and the Tank Automotive Research, Development and Engineering Center (TARDEC). The Study included three main actions: (1) problem definition through stakeholder surveys on prominent threats to combat vehicles, (2) solution identification through a request for information to Industry and Army Researchers on advanced protection technologies, and (3) assessment of solutions through simulations, capability assessments and war gaming. This presentation will focus on the capabilities war game methodology used in this Study.

Results of the Study were provided to Army Senior Leadership for their consideration.

The MDTF is a potential solution that could enable the Army to deploy, fight, and win decisively by utilizing information and intelligence, and kinetic and non-kinetic fires across domains in light of the emerging operational environment. The United States Army Pacific has conducted and planned a series of analytic events, including exercises, simulations, wargames, and workshops to inform Multi-Domain Operations and the Multi-Domain Task Force concept of operations and employment, provided insights into the manner in which the desired capabilities contribute to joint operations, and highlighted multiple capabilities and technologies for further exploration.
Honoring Walt Hollis

13 Nov 1926 – 27 Jul 2018

ORSA HOF Induction: 27 Jun 2006


1973 – 1980: Scientific Advisor to Commander, Operational Test & Evaluation Agency

Mr. Hollis served his country as an Army Soldier in World War II and continued to served as a civilian for 56 years at the U.S. Department of Defense. He fundamentally changed the way the Army does business for the better by demanding the rigorous testing executed today on systems. His family knew of his motivation for public service and devotion to the Army while his principle motivation was the safety, well being, and effectiveness of the warfighter.

His Army family recognizes his many achievements and appreciate his early vision to improve the relationship between the tester, acquisition community, and the analysts. Former Secretary of the Army, John McHugh, wrote "His remarkable career and tireless commitment to providing our Warfighters with the latest and most advanced equipment, Soldier support systems and technology set the standard for excellence in selfless service to country."

Mr. Hollis created the ORSA Hall of Fame to honor noteworthy contributions made to Army-wide operations research and systems analysis by individuals whose transformational and outstanding personal leadership inspired and motivated others in the field. We honor Mr. Hollis for his years of dedicated service and his promotion, support, and influence on our community. Thank you Mr. Hollis for your leadership and vision. Your “passion for teaching and mentoring new generations of analysts to think, be creative, challenge assumptions, and to do the right thing,” will live on.
2018 ORSA Hall of Fame

Each year, AORS hosts the ORSA Hall of Fame Banquet, which features the induction of historically distinguished Army operations research practitioners into the ORSA Hall of Fame. This year’s inductee is Mr. David J Shaffer, nominated by Mr. James Amato.

Mr. David J. Shaffer
Executive Deputy to the Commander
U.S. Army Research, Development and Engineering Command

The inductee for 2018 is Mr. David Shaffer, who retired as the Deputy to the Commander of the U.S. Army Research, Development and Engineering Command in 2008. In that position, Mr. Shaffer directed the Army’s intensified research, development and acquisition process for fielding technologies that sustained America’s Army as the premier land force in the world.

Prior to assuming his current duties, he served as the Director of the U.S. Army Materiel Systems Analysis Activity from 1998 to 2006.

Congratulations Mr. Shaffer and thank you for your valuable contributions to Operations Research!

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Do you have a nominee for the ORSA Hall of Fame?

**Basis for Nomination:**

- [x] Significant contributions to Operations Research over extended period of time
- [x] Significant impact through doctrinal/technical accomplishment and/or innovative development
- [x] Inspired others with outstanding leadership and achievements

**Nomination Procedures:**

- **Eligibility:** Former US Army military or civilian (Civil Service)
- **Nominator:** Any member of the US Army (military or civilian), former member, or their family members can nominate
- **Packet:** Submit nomination packet to ORSA HoF Recording Secretary between 1 April and 31 May

Recording Secretary: Heather McMahon-Puhalla
410-278-7906  heather.m.mcmahon-puhalla.civ@mail.mil
Interested in an OR Developmental Opportunity?

US Military Academy
West Point, NY
Visiting Professor
GS 13-15
24 months

US Army Pacific
Fort Shafter, HI
OR Analyst
GS 13-15
18-24 months

US Army Europe
Wiesbaden & Kaiserslautern, Germany
OR Analyst
GS II-13
25 months

All selectees remain on present organization's TDA with duty as assignment locations. Additional information follows.

USMA Visiting Professor

WHO: DA Civilian GS-13 through GS-15 in the IS15 series, or equivalent; possess a MS or higher in OR, Systems Engineering (SE), Engineering Management (EM), or related field. Applications not from ORSA related career fields will be considered on a case-by-case basis. Teaching experience is not necessary. Must have impeccable character and be a strong motivator to mentor cadets.

WHERE: United States Military Academy (USMA), West Point, NY. Campus housing may be available.

WHAT: Advanced professional opportunity to teach, inspire, and develop cadets and future Army leaders. Serve 2 functions: 1) teach 2 sections per semester of appropriate SE/EM courses and advise a cadet-led capstone design team; 2) sustain and grow Department of SE and Army Analytical Community initiatives to enhance analytic collaboration.

WHY: Teach/mentor the Army's next generation of officers. Provide interaction across breadth of the Army Analytic Community and technical development in the areas of SE/EM and OR. Gain a better understanding of the Army mission and culture, Army corporate perspective, and National Defense integration.

WHEN: Tour length: 24 months. Application Due Date: 15 Nov 2018; Phone Interviews: 1 Dec 2018; Notification Date: NLT 15 Dec 2018; Reporting Date: NLT 1 Jul 2019.

HOW TO APPLY: Work through organizational chain of command. Send application package consisting of: (1) Resume, (2) cover memorandum outlining your reasons for applying and your potential contributions to the program, and (3) a command endorsement memorandum addressed to Director, CAA nominating you for the program and certifying your availability. Note: The ASPMO will pay basic salary & direct benefit costs.

POCs: Jeffrey.demarest@usma.edu and sheri.l.palmer4.civ@mail.mil • 202-329-1903
U.S. Army Pacific (USARPAC) Rotational Analyst

**WHO:** DA Civilian GS-11, 12, & 13, in the 1515 job series, a minimum of a SECRET clearance. Applicants not in an OR related career field will be considered on a case-by-case basis.

**WHERE:** USARPAC Headquarters, Fort Shafter, Hawaii.

**WHAT:** Perform a wide range of quantitative analyses and/or critical thinking; participate in and lead operational assessments relevant to USARPAC’s theater of operations in support of the US Indo-Pacific Command, analytical campaigns for Multi-Domain Task Force–Pilot Program and SES/GO directed projects that relate to readiness, theater posture, emerging concepts and capabilities, and/or logistics.

**WHY:** Advanced professional development opportunity to gain a broader perspective of OR operations as they relate to ASCC responsibilities, Theater Joint Forces Land Component Command Operations, and Multi-Domain Operations.

**WHEN:** Tour Length: 18-24 months; Application Due Date: Extended 30 Oct 2018; Phone Interviews: 1-8 Nov 2018; Notification Date: NLT 13 Nov 2018; Reporting Date: on/ about 7 Jan 2019.

**HOW TO APPLY:** Send electronic application package consisting of: (1) Résumé, (2) a cover memorandum outlining your reasons for applying and your professional development goals, and (3) a command endorsement memorandum nominating you for the program and certifying your availability to POC below.

---

U.S. Army Europe (USAREUR) Rotational Analyst

**WHO:** DA Civilians GS-11 - GS-14 in the GS-1515 series with a SECRET clearance. Applications from ORSA-related career fields will be considered on a case-by-case basis.

**WHERE:** 3 assignments with the USAREUR Headquarters in Wiesbaden, Germany and 2 with the 21st Theater Sustainment Command (21st TSC) Headquarters in Kaiserslautern, Germany.

**WHAT:** Analysts work on current and relevant problems in the functional areas of Operations (NATO and US), Logistics, Resource Management, Personnel, Base Operations, and Training. Opportunities to visit training / exercise events and to visit with other analytical agencies in Europe.

**WHY:** Advanced professional development opportunity for to get first-hand experience with the forward deployed Army by working at the major headquarters elements within the U.S. Army, Europe. Analysts return home with a broader defense perspective and a more strategic focus for addressing field requirements.

**WHEN:** Tour Length: 25 months; Application Due Date: 21 Dec 2018; Phone Interviews: 14-23 Jan 2019; Notification Date: NLT 31 Jan 2019; Reporting Date: Jun - Aug 2019. Selection will be based on background experience and other special analytical skills.

**HOW TO APPLY:** Send electronic application package consisting of: (1) Résumé, (2) a cover memorandum outlining your reasons for applying and your professional development goals. Include preference for either USAREUR HQ or 21st TSC HQ, and (3) a command endorsement memorandum nominating you for the program and certifying your availability.

USARPAC/USAREUR POC: Sheri Palmer 202-329-1903 ♦ sheril.palmer4.civ@mail.mil
USAREUR POC: Patricia Alexander DSN 314-337-3596/COM ♦ +49-0611-143-337-3596 ♦ patricia.l.alexander.civ@mail.mil
Directions to Events

**56th Annual AORS**

Mallette Training Facility  
6008 Jayhawk Rd, Aberdeen Proving Ground, MD 21005

**From 715 Gate (Red Arrows):**
- Enter APG through Rt. 715 Gate, Maryland Boulevard
- Right onto Combat Drive
- Left onto Bel Air Street
- Limited parking on left side of Bel Air Street (Left on Jayhawk)
- Full parking on right side of Bel Air Street

**From 22 Gate (Purple Arrows):**
- Enter APG through Rt. 22 Gate, Harford Boulevard
- Right onto Maryland Boulevard
- Left onto Aberdeen Boulevard
- Right onto Frankford Street
- Left onto Bel Air Street
- Limited parking on right side of Bel Air Street (Right on Jayhawk)
- Full parking on left side of Bel Air Street

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**ORSA Hall of Fame**

Water’s Edge Events Center  
4687 Millennium Drive, Belcamp, MD 21017 – Ph. 410-297-9467

**95 North from Baltimore**
Take exit 80 for MD-543 towards Belcamp. Keep right at the fork and follow signs for US-40. Merge onto MD-543 S. Use left lane to turn left onto US-40 W. Turn left onto Bata Blvd. Turn right onto Millennium Dr.

**From Aberdeen Proving Ground**
Merge onto US-40 W. Turn left onto Bata Blvd. Turn right onto Millennium Dr.

---

**Night Owls Social**

Top of the Bay  
30 Plum Point Loop W, Aberdeen Proving Ground, MD 21005 – Ph. 410-278-3062

**From Mallette Training Facility**
Turn left onto Jayhawk Rd. Turn left onto Bel Air St. Bel Air St turns slightly left and becomes Frankford St/Ravenna Rd. Turn right onto Frankford St. Turn right onto Aberdeen Blvd. At the fork, turn left onto Civil Road. Turn left onto Plum Point Loop.

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AORS Website: http://www.aors.army.mil
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