



86th Symposium

Group Prospectus

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WG 1 – National Security Strategic Operations

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WG 1 Strategic Operations National Security Analysis fosters the use of operations research approaches, techniques, and methodologies to create a better understanding of the strategic dimensions of national security, security cooperation, stability, deterrence and assurance. Our primary focus is on strategic planning and operations (to include nuclear, cyber, and space) where instruments of national power are tasked to protect national security interests, enhance strategic stability, deter conflict, assure allies and set conditions for future contingency operations. Areas of interest include strategic force structure alternatives and their impacts, treaty implications, changes in roles and missions, WMD proliferation, expansion of cyber capabilities and domain, and other related topics. This Working Group also investigates the status and future prospects for regional stabilities, military capabilities, and the arms control process. This analysis will provide ways to conceptualize and analyze the sufficiency of forces and strategies in support of deterrence, assurance, counter proliferation and stability operations across the spectrum of conflict for US military planners, policy analysts, or anyone involved in formulating warfighter, service, and agency policy and planning.

To address this issue from a global perspective, we solicit analytically rigorous papers on the full spectrum of current and future issues to include: Non-Proliferation; Threat Assessment and Threat Reduction; Deterrence, Causes and Prevention of War; Conflict and Peacekeeping; Emerging, Catastrophic, and Disruptive Events; Regional Security Forces and Strategy; Theater Security Cooperation; Arms Control; Proliferation Maintenance, Monitoring, Prevention and Mitigation; Stability and Escalation Dynamics; Diplomatic and Military Approaches; Delivery and Defenses; Alternative/Potential Futures; Sustainment; Development; and Changing Environments.

Papers employing modeling, game theory, optimization, decision analysis, management science, assessment across PMESII and other quantitative/analytical techniques are especially welcomed. Both completed tasks and works in progress are encouraged.

WG 2 – Chemical, Biological, Radiological, Nuclear and Advanced Explosives (CBRNE) Defense

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Chemical, Biological, Radiological, Nuclear and Advanced Explosive (CBRNE) threats pose serious challenges to US military operations. In the contexts of force protection, major and irregular combat operations, homeland defense and other missions, the proliferation of technical expertise and the availability of once scarce resources (such as computational capabilities, biomedical engineering equipment, and radiological industrial sources, etc.) necessitates that future military capabilities to effectively detect, respond, deter, and maintain mission performance be strengthened against an increasingly wide set of possible scenarios. In an environment of uncertain budgets, ensuring that CBRNE risks and hazards to military operations are well-understood is a fundamental challenge to national military, political, intelligence, and homeland security defense efforts.

This MORS working group seeks presentations on quantitative or qualitative CBRNE analysis efforts attempting to tackle difficult real-world problems despite inherent data shortfalls and other limitations. Presentations that support a balanced modern and ready nation are of particular interest.

WG 3 – Infrastructure Analysis, Protection and Recovery (IAP&R)

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The subject of Working Group 3, IAP&R, has a natural rhetorical connection to the theme of the 86th MORSS, “Supporting a balanced modern and ready nation.” The major thrust of this working group is the examination of critical infrastructure, particularly as it pertains to the loss of function and the requirements for restoration in the event of a natural or man-made disruptive event.

The term *critical infrastructure* was defined by the USA PATRIOT Act of 2001 as “systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters.”

Critical infrastructure systems can be military or civilian. Critical infrastructure systems in the United States consist of a diversity of interdependent networks and more complex systems, varied operating and ownership models, systems in both the physical world and cyberspace, and stakeholders from multi-jurisdictional levels.

Presidential Policy Directive 21 (PPD21) summarizes the government's objective with regard to critical infrastructure: “The Federal Government also has a responsibility to strengthen the security and resilience of its own critical infrastructure, for the continuity of national essential functions, and to organize itself to partner effectively with and add value to the security and resilience efforts of critical infrastructure owners and operators.” In PPD21, the term resilience is defined explicitly to mean “the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions.” These statements make clear that resilience is distinct from risk management in two respects: whereas risk management aims to reduce losses, resilience seeks to maintain the capabilities and functionality of a system, and where risk management takes place before and during an event, resilience should be further-reaching,

considering also how the system will recover and adapt.

Because of their interconnected nature, infrastructure systems face the potential for large-scale disruption resulting from both deliberate threats (e.g., attacks, sabotage) and non-deliberate hazards (e.g., accidents, failures, natural disasters). Large-scale disasters have revealed that decision makers often struggle to identify or determine key components and interdependency relationships in infrastructure systems, optimal resource allocation to increase resilience or reduce risk, and optimal response plans. These dependencies can occur within or between the physical, informational, cognitive, and social networks of the system, requiring decision makers to have knowledge and understanding of across these domains.

Working Group 3 (WG 3) welcomes papers in concepts under development and research as well as proven applications and techniques from all disciplines that highlight the use of operations research methods in the following subject areas:

- Metrics for measuring the resilience of critical infrastructure systems; Contrasts across infrastructure sectors; Perspectives from owner-operators, state, local, and federal agencies; Perspectives from military commanders;
- Modeling, analytical techniques, and decision support tools to determine vulnerabilities in critical infrastructure, assess resilience, and/or inform planning and investment;
- Modeling and analysis in support of assessing interdependencies across critical infrastructure systems and estimation of consequences of failure across infrastructures, with emphasis on defense and homeland security applications; Case studies and examinations of cascading impacts of infrastructure failures;
- Cyber-physical interdependencies in critical infrastructure analysis;
- Dependency of critical infrastructure resilience on the organization and performance of data collection, decision makers, and system users.
- Strategic guidance, development and implementation of national policies for military and/or civilian infrastructure systems;
- Best practices or case studies for critical infrastructure prior to, during, and after an event or incident; restoration of critical infrastructure systems following large scale disasters; and
- Methods, policies, techniques and programs for working across organizational or jurisdictional lines to assess and assure resilient critical infrastructure.

Presenters can include operations research analysts, statisticians, behavioral scientists, clinical providers, medical planners, logisticians, and other scientists. Papers that describe development of IAP&R analysis tools, techniques, and methodologies are welcome. Note that all presentations and discussions must be kept at the Secret level or lower. We look forward to hearing from you!

WG 4 – Homeland Security, Homeland Defense, and Civil Support

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National Security analysts have new challenges accurately characterizing future terrorist attacks. New problems are created by agile adversaries affecting how to address public safety. What are the appropriate issues that should be analyzed to support immigration control and illegal trafficking across our borders? Given limited security assets, how is risk calculated and how to use constrained resources to minimize this risk?

Working Group 4 (WG4) supports this year's MORS Symposium theme "Supporting a balanced modern and ready nation" by encouraging analysts in the Homeland Security (HLS) and Homeland Defense (HLD) communities to share best practices and new methodologies. Best practices emerge from the bedrock principles of military operations research that have evolved over the past 50 years. New methodologies are being tested to support HLS and HLD missions. WG4 provides the collaborative forum to share information and build upon the collective knowledge to strengthen HLS and HLD efforts. WG4 is home to an analytic cadre from DHS, its Components, and USNORTHCOM.

DHS was established to provide a unifying core for the vast national network of organizations and institutions involved in efforts to secure the United States of America. DHS's mission is to prevent and deter terrorist attacks and protect against and respond to threats and hazards to the nation. DHS works to ensure safe and secure borders, welcome lawful immigrants and visitors, and promote the free-flow of commerce.

USNORTHCOM is teamed with the bi-national North American Aerospace Defense Command (NORAD) with their complementary missions to collaborate with homeland defense, security, and law enforcement partners, to prevent air attacks against North America, to safeguard the sovereign spaces of the United States and Canada by responding to unknown, unwanted, and unauthorized air activity approaching and operating within these airspaces, and to provide aerospace and maritime warning for North America.

Many of the goals from last year will remain our areas of emphasis: (a) identifying and working through obstacles and differing priorities in the homeland security and homeland defense continuum, (b) assessing the issues, authorities, and associated policies of DHS and DoD's support to civil authorities, (c) evaluating information sharing within and across US and global partners, (d) sharing or exchanging information among national and international partners, and

(e) highlighting technical or methodological advances that improve HLS and HLD efforts.

WG4 intends to work throughout the year to address some of these analytic areas and will be active in MORS events to demonstrate our commitment to conducting analyses that can lead to improvement of interaction and response for all agencies involved in National Security.

WG 5 – Information and Cyber Operations

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Joint Publication 3-13, Information Operations (IO), dated 27 November 2012; incorporating change 1, dated 20 November 2014, defines IO as the “Integrated employment, during military operations, of information-related capabilities (IRC) in concert with other lines of operation to influence, disrupt, corrupt, or usurp the decision- making of adversaries and potential adversaries while protecting our own.” The newest revision of Joint Publication 3-13, introduces new models of information-influence relationships and environments; as well as, clarifies staff roles and desired effects upon target audiences (TA). There are many military capabilities that contribute to IO and should be taken into consideration during the planning process. These include: strategic communication, joint interagency coordination group, public affairs, civil-military operations, cyberspace operations (CO), information assurance, space operations, military information support operations (MISO), intelligence, military deception, operations security, special technical operations, joint electromagnetic spectrum operations, and key leader engagement.

JP 3-12, dated 5 February 2013 defines Cyberspace as “A global domain within the information environment consisting of the interdependent networks of information technology infrastructure, including the internet, telecommunications networks, computer systems, and embedded processors and controllers” and for cyberspace operations (CO), Joint Publication 3-0, “the employment of cyberspace capabilities, where the primary purpose is to achieve military objectives or effects in or through cyberspace.” The WG recognizes that information and cyber operations efforts must also be globally integrated with actions taken by other instruments of national power, and as such must consider Interagency, non-government, and Coalition partners, as well as potential opponents and neutrals across the full spectrum of conflict. Moreover, the heavy reliance upon information technologies and ensuing global integration has increased the importance of information and information superiority to the point that information technologies and information are becoming critical objectives for future conflicts. The WG encourages submission of presentations relevant to the information and cyber operations areas outlined below; especially as they identify, clarify and relate IO and CO. The submission may be finished work, work-in-progress, or ideas and concepts. There is a rising demand for IO/Cyber professionals across the Interagency, Department and Service communities. Professional development and continuing education to grow the workforce to

meet this demand cannot be of higher priority.

The WG encourages submission of presentations relevant to the information and cyber operations areas outlined below; especially as they identify, clarify and relate IO and CO. The submission may be finished work, work-in-progress, or ideas and concepts. There is a rising demand for IO/Cyber professionals across the Interagency, Department and Service communities. Professional development and continuing education to grow the workforce to meet this demand cannot be of higher priority.

- Studies, activities and analyses illustrating the development and evaluation of IO/Cyber learning, instruction tools, hands-on or virtual learning, or exercises
- Multidisciplinary approaches to defining and solving information and cyber operations problems leading to new tactics, techniques and procedures
- Activities and analyses that demonstrate the integration of capabilities at the strategic, operational, and tactical levels of war to produce effective US Government responses
- Real-world applications of IO/CO tools, techniques, and simulations for IO/cyber workforce skill acquisition and sustainment-
- Training analyses of network operations that demonstrate the impact of information attack, defense, exploitation and assurance as well as on attack detection, and/or restoration across the spectrum of conflict
- Studies using tools applied to any of the core competencies described above
- Studies that examine the effects of attack, defense, and influence operations on friendly, adversarial, and/or neutral organizations
- Symposia, games, exercises, experiments or acquisition testing that involved information and cyber operations, emphasizing the vulnerabilities of information- dependent organizations
- Development of IO and CO modeling and simulation-based analysis tools, and
- Analyses of historical examples of successful and unsuccessful information and cyber operations.

Presentations that describe development of information and cyber operations analysis tools, techniques, measures of effectiveness, damage indicators and damage assessment methods—or the refinement of existing ones—are welcome. Presentations that address this year’s theme of a balanced modern and ready nation are of particular interest. We look forward to hearing from you!

WG 6 –Command and Control (C2)

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Command and Control (C2) is one of the seven joint functions that enable the conduct of joint, interagency, intergovernmental and multinational tasks across the range of military operations. Joint Publication 3-0 states that C2 “encompasses the exercise of authority and direction by a commander over assigned and attached forces to accomplish the mission.” For more than two decades the United States has been increasingly relied upon to command and control joint, interagency, intergovernmental and multinational forces during offensive, defensive and stability operations in locations around the world. Analysts have been involved in not only helping plan and support these operations but are responsible for identifying and providing solutions to C2 issues occurring anytime from planning to troops-in-contact situations.

The size, diversity and age of the processes, networks and systems comprising C2 represent a critical concern for national security, making it crucial for our National Security Analysts to have the skills necessary to understand, monitor and influence our C2 procedures, systems and systems-of-systems. Current and future operations will require the development and implementation of changes to C2 capabilities allowing forces to respond dynamically to asymmetric threats; operations in urban environments; collaboration with joint, interagency, intergovernmental and multinational entities; and planning, employing, organizing, directing, coordinating, controlling, and protecting military forces. In order to achieve the capabilities envisioned necessary to expand the ability of the military commander to plan operations, assess their progress and quickly effect changes that appropriately respond to developments on the battlefield analysts at every level will be vital in developing and evaluating the necessary and sufficient C2 solutions.

For the 86 MORSS, WG 6 will provide an opportunity for military, government, and civilian operations research analysts to examine topics, methodologies, analyses, and innovations pertinent to the challenges of C2, especially within the context of national security. WG 6 invites papers and discussions regarding the current and future analysis of C2 issues, systems, architectures, investment strategies and processes as well as educational programs, training programs and tools that support the continued growth and development of the nation’s C2 capabilities. Presentations may include completed studies or work-in-progress

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Robust and efficient analysis and operations research methods provide critical support to our Intelligence, Surveillance, and Reconnaissance (ISR) capabilities as our Nation continues to deal with uncertain global asymmetric and strategic threats. The purpose of the ISR Working Group is to promote the exchange of analytical techniques, permit the peer review of methods and results, and provide a means for continued growth of military operations research and related disciplines as applied to ISR analysis across the spectrum of peace, crisis, Stability and Support Operations (SASO), and Major Combat Operations (MCO). The theme of the 86th Symposium is "Supporting a balanced modern and ready nation." Intelligence, Surveillance and Reconnaissance is a critical function of the US Military and an essential building block of our nation's security.

For the foreseeable future, the United States will maintain the technological edge in "battlefield awareness" and precision-guided weaponry. However, in the decades to come, we will face three types of threats: Asymmetric threats in which state and non-state adversaries avoid direct engagements with the US military but devise strategies, tactics, and weapons to minimize US strengths and exploit perceived weaknesses; Strategic threats, including mobile missile and submarine threats where a few countries will have the capability to strike the United States or its allies; and regional military threats, in which a few countries maintain large military forces with a mix of Cold War and post-Cold War concepts and technologies. Many of these potential adversaries are undertaking increasingly sophisticated Cover, Concealment, Camouflage, Denial and Deception (C3D2). These efforts are designed to hide key activities, facilities, and capabilities (e.g., mobilization or attack preparations, WMD programs, advanced weapons systems developments, treaty noncompliance) from US intelligence; to manipulate US perceptions and assessments of those programs; and to protect key capabilities from US precision strike platforms. With the increase in dynamic targeting, smaller yield weapons, a desire for reduced collateral damage and a large and growing inventory of coordinate-seeking weapons, special emphasis will be placed on the ability of intelligence assets to provide accurate target location accuracy. Foreign knowledge of U.S. intelligence and military operations capabilities is essential to effective C3D2. Advances in indications and warning capabilities; the growing availability of camouflage, concealment, deception, and obscurant materials; advanced technology for, and experience with, building underground facilities; and the growing use of

fiber optics and encryption will increase the C3D2 challenge.

The ISR Working Group seeks to provide a forum for ISR analysts to present their work across all intelligence disciplines (GEOINT, SIGINT, MASINT, HUMINT, etc.). The work may be focused on optimizing ISR assets, ISR modeling and simulation techniques and case studies, providing actionable intelligence to commanders and decision makers, the use of operations research techniques in support of ISR planning or execution, or the organized use of multidisciplinary teams combining less mathematical areas such as psychology, political science, cultural specialists, etc., to solve hard problems, including those in the intelligence arena.

In addition, the ISR Working Group provides a forum for information sharing within the ISR community. This includes information on ISR system's algorithms, data structures, and fusion capabilities in order to improve the knowledge base on which analysts perform assessments. The goal of the working group is to provide information to improve and grow ISR analysis to best support the community in current and future operations.

WG 8 – Space Acquisition, Testing and Operations

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Working Group (WG) 8 focuses on Operations Research (OR) efforts that help our nation “secure the high ground” in space. The presentations will demonstrate analytically sound OR techniques that help our nation acquire and operate space capabilities/systems by assessing their strategic, tactical, and operational contributions (real or projected). Presentations will further our understanding of space capabilities incorporating this year’s theme: “Supporting a Balanced Modern and Ready Nation.”

Today, more than ever, space is the true “high ground” given that more nations around the world have access to the space domain through organic or commercial space capabilities. Leveraging space provides the most global perspective possible allowing for enhanced global security, protection of lives and assets, movement of information, and augmentation of the Warfighter’s operational environment. As nations around the world continue to leverage and acquire space capabilities, it becomes increasingly critical for the U.S. to maintain Space Superiority across the broad range of space operations in an increasingly congested, contested, and competitive space environment. This WG discusses the analysis of technological challenges and solutions that bring about unrestricted use of space and space-enabled cyber, enabling our military and intelligence communities to effectively decide, detect, and deliver on a global scale.

We are seeking presentations on strategic, tactical, and operational contributions from space capabilities/systems, space families of systems, or space architectures whether in the concept, R&D, acquisition, or operational phase. Presentations may also address innovative analytical processes, methodologies, utilization of models and simulations, or techniques as they are applied to space capabilities/systems operations and/or acquisition. Submissions should demonstrate operations research techniques, whether innovative, unique, or traditional, and may be completed works or works in progress. It is the intent of this WG to obtain a variety of topics to ensure an interesting exchange of approaches, interests, and ideas among the space-focused OR community.

WG 9 – Air and Missile Defense

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US National Security Policy defines the requirement to enhance Homeland and Regional Security through integration of new mission elements such as Cyber Defense/Attack, continued cooperation with Allied defense initiatives, and the ongoing need to deter/defeat the growing threat from weapons of mass destruction and their delivery means (US NSS, 2015). NATO Policy states: “Proliferation of ballistic missiles poses an increasing threat to Allied populations, territory and deployed forces. The proliferation of these capabilities does not necessarily mean there is an immediate intent to attack NATO, but it does mean that the Alliance has a responsibility to take this into account as part of its core task of collective defense (NATO, 2016). Both US and NATO doctrine emphasize “Integrated Air and Missile Defense (NIAMD) as an essential, continuous mission in peacetime, crisis and times of conflict, which safeguards and protects [US and] Alliance territory, populations and forces against any air and missile threat and attack. It contributes to deterrence and to indivisible security and freedom of action of the Alliance” (NATO, 2016).

An analyst in the complex world of Integrated Air and Missile Defense (IAMD) must deal with a multitude of complex factors to prevent an adversary from effectively employing any of its offensive capabilities. The proliferation of highly sophisticated long-range missile systems (hyper-sonic weapons, advanced countermeasures, and maneuvering re-entry vehicles come to mind) coupled with advance target capability enabled by robust adversarial ISR challenges our Force Projection and Assured Access. While the tenets of IAMD endure, the analyst must also weight non-kinetic and cyber effects which are becoming increasingly more sophisticated and available. Our working group seeks to prepare the IAMD analyst and Combatant Command staff with new analytic tools to guide decisions on Joint force capabilities, enhance capability and develop tactics to counter the full spectrum of air, missile, space, and cyber threats. While leveraging existing tools, we must also address consequence management (combatting WMD to denial of services), and support both material development and operational planning. A holistic approach of integrating air and missile defense is required and will only succeed if we leverage all of our operational and analytic capability. Exploiting the capabilities of joint interoperability, multi-role, multi-mission assets may provide the leverage needed to accomplish our goals. Thus, our focus is to share foundational and groundbreaking analytic techniques and research as they apply to the current and emergent IAMD threats and defensive systems allowing us to retain an operational advantage.

WG 10 – Joint Campaign Analysis

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The Joint Campaign Analysis Working Group (WG 10) concentrates on the integration of land, sea, air, space, cyberspace, special operations and interagency concerns related to all phases of campaign operations. The primary goal of WG 10 is improving the quality of all aspects of campaign analysis and thereby supporting better-informed decision making at all levels.

WG 10 provides a forum for presentations and discussions that primarily relate to joint campaigns. Of special interest to WG 10 are models, analytical simulations, and automated tools supporting decision making based upon joint campaign analysis. Results of analysis will be presented and measures of effectiveness will be discussed. Peer review of the analysis techniques and results will be an important element of the working group activity.

The 86th MORS Symposium provides WG 10 the opportunity to review recent work that has a proximate influence on campaign analysis and share with the operations research community possible directions, cautions, and other benefits of its experience. Prime candidates of interest to WG 10 include:

- Studies related to joint campaigns (all phases)
- Analysis, research techniques, methodologies and models/simulations related to joint campaigns
- Emerging or innovative warfighting analysis methodologies and techniques
- Results of recently completed warfighting analysis (or ongoing works-in-progress)
- Analysis in support of programming and policy decisions
- Analysis informing the direction and scope of transforming forces
- Analysis of deliberate and crisis action decision-making
- Innovative or improved automated decision support tools

WG 10 solicits thought-provoking papers in these areas which relate to the 86th MORS Symposium theme – *“Supporting a Balanced Modern and Ready Nation”*. Based on previous symposia, presenters should be prepared to deliver their briefings in 30 minute periods to include questions.

WG 11 – Land and Expeditionary Warfare

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The application of land and expeditionary warfare is essential to achieving strategic success, advancing national interests, deterring future conflict, and building partners. We face a dynamic and uncertain environment with ever-changing threats. These threats include an increasingly aggressive North Korea, Russian aggression in Eastern Europe, Middle Eastern terrorist networks, and China's military buildup. In order to support a balanced, modern, and ready nation the operations research community must maintain its ability to inform decisions about concept development, acquisition, force design, force mix, and tactics, techniques, and procedures development.

We are seeking presentations from the land and expeditionary warfare domain that enhance analysts' professional development in military operations, operations research techniques, methodologies, and models in the following areas:

- Operations against peer and near-peer threats.
- Operations in complex and urban environments.
- Operations against non-state actors.
- Interoperability between conventional and special operations forces.
- Influence of social, cultural, political, and historical knowledge on land operations.
- Combat and stability operations involving nonmilitary and multinational partners.
- Future concepts in the analytical field as they relate to land and expeditionary warfare.

Working Group 11 invites all analytical agencies, services, and centers of excellence to submit presentations that can increase our professional development and educate our community on current studies and the future direction of land and expeditionary warfare. Efforts of interest include, but are not limited to, historical, current, and future force analysis, innovative applications of modeling and simulation, studies that underpin the development of future warfighting concepts, and analytic efforts supporting critical resource allocation decisions.

WG 12 – Maritime Operations

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The littoral regions of the world are where American influence and power have the greatest impact and are needed most often. Naval Forces will be focused on defeating anti-access capabilities — such as small, fast surface combatants, quiet diesel submarines, and sea mines — in order to enable control of the seas near land and assure freedom of maneuver of joint forces from the sea base to the objective.

Dominating the littorals allows Naval Forces to project power ashore and influence the land campaign. Continuing this domination in the near- and long-term future requires innovative and perhaps radical concepts for systems, tactics, support, maritime domain awareness, and force structure. Our evolving, integrated naval capability must be built wisely, with limited resources and assured effectiveness. Fresh ideas and bold new concepts, bolstered by sound analytic thought, are essential to foster the creativity and critical thinking needed.

The objective of the Maritime Operations Working Group is to promote the exchange of analytical techniques and encourage peer review of methodologies and results from research performed. This provides a means for continued growth of military operations research and related disciplines with respect to maritime operations and with specific emphasis on the littoral warfare and regional sea control missions.

The principle focus of WG-12 will be to examine maritime operations, littoral warfare, and regional sea control in contingency operations. This examination will be analyzed within the framework of interagency warfare. Our objective, in keeping with the 86th MORSS theme, “Supporting a balanced modern and ready nation,” will be to enhance Naval Operations Research in this area by calling for papers that link their analytical conclusions to practical recommendations. We seek innovative presentations displaying original and focused analysis that stimulates thought, commentary, and perhaps, even controversy. Analysis presented can be work that is complete or still in progress.

WG 13 – Power Projection and Strike Warfare

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The U.S. capability for global projection of power continues to be a crown jewel for the nation. This capability requires our military programs and analysts to discover new ways to apply precision force in support of national security objectives. It also requires us to examine the constraints that our adversaries invent to prevent strike weapons concepts from succeeding. Both of these areas challenge us in the uncertainty within both the operational and the programmatic arenas. We welcome contributors that have ideas on maximizing harm to our true adversaries while minimizing the costs (in non-combatant lives, property, and cost to the tax payer). In keeping with the 86th Symposium's theme of "supporting a balanced modern and ready nation," WG-13 seeks presentations (either completed or work in progress) that focus on the development and evaluation of concepts of operation; tactics, techniques, and procedures; systems engineering; and new technologies that support warfare derived from the following:

- Studies and analysis
- Test and evaluation
- Experimentation / Advanced Concept Technology Demonstrations
- Training exercises
- Real world operations

WG-13 encourages submission on a wide range of topics including:

- Command, control, and communication for strike operations
- Intelligence, surveillance, and reconnaissance in support of strike targeting
- Electronic Warfare / Countermeasures in support of strike survivability
- Asymmetric threats to U.S. power projection assets and doctrine
- Methods to overcome adversary-imposed constraints on strike missions
- Modeling, mission planning, execution and assessment
- Joint fire support / Deep fires
- Manned and unmanned system concepts to execute strike warfare missions
- Strategic attack
- Land/Sea-based strike
- Distributed strike weapons concepts
- Precision weapon employment

WG 14 – Air Warfare

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Military power is most effective when it is integrated, combined, joint, and interagency. The Air Warfare Working Group is focused on one of several components of integrated military power: the employment of combat air power. Our focus includes the effective utilization of relevant sub-systems, operational employment concepts, and the integration of air assets during the conduct of joint and combined military operations that support national strategic and theater operational objectives.

Combat air power is intended to achieve specific desired effects that contribute directly to the achievement of military and political outcomes and objectives. Therefore, the primary focus of this working group is on conventional combat missions intended to destroy, degrade, defeat, or disrupt enemy forces. These missions include Counter-Air (Offensive and Defensive), Counter-Land (Close Air Support and Interdiction), Counter-Sea, and Strategic Attack.

The entire air warfare domain is rapidly changing and increasingly challenging as the environment and employment concepts evolve. Specifically, some of the toughest challenges we have faced in the combat arena, providing the most fertile ground for analysis, are the following: synergistic airborne force mixes to achieve desired capabilities, advanced technologies and technology requirements, rules of engagement, target identification, prevention of fratricide, effects-based operations, tactical battle management, autonomous air combat operations, command and control, electronic warfare, tactical control of air assets, integration of unmanned aerial systems, manned/unmanned teaming, time-critical targeting, employment of air-delivered munitions in a net-centric environment, hard targets, moving targets, preventing collateral damage, urban targets, as well as interoperability in the joint, combined, and interagency arena. Therefore, the emphasis of WG 14 presentations is on applications, analyses, tools, concepts, and methodologies that improve our understanding of the dynamic phenomena of air warfare and the myriad of factors that impact success. These factors include air vehicle performance, capabilities of air-delivered munitions, emerging technologies, countermeasures, concepts of employment, doctrine, tactics, techniques, procedures, rules of engagement, combat identification, threats, operating environments, proficiency, interoperability, and air operations planning.

WG 14 strives to assist in developing capabilities to cope with emerging threats, new environments, and technological breakthroughs. In keeping with the 86th MORS Symposium theme of “Supporting a balanced modern and ready nation”, this working group focuses on the

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use of new analytical tools, processes, applications, methodologies, and metrics. Thus, we provide a forum for discussions and presentations relating to the unique challenges faced when attempting to conceptualize, model, simulate, analyze, and experiment with the employment of combat air power and the many factors that affect success in the combat arena and improve our understanding of air warfare.

WG 14 encourages presentations on both completed work and work in progress. Final presentation selection will be based on both the 86th MORS Symposium theme and the focus of this working group. Presentations will be made in individual working group, combined working group, or composite group sessions. Presenters should be prepared to deliver their briefings in 30-minute periods including questions.

WG 15 – Casualty Estimation and Force Health Protection

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The 86th MORS Symposium theme, “Supporting a Balanced Modern and Ready Nation,” emphasizes the critical operations research advancements keeping the military on the cutting edge. The symposium brings together researchers and military analysts who are passionate in the pursuit of knowledge and the application of their craft in defense of the nation. The Casualty Estimation and Force Health Protection working group welcomes participants interested in the application of operations research to protect those whose life and health are at risk in that endeavor.

The major thrust of this working group is the development and application of quantitative methods for estimating casualties and determining the medical planning requirements to manage the casualties in the health service support system. Casualty estimation encompasses personnel losses, such as the incidence of wounded-in-action, killed-in-action, disease and non-battle-injured, psychiatric casualties, and fratricide. Health service support includes, but is not limited to, the theater level medical treatment facility capabilities/functions; patient movement; forward resuscitative surgery; evacuations, admissions/occurrences, staffing, return-to-duty, preventive medicine, combat and operational stress control; and logistic support and estimation.

The range of military operations has created a tremendous challenge in providing the needed medical care and support of our military forces. The operational environments of interest range from stability, security, humanitarian, disaster relief, reconstruction operations and finally to major combat operations with always the threat of chemical, biological, radiological, and nuclear weapons.

Working Group 15 welcomes presentations in concepts under development and research as well as proven applications and techniques from all disciplines that highlight the use of operations research methods in the subject areas listed. Past presenters have included operations research analysts, statisticians, behavioral scientists, clinical providers, medical planners, logisticians, and other scientists.

WG 16 – Strategic Deployment & Distribution

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The overall goal of the Strategic Deployment and Distribution Working Group (WG 16) is to present and discuss applied analysis to evaluate capabilities to meet the deployment and distribution requirements of the United States Military at the most affordable levels.

Abstracts submitted to this working group should focus on 1) examining state-of-the-art improvements to deployment and distribution processes through modeling and/or analysis, 2) developing new operations research techniques or modeling objects, families, and classes that represent mobility and transportation systems, 3) sharing new or changed doctrines, concepts of operation, missions, or fundamental assumptions regarding deployment and distribution processes, or 4) describing how defense distribution systems and processes are balancing the risks (e.g., operational, costs, security) involved in facing an uncertain future. We encourage presentations of works in progress as well as completed papers. The most critical component in any abstract is a clear statement regarding how the analysis yields insights into how different approaches are likely to yield differences in the most relevant outcomes, and at what cost and risk.

Analyses presented at this year's MORSS in WG 16 should cover some, but preferably multiple aspects, of operations research analysis to include operational effectiveness, cost, risk, capability, and/or metrics useful for senior level decision making and policy guidance and of interest to the wider mobility and distribution community. Preference will be given to those abstracts that not only discuss the analytic approach and findings, but provide a live demonstration of the supporting models. Additionally, preference will be given to those abstracts that provide outcomes as uncertainty distributions, or as a minimum, confidence bands. Presentations that address this year's Symposium theme of "supporting a balanced modern and ready nation" will be given preference. Lastly, analysis that demonstrates a flexible framework that supports interactive sensitivity analysis is highly desired; as well as analysis that provides a more holistic evaluation across a portfolio of distribution capabilities. For example, are there second- and third-order effects of the phenomena and, from a system-of-systems view, what is the impact?

WG 17 – Logistics, Reliability, and Maintainability

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The nature of warfare constantly evolves, and challenges analysts to develop new problem-solving approaches and use existing techniques and models in new applications. Logistics, reliability, and maintainability are key aspects for supporting our warfighters and our allies around the globe. Technological improvements increase the information available to logisticians and the need for advancements in methods of organizing, mining, and presenting that information to decision makers in a manner which supports effective actions.

Working Group 17 provides a forum for discussing a wide variety of logistics analyses, including support to deployed forces, logistics impact on readiness, supply chain management, system reliability, designing for improved system maintainability, life cycle cost and operational effectiveness, product support management, support for joint and coalition operations, inter-agency support, and reverse logistics. This list is far from exhaustive; papers that seek to solve important problems in other areas of logistics are valued as well.

Especially of interest are new analytical approaches and tools for handling amorphous, hard-to-define, or long-standing problems, or applying existing techniques in areas that are usually considered to be more qualitative. Studies and applications that support this year's theme of "supporting a balanced modern and ready nation" are of particular interest. Existing analytical techniques include mathematical modeling, statistical analyses, stochastic or deterministic optimization, forecasting, and simulation. We welcome analyses or analytical tools that are completed work, particularly those with demonstrated impact, as well as "work in progress" — often the best aspect of the sessions is discussion, questions and feedback from your peers.

WG 18 – Manpower and Personnel

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The individual and collective talents, skills, and capabilities of the total force of active duty, reserve, civilian, contractor and interagency personnel are required to accomplish the mission and goals of our national security strategy. Success in this complex environment requires decision makers to depend upon a sophisticated human resource management system to access, recruit, train, assign, distribute, motivate, care for, evaluate, retain, and separate personnel. Integral to this success is the analytical support the manpower and personnel research community brings to bear on the toughest personnel challenges facing civilian and military leaders.

Keeping with the theme of the 86th MORSS, “Supporting a balanced modern and ready nation” the Manpower and Personnel working group seeks to embrace new technologies and research ideas, from both traditional and non-traditional sources of manpower and personnel analysis. We encourage the involvement of new communities in this important analytical area to boost the existing analytical power of the field. We seek individuals who innovatively addressed these challenges to share high quality presentations that describe their work or work-in-progress. Presentations should be rigorous in content and address one or more of the following: requirements determination, manpower planning, recruiting, screening and personnel selection, measurement of personnel readiness, attrition, retention, compensation, compensation reform, assignments and distribution, performance evaluation, and other manpower and personnel issues. To generate discussion and share ideas, presenters seeking input on work-in-progress, techniques currently under development, and completed analyses/papers are encouraged to submit abstracts to the working group chair/co-chairs or to the MORS office.

WG 19 – Readiness

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The Department of Defense will continue its transformation during the coming years to meet global challenges which confront the nation during the 21st Century while simultaneously operating with limited resources. As a result, analysis of readiness must address the complexities of considering the capabilities of interagency and coalition partners, private and non-governmental organizations, and state and local authorities.

Traditional readiness constructs must be rethought to provide efficient, cost effective, agile and dynamic organizations with expanded mission capabilities, including traditional and non-traditional roles both at home and abroad. Terminology such as rotational readiness, expeditionary forces, language and cultural capabilities, multiple service/component solutions, mission capability assessments, full spectrum operations, irregular warfare, and Stability, Security, Transition, and Reconstruction Operations (SSTRO), will dominate Department discussions for the foreseeable future. Therefore, what tools can be used to assess and manage organizations and individuals for the missions we face? Can we involve and assess interagency and coalition partner capabilities? How do we engage all of these diverse entities in order to synergistically leverage collective readiness capabilities? What type of readiness analysis needs to be developed for the 21st Century?

This Working Group focuses on readiness capability assessment tools, particularly as they aid in the support to a balanced modern and ready nation. This includes organizations/force management/force generation, and all relevant material, training, and personnel readiness issues. We consider analytic techniques and tools that allow for real improvements in how we plan, manage, and assess the readiness of our organizations to meet real world missions. Presentations on a wide range of subjects are welcome.

WG 20 – Analytical Support to Training and Education

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As the Armed Forces of the United States continue to transform to meet the challenges of the 21st Century, they work toward a common frame of reference for joint force concepts, capabilities, and requirements. For more than a decade our forces have been continually challenged in an uncertain and unpredictable strategic environment. The expansion of our national security boundaries requires individuals, units and their staffs be trained and educated to meet the needs of the Combatant Commanders for all operations as well as emerging capabilities for future operations. Evolving trends within the military environment highlight the importance of continuing to evolve training and education programs to meet our security challenges and to develop, sustain, and assess this challenge from a joint perspective in order to meet operational readiness requirements to respond to the security challenges faced in the long war. Department of Defense (DOD) Directive 1322.18, Subject: Military Training provides policy and guidance for the training of DOD personnel and the DOD components to support the operational needs of the combatant commanders.

Training and education are key elements of readiness and national security. Readiness is “the ability of U.S. military forces to fight and meet the demands of the national military strategy.” Readiness is the synthesis of unit readiness, derived from the ability of a unit to deliver the outputs for which it was designed, and joint readiness, the combatant commander’s ability to integrate and synchronize ready combat and support forces to execute the assigned mission. Budgetary pressures demand we use the most effective and cost-efficient methods of training and education to attain the necessary readiness to support Combatant Commanders’ mission requirements and capabilities. Our ability to develop and use new analytical processes, frameworks, metrics, and tools, as well as new ways to use the old methodologies, to help solve the problems facing commanders and the training communities, is an important aspect to improving force readiness and contributing to our national security analyst needs. We must ensure we develop methodologies to measure, quantify, and assess improvements in training and education to meet the commanders’ needs and our national security goals.

The 86th MORS Symposium offers an opportunity to review recent work, training concepts, and new training and education developments that address national security issues. We seek analytical presentations addressing any of the mission priorities and concerns outlined above. Both completed work and works-in-progress are welcome.

WG 21 – Operational Energy

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TOPICS: MORSS WG21 (Operational Energy) provides Energy Professionals and their associated disciplines, a forum for active discussion on a wide variety of topics, from the cutting-edge, state-of-the-art to critical foundational energy operations. These topics include, but are not limited to, Power grid security, Cyber and energy, Baseline metric development, Quantifiable improvements in energy performance, efficiency, innovations, cost and risks, Benefits of other alternative fuels, Renewable energy integration, Solving important problems in energy policy, etc.

Why we have a WG21: The nation's military faces a strategic environment that is increasingly complex and unpredictable. Analysts must enhance analytic skills and improve knowledge-sharing procedures. The DOD published an Operational Energy Strategy (OES) Implementation Plan to guide the nation through an uncertain energy environment, and enhance research, development and information sharing using a three-fold approach:

- **More Fight, Less Fuel: Reduce Demand for Energy in Military Operations.** Today's military missions have growing energy demands with supply lines that can be costly, vulnerable, and a burden on Warfighters. The Department needs to improve its ability to manage overall operational energy as a system, reduce demand, and optimize conversion to enhance combat effectiveness.
- **More Options, Less Risk: Expand and Secure Energy Supplies for Military Operations.** Reliance on a single energy source – petroleum – has economic, strategic, and environmental drawbacks. In addition, the security of energy supply infrastructure for critical missions at fixed installations is not always robust. The Department needs to diversify its energy sources, leverage novel, situation dependent sources, and protect access to energy supplies to have a more assured supply of energy for military missions.
- **More Capability, Less Cost: Build Energy Security into the Future Force.** While the force's energy requirements entail tactical, operational, and strategic risks, the Department's institutions and processes for building future military forces do not systematically consider such risks and costs. The Department needs to integrate operational energy considerations into the full range of planning and force development activities.

WG 22 – Experimentation

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The Experimentation Working Group provides an opportunity for military, government and civilian operations research analysts to examine topics, methodologies, analyses, and innovations pertinent to all aspects of designing, planning, executing, analyzing and reporting the results of experimentation supporting the Department of Defense and other government departments and agencies such as the Department of Homeland Security. As we address the theme for this year's symposium— Supporting a balanced modern and ready nation —Working Group 22 emphasizes rigor in analytical processes and experimentation efforts that drive innovation in this important area. We welcome all completed or in-progress studies and topics that affect any facet of experimentation, such as:

- Designing credible experiments with limited resources
- Developing coherent strategies for campaigns of experimentation
- Developing meaningful measures of merit / measures of effectiveness
- Accounting for small sample sizes
- Conducting experiments in training exercises or field tests
- Addressing challenges with participants
- Integrating modeling into experiments
- Reconciling data collection and player participation
- Analyzing results in a timely manner
- Addressing continually evolving experimental objectives
- Effectively sharing results and lessons learned
- Transitioning results into tangible action
- Assessing return on investment
- Analyzing qualitative data with rigor

Working Group 22 also sponsors the MORS Experimentation Community of Practice, a group that meets throughout the year to continue discussing experimentation issues and achieve consistency across government, industry and academia.

WG 23 – Measures of Merit

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Our nation is confronted with global enemies who adapt to strike at U.S. military forces and our Homeland where and when we least expect, jeopardizing our existence and our way of life. To mitigate this ongoing and ever-changing threat, our military forces continue to transform to best defeat these enemies in the modern operational environments. This adaptive military stance challenges the ability of traditional measures of merit (MOMs) to measure success. New MOMs are necessary to quantitatively assess the effectiveness of the adaptive combat plan for countering dynamic threats.

While the U.S. continues to transform its forces to meet current and future needs within a fiscally constrained environment, the analytic challenge is to develop appropriate measures that will assist decision makers and reduce the risks that our nation faces. This is reflected in the theme of this year's symposium, "Supporting a balanced modern and ready nation."

Operations research is a field that includes various tested and well-established methods for conducting analyses, as well as methods that are still being explored and discovered. One feature common to all analyses is their reliance on quantifiable measures to gauge outcomes. This characteristic provides a strong foundation, which can be leveraged to meet the challenge of developing appropriate MOMs for increasingly complex analyses.

WG 23 solicits papers that successfully use MOMs to facilitate decision analysis; to assess changes in capability or operational effectiveness; to monitor system performance or reliability; to reduce the risks faced by our military and national security forces; to improve transformation or modernization; or to enable U.S. shaping of the international environment. Papers should focus on, but are not limited to, the associated measures used to support analyses and studies within these focus areas:

- Joint acquisition, force effectiveness, force allocation processes, force readiness and training.
- Conducting operations in urban and restrictive environments.
- Human Factors / social sciences/ civil affairs.
- Protecting and sustaining coalition forces.
- Intelligence, Surveillance, Reconnaissance, and Situational Awareness.

WG 24 – Test and Evaluation

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Test and Evaluation (T&E) is a dynamic and challenging field. Made up of military, government, and civilian organizations, T&E provides the information necessary for decision makers to make decisions regarding the readiness of our nation's warfighting capabilities.

The T&E Working Group provides a forum for operations research analysts to examine topics, methodologies, analyses, and innovations pertinent to all aspects of planning, designing, executing, analyzing, and reporting formal T&E in the Department of Defense and other government departments and agencies, as well as industry and key international allies.

The T&E Working Group will bring together Service, government, academic, and industry testers to share lessons learned to improve test strategies and methods that are key to "supporting a balance modern and ready nation". T&E topics to be addressed include:

- Implementation of design of experiments in T&E
- Reliability and reliability growth
- Cybersecurity T&E
- Interoperability T&E
- Data analytics and data mining for T&E
- Software T&E
- Designing credible tests with limited resources
- Developing meaningful measures of effectiveness
- Implementation and sharing of results/lessons learned

The T&E Working Group solicits input and discussion from analysts and senior leaders who are involved in all aspects of planning, designing, and executing tests and the subsequent analysis and evaluation of the data. To understand and improve the entire process, participants from throughout the entire T&E community will be included. This community includes the organization leaders who develop and approve test and evaluation plans, combat developers who write testable requirements and provide concepts of employment and mission scenarios, developmental and operational testers, and operational forces who support T&E as participants.

We provide a forum for discussions and presentations relating to the unique challenges faced when attempting to plan, design, execute, and analyze experiments. WG-24 encourages presentations on both completed work and work in progress.

WG 25 –Analysis of Alternatives (AoA)

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Capability Development is the process used by the military Services to identify, evaluate, develop, field and sustain capabilities in an environment of limited resources. All Services have a version of a Capability Development process that allows them to perform in a manner consistent with the Joint Capabilities Integration and Development System (JCIDS), the Defense Acquisition System (DAS), and with each Service's Planning, Programming, Budgeting and Execution (PPBE) activities. Capability Development establishes the foundation for the development of materiel and non-materiel solutions to address the Services' Title X responsibilities as Force Providers to the Combatant Commands (COCOM). Capability Development encompasses three major activities: 1) Capability gap identification, 2) Risk assessment, and 3) Solution development. Respectively, these activities are used by planners, developers, engineers and analysts to characterize shortfalls, to assess the likelihood of mission failure, and to identify, assess, and recommend solutions to mitigate capability gaps. Studies and analyses are used in each Service's Capability Development process to aid in the characterization of gaps and assessment of potential solutions. WG 25 seeks to capture and share effective study approaches and analytic techniques utilized by practitioners throughout the broader acquisition and analysis communities. Utilizing best practices, innovative methodologies, and effective stakeholder collaboration; planners, developers, engineers, and analysts can combine the art and science of Capability Development to provide insight and critical data to decision-makers responsible for prioritizing capabilities. Successful Capability Development enables initiation and execution of the strategic-level planning required for entry into JCIDS. Capability Development is a critical part of thorough and robust Capabilities Based Assessments (CBAs) and Analyses of Alternatives (AoAs) as the application of rigorous and deliberate activity early in the process helps refine the tradespace, identify complementary solutions to mitigate gaps, and establish a clear path that stakeholders with competing interests can agree on.

WG-25 is open to examining any Capability Development approach utilized to achieve effective warfighting solutions. Topics of particular interest include Development Planning, AoA preparatory work (including Capability Based Assessments (CBA) and pre-Materiel Development Decisions (MDD) analyses), gap identification and prioritization, risk assessment, AoAs, science and technology initiatives, experimentation and rapid prototyping, and other emerging technologies that aim to mitigate capability gaps.

The theme for the 86th MORSS is "Supporting a Balanced Modern and Ready Nation". WG25 looks to address this theme by providing a wide ranging selection of topic presentations which demonstrate how creative and dedicated analysts are working in the Capability Development arena to set the conditions for the ultimate delivery of operational relevant and cost effective warfighting capabilities which deter aggression against our Nation.

WG 26 – Cost Analysis

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The theme for the 86th Military Operations Research Society Symposium is “Supporting a Balanced Modern and Ready Nation”.

Operations Research (OR) plays a vital role in the defense of the nation. The projection of military, economic, diplomatic, and political power involves extensive research and well-informed analysis. National security is an expensive endeavor; one challenged by fiscal constraints, and one requiring a balance of limited monetary resources.

Detailed cost, affordability, risk and uncertainty, and capability analyses are mandatory requirements to inform decision makers. Such analyses have far-reaching impacts on decisions made during the development, procurement, and sustainment of today’s modern acquisition programs. In addition, providing realistic life cycle and total ownership cost estimates for all phases of proposed systems, early enough in the design process to support trade-off decisions, presents a significant OR challenge. Armed with the latest tools, practices, and techniques, analysts can build and document the most accurate cost estimates and assessments to ensure that the nation is ready to meet any threat.

Working Group (WG) 26 seeks to strengthen the community’s knowledge base by focusing on today’s “cutting edge” topics in cost analysis. Submissions or proposals relating to military cost analysis, economic analysis, risk and uncertainty analysis, and related disciplines are welcome. Preference will be given to study results that incorporate creative uses of OR tools to develop improved cost estimates and analysis to support better decisions. Effective methods for presenting the results of complex operational analysis in a clear, concise manner are always of interest. WG 26 also solicits topics suitable for a panel discussion format, and recommendations of subject matter experts willing to participate in such discussions.

Specific topics of interest include those that highlight OR contributions to expanding cost analysis scope and accuracy, such as:

- Affordability analysis in support of OSD, DoD, and Congressional mandates
- Cost and capability impact of technology insertion
- Projecting and managing costs for evolving threats, including terrorism
- Impacts of aging and deferred maintenance on sustainment costs
- Costs of implementing cybersecurity and information assurance measures

- Portfolio analysis and decision support frameworks
- Costs and benefits of employing open standards and open architectures
- Advances in cost, schedule, and performance risk and uncertainty analysis

Presentations may be completed works or works-in-progress.

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WG 27 – Decision Analysis

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Decision Analysis as a discipline provides operations researchers with the philosophies, theories, and methodologies to address challenging, complex decision situations in a formal manner. It encompasses many procedures, methods, and tools that enable the analyst to model and evaluate the important aspects of a decision, with the goal of aiding the decision maker in making the best-informed decision possible in the allotted time.

Within WG27, emphasis is placed on two general categories of practice:

- 1) The assessment of decision maker's preferences in the evaluation of alternatives; and
- 2) The incorporation of uncertainty about the outcomes and about the information used in the decision.

One of the objectives of WG27 is to grow the capabilities of the current decision analysis practitioners continuously while building on the foundations set by our predecessors. We view the WG27 forum as a place to not only share the results of our work, but also to grow and learn from each other and continue to build on the legacy of military decision analysis.

Decision analysis methods are incorporated as components of multi-disciplined approaches, combining techniques such as mathematical programming, simulation, Bayesian Networks, Markov Decision Processes and Machine Learning, in a variety of applications.

WG 27 invites papers describing completed work or work in progress that describe innovative methods, models, and case studies in the use of Decision. In particular WG 27 seeks papers that align the symposium's theme of "Supporting a Balanced and Modern Nation" with the following agenda of topics:

- Innovations in Decision Analysis Practice and Theory
- Application of Soft Skills within Decision Analysis
- Modeling Risk and Uncertainty in Decisions
- Acquisition Applications of Decision Analysis and Risk Management
- Portfolio Analysis
- Modeling Human Decision Processes
- Large Data, Business Analytics, and Decision Analysis

To ensure a fair evaluation of abstracts and to help authors distinguish themselves, we

encourage authors to emphasize the decision analysis aspects of their work, provide at least one published reference in their abstract submission, and link their submission to at least one of the agenda topics.

We look forward to hearing from you!

WG 28 – Modeling and Simulation

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Modeling and Simulation encompasses a broad range of techniques employed by the military operations research community to answer questions about strategy, doctrine, force structure, weapons, systems, and requirements. Our goal is to present a diverse mix of interesting analyses that cover a variety of operational issues and analytic techniques across the full spectrum of simulation. We seek papers that discuss the application of sound simulation techniques from the joint strategic level down to system engineering level issues. WG-28 presentations should highlight unique and innovative approaches to simulation development, application, and verification and validation as well as unique applications of simulation tools and techniques such as discrete event simulation, systems dynamics, agent based simulation, or any digital mechanism. WG-28 presentations can support this year's theme "Supporting a Balanced Modern and Ready Nation" by placing emphasis on unique aspects of national security problems, and providing quantitative results to decision-makers.

WG 29 – Computational Advances in Operations Research

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As analysts, we are challenged to develop solutions in order to support a balanced modern and ready nation. Meeting this challenge requires innovative problem solving approaches and techniques to address the multiple problem domains facing today's military analyst.

Working Group 29, the Advanced Mathematical, Statistical and Computational Methods Working Group, is focused on improving the ability of analysts to develop solutions to these critical issues and equipping decision-makers with new ways to handle complex decision-making. WG 29 seeks to continue building on a strong foundation of previous advancements in this topic area. This can be accomplished by providing a forum for OR analysts to examine and gain insight into the analytical and operational uses of existing and emerging mathematical and statistical techniques. This includes computational technologies and their associated methodologies. WG 29 solicits presentations that delve into the creation and application of innovative algorithms or computational advances to address challenging problems in the OR domain. We welcome presentations on work currently under development or fully completed. The following is an incomplete list that is illustrative of advancements in this topic area:

- high-dimensional data mining and analysis;
- big data and data analytics;
- advancements in complex adaptive systems, artificial intelligence, or machine learning techniques;
- advancements in campaign analysis or social network analysis;
- advances in distributed interactive simulations, federations, and architectures;
- rapid scenario generation techniques to support broad exploratory analysis;
- support to Enterprise-level information analysis in an operational sense;
- advanced modeling of the environment and environmental parameters, such as terrain and weather
- addressing computationally challenging problems in OR (e.g. NP-hardness)
- design space exploration using advanced heuristic, clustering or classification algorithms
- uncertainty quantification

WG 30 – Wargaming

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Wargames support all levels of government by presenting consequential, turn-based scenario adjudication to problems centered on human decision-making. The practice is found in training curricula in military schools, businesses, and university courses. Most wargames are structured to address specific issues, such as current or future national security challenges, but, in general, wargames provide a low-cost evaluation of alternatives. Outcomes tend to be qualitative in nature, but still of substantial interest to key decision-makers. Wargames are attractive to decision-makers because of the human interaction between experts and those with a vested interest in the issues. Operations research applies quantitative methods to games.

Although the narratives derived from a game are sometimes more important than the raw data, relating narratives to quantitative analysis is the value added by operations research.

The emphasis of Working Group (WG) 30 presentations is metric determination, game design, statistical analysis, game verification, tools to present information to players, models and simulations for game play, and best practices. Enduring special interests of the working group include considerations of interdisciplinary games, applications of game theory, complexity theory, and chaotic behaviors. In accordance with this year's theme of "Supporting a balanced modern and ready nation," our WG invites presentations on historical and educational aspects of wargaming. WG 30 encourages presentations on theory, completed projects, and work in progress.

WG 31 – Operational Environments

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Working Group (WG) 31 – Operational Environments provides a forum for discussions of the operational environment's role in the full spectrum of military and national security operations from warfighting to non-adversarial crisis prediction and response (e.g., humanitarian assistance, disaster relief, or emergency response). The operational environment consists of four major classes – natural environment (terrain, ocean, atmosphere, and space), human-constructs (infrastructure, hardware, and software), humans (civilian and military), and social science factors (political, social, cultural, and economic) – and their synergistic interactions as they impact present and future operations. WG 31 focuses on identifying, describing, and incorporating appropriate operational environment subsets into various applications for military and homeland security operations.

The operational environment is dynamic, even volatile, as demonstrated by recent world events, including new and emerging threats. Technological advances in hardware and software affect the capabilities of both allies and foes as well as the US military and civilian communities. Such advances affect both human behaviors and social science factors (political, social, cultural, and economic). WG 31 is interested in soliciting innovative approaches to assessing increased remote surveillance capabilities, improved socio-cultural and economic analysis, political and social shifts forecasting, advances in data analysis and visualization tools, improved natural environment data, and other technological advances that alter either the operational environment itself or the ability to understand the operational environment.

The theme of this year's symposium is "supporting a balanced modern and ready nation" and WG 31 solicits thought-provoking presentations of studies, research and development, and experiments that describe in broad terms the human talent and operational capabilities that will be required for the joint force to succeed across a full range of operational environments. WG 31 invites presentations that offer insights into the challenges and opportunities that will confront national security analysts from the operational environmental perspective. WG31 encourages presentations concerning on-going and successfully completed research that would improve the analytic capability of the nation with complex issues by aiding decision-makers in understanding underlying operational environment factors.

WG 32 – Special Operations and Irregular Warfare

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The challenges posed by transnational terrorists and the focus on irregular threats from defense strategy create an irregular warfare (IW) environment that highlights the importance of joint special operations mission areas. The days of fighting known conventional threats in known parts of the world, while still a possibility and very dangerous, appear to have taken a back seat to the increasingly common IW threat. Groups like Al-Qaeda and the Islamic State have grown and continue to attract fighters from around the world, posing a significant challenge to the U.S. and our partner nations. These irregular threats create instability and challenge nation states around the world.

IW is a warfighting philosophy which seeks to achieve strategic objectives primarily by nontraditional, indirect, or asymmetric means and is characterized by the following operations: military information support operations (formerly psychological operations), information operations, counter proliferation of WMD, counterterrorism, counterinsurgency, intelligence activities, computer network operations, foreign internal defense, and stability operations.

Although IW continues to be a core competency of joint special operations forces, many organizations in the Department of Defense (DoD) as well as other governmental agencies contribute unique capabilities to IW operations. Just as we have provided exceptional analytical support to the DoD community for conventional fights in the past, the operations analysis community must continue looking for ways to support the IW fight. Organizations and stakeholders with interests in the IW arena will benefit from the analytical community in the areas of strategic decision making and policy determination using mission planning tools and analytical aids, simulations and analysis, and by systemic collection and dissemination of data and lessons learned from previous IW operations and interagency activities. These analytical capabilities include contributions from the social science disciplines, as well as from traditional national security operations research.

The conduct of operations such as peacekeeping and peace enforcement missions, disaster relief, and humanitarian assistance are also characterized by small scale operations very focused on specific missions and a lack of conventional mission effectiveness criteria. Working Group (WG) 32 includes these communities because they share many of the unique characteristics and analytical challenges as IW operations. The WG seeks the participation of analysts who inform decision making related to special operations and IW at the strategic, operational, and tactical levels. General examples of WG 32 interests include (but are not limited to) dealing with the risk and uncertainty of diverse missions and functions, allocation of critical resources, and formulation and evaluation of policy and strategy decisions that affect current and future

obligations of special operations forces.

The theme of this year's symposium is "supporting a balanced modern and ready nation," and WG 32 is especially interested in serving as a venue for interagency analysis topics that are more transnational in nature and not usually viewed through the national defense prism.

WG 33 – Social Science Methods and Applications

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Working Group (WG) 33 explores methodologies for the human, social, cultural, and behavioral sciences, and their applications supporting the needs of the national security analysis community. Applicable methodologies may be derived from a number of social science disciplines, including: anthropology, cultural studies, demography, economics, geography, political science and political economy, psychology, and sociology; to name just a few. The representations of these theories take a variety of forms, including etic and emic methodologies particular to the social science disciplines at both the micro and macro levels of resolution, as well as statistical, mathematical (e.g., graph theory, social network analysis, game theory, and differential equation) and computational social science (i.e., simulation) representations and analyses. Papers are welcome in both basic research on and the application of these methodologies. Applications of these methodologies should reflect the scientific method (i.e., demonstrate an understanding of the testing of hypotheses with the use of evidence to accumulate knowledge) as the basis for the social scientific approaches undertaken by researchers in this area, and research should be focused on closing the gaps in scientific validity that exist in all of these methodologies, as is required for national security analysis. Additionally, inductive and adductive studies are also of interest and welcome.

Social science encompasses a wealth of knowledge that could be utilized by the national security analysis community to understand, detect, forecast, and mitigate social phenomena at the strategic, operational, and tactical levels.

Application areas include, but are not limited to: understanding of regimes and regime change; the evolution and adaptation of terrorist networks; the complex multi-faceted challenge posed by Transnational Criminal Organizations (TCO); the dispersion of ideas through social media and other new mechanisms of communication; epidemiological insights; evacuations following a man-made or natural disaster; and direct and indirect effects of kinetic and non-kinetic interventions, including Civil Military Operations and Military Information Support Operations on host nation populations. Application papers should clearly identify how social science methodological research and technologies have been or are being applied to these national security domains or operations, or propose how emerging methodological research and technologies can fit current or emerging national security challenges.

This WG solicits papers that detail contributions to the cumulative knowledge and methodologies of social science, in support of national security. In particular, papers should

contribute to the body of knowledge in one or more of the following areas and relate to the theme of this year's symposium "supporting a balanced modern and ready nation":

- Provide a framework for understanding how social science methods, models, and techniques can anticipate, foster understanding of, and support decision making for emerging security challenges;
- Support efforts to promote data discovery, collection, rationalization, and integration methods that can further social science in the national security community;
- Detail approaches to incorporate proven social science methodologies into national security analyses;
- Provide insights and lessons learned from prior analyses and from the experiences of the social science communities;
- Draw on experts in the social sciences to create an institutionalized knowledge base for the Department;
- Integrate hybrid Computational Social Science (CSS) approaches for cultural understanding and/or modeling based on varying data quantity, fidelity, and confidence levels;
- Address data and data processing tools to support CSS data collection, processing, and modeling to include model validation and verification;
- Analyze social networks, their inter- and intra-network relationships, and their integration with other types of networks to include logistic, financial, physical processes;
- Visualize data, tool, and model output;
- Develop course of action and decision analytics that incorporate human socio-cultural and/or behavioral factors;
- Forecast human terrain such as sentiment or affinity analysis, geophysical analysis based on human socio-cultural behaviors, and assessment of micro- and macro-level conditions that support or inhibit behaviors;
- Use social media or other open source data to support socio-cultural analysis and automated model coding;
- Train using CSS models and tools; and mission rehearsal using human socio-cultural factors and models;
- Further develop the scientific underpinnings of social science methodologies including emic, statistical, mathematical, and computational methodologies;
- Describe and discuss the validity of computational representations of social theory; and
- Conduct meta studies of social science and CSS that look across groups of prior studies of particular types, including from cross-disciplinary perspectives.

DWG 1 – Human Behavior and Performance

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Traditionally, operations research has used conventional techniques from all the sciences, mathematics and engineering; and has developed methodologies of its own. Sometimes the most important part of a system is the human operator so it is crucial that today's analysts place more emphasis of the human factor on their analyses than ever before. Regardless of technological advances, the weapon systems developer and implementer are navigating through uncertain times and should work together. Cognitive demands for weapon system operators are increasing despite requirements to the contrary. Training and aptitude prerequisites are increasing in recruitment. Individuals must perform the primary tasks of maneuver, target acquisition, engagement, and communication with decision making occurring at much lower levels on the modern battlefield. Technology will confuse as often as it will support the warrior. Transformation in how the services operate will force everybody – even the most junior – to think. We need to avoid the adverse impact technology insertion and mission change can have on humans and their performance. For that reason, enhanced human behavior and performance are part of the integrated solution to the mission problem. Representing and incorporating these factors adequately into models, simulations, and studies are sizeable challenges. Because of the extreme variability of the individual's behavior and performance on the modern battlefield, engineers and analysts may not be able to perform standard parametric or non-parametric analyses of the available data and must develop new tools to assist them.

For the 86th MORSS, the Human Behavior & Performance (HB&P) Distributed Working Group is soliciting presentations in accordance with this year's theme "Supporting a balanced modern and ready nation" and covering the following topics:

- What are the second and third-order effects of designing systems with high cognitive requirements for servicemen and women? How do we recruit/train/retain such individuals?
- Can training systems be developed that detect student-specific deficits so instructors may target training to individual needs?
- What are the individual differences in human performance? What about training effectiveness and human behavior?
- How do we effectively develop human-in-the-loop experiments, tests and war games while capturing the human element appropriately?
- What are the best data gathering techniques for capturing human performance as a variable of interest?

- How does the analyst observe and measure human performance without interfering with that performance?
- How do we design surveys?
- How can these data be better correlated with the more traditional “hard” data points we tend to collect (time to kill, time to detect, etc)?
- How do we incorporate fatigue, fear, exuberance, morale, anger, esprit de corps, and other factors affecting humans in combat?
- There is a growing disparity between warriors engaged in direct battle, face-to-face with the enemy, and those who fight from thousands of miles away from the battlefield (operating standoff weapons via satellite data link). Is that disparity leading to conflict within the military community?
- What set of incentives influence decision making behavior and how might it be potentially shaped to the benefit of the strategy or operational objective?
- What are the social components that affect decisions and communication and “stickiness” of those decisions?
- How does cognitive psychology fit in decision analysis?
- Are there models and simulations to analyze human abilities (cognitive and behavior), human decisions, and human group decisions to help servicemen and women perform better? If so, how have they been used in practice?
- How do we create a human-centered approach in the design, acquisition, testing, and operation of human-machine interfaces? What about human considerations as the top priority in systems design/acquisition to reduce life cycle costs and optimize system performance?

The HB&P Distributed Working Group Leadership is working with other Working Groups to discuss these topics by developing potential joint sessions with Manpower & Personnel (WG 18), Analytical Support to Training (WG 20), Experimentation (WG 22), Decision Analysis (WG 27), Modeling and Simulation (WG 28), and Wargaming (WG 30).

The Human Behavior and Performance Distributed Working Group Leadership encourages the submission of presentations and relevant to the areas outlined above and other areas not mentioned. The submission may be finished work, work in progress, or ideas and concepts. We look forward to hearing from you!

DWG 2 – Unmanned Systems

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In recent years, unmanned systems have become an increasingly common and integral part of many military, law enforcement and border security operations. Commercial unmanned systems are more widely available, technologically advanced and more affordable than ever before, enabling their use in legitimate agricultural and commercial operations as well as for nefarious purposes. Today, a wide variety of unmanned systems are operated by state and non-state actors to perform missions in the air, land, surface and undersea domains. Tomorrow will surely see new and innovative unmanned systems pushing the art of the possible.

There are many challenges and opportunities related to unmanned systems. The theme of the 86th MORSS is: “Supporting a Balanced, Modern and Ready Nation.” Unmanned systems will undoubtedly play an increasingly important part in achieving this vision in the years to come as unmanned system challenges are overcome and opportunities are realized. DWG-2 invites you to share your work and insight with us at the 86th MORS Symposium on unmanned system topics such as:

- Analysis of current unmanned systems, their application, and their successes.
- Analysis of the planning and management of unmanned system operations including scheduling, system allocation, maintenance, communication and data link requirements, control stations, human operator, attached payloads, etc. across diverse mission scenarios.
- Evaluation of unmanned system operational effectiveness for specific missions via the analysis of system metrics such as speed, range, persistence, etc.
- Modeling and simulation of unmanned systems reliability, availability, and maintainability.
- Determination of the optimal mix of tactical unmanned aerial vehicles (UAVs) for a given operational scenario. For example, development and analysis of concepts of operation that utilize cross-domain mixtures of unmanned systems (unmanned land/sea/air platforms operating in conjunction with each other).
- Power (fuel) availability and its impact on mission range, flight duration, tactical planning and communication requirements.
- Cost and operational effectiveness analysis of the employment of unmanned systems over manned systems.
- Cooperation between manned and unmanned vehicles, including concepts such as the Army’s Manned/Unmanned Teaming (MUM-T) concept.
- Solutions for safely managing the operational coordination of unmanned and manned

systems within the same airspace/water space. For example, UAV and manned aircraft “sense and avoid” capabilities needed to safely integrate UAVs into the national airspace.

- Properly managing the endurance of the human operators of UAVs in order to maintain a high level of mental sharpness and operational awareness as well as avoiding “burnout” when flying an aircraft from a remote location.
- Techniques for on-board and off-board exploitation of collected data, such as full motion video, for intelligence purposes.
- Novel system deployment concepts such as the deployment of unmanned systems from manned system platforms and unmanned systems from unmanned system platforms.
- Translation of commercial unmanned system applications or law enforcement applications to military roles.
- Feasibility of the tactical employment of novel ground-based unmanned systems such as legged systems, e.g. Legged Squad Support System, and micro UAV platforms using biomimetic flight methods.
- Analysis of the use of unmanned systems for logistics purposes and for casualty evacuation.
- Analysis of the use of undersea gliders for naval applications.
- Effectiveness of unmanned surface vehicles (USVs) and unmanned undersea vehicles (UUVs) in undersea warfare and as mine countermeasure tools.
- The application of high altitude/near-space (>60K ft.) unmanned aircraft systems including airships to persistent surveillance roles.
- Evaluation of levels of autonomy from expense, complexity and capability standpoints
- “Swarm” control of unmanned vehicles: controlling a group as a single unit or giving the group a general task with individual vehicles autonomously determining how to cooperate. Swarming to include land sea and air applications.
- Quantifying the relative threat posed by unmanned systems when used for nefarious purposes and the ability to neutralize that threat. How do we protect friendly unmanned systems from being electronically hijacked by adversaries? How do we employ electronic techniques to neutralize adversary unmanned systems while maintaining the ability of friendly vehicles to operate in the same space?

The Unmanned Systems Distributed Working Group Leadership is cooperating with other Working Groups to discuss these topics by developing joint sessions. In keeping with the dynamic nature of the unmanned system, DWG-2 welcomes papers describing ongoing analyses, data collection, problem formulation, metric definition, operational experience, and cost effectiveness and mission effectiveness analyses. The submission may be finished work, work in progress, or ideas and concepts.

Focus Session 1 – Analysis Status and Gaps for Military Autonomous Complex Adaptive Systems

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The purpose of the Focus Group is to identify, in broad terms, the state of knowledge about Autonomous Complex Adaptive Systems (ACAS), the gaps in knowledge, the state of research and analyses underway, and the folks active in the problem area. The ultimate purpose is to lay the ground work for a special meeting and a possible new working group. The objective of the working group is to identify on-going and completed analyses related to ACAS systems throughout the operations analysis community; determine needed areas of analyses not yet undertaken (analytic gaps); and to produce guidance for further investment by MORS. Possible next steps include a provisional working group for under Composite Group C: Joint Warfare for 86th MORS and a near-term special meeting (either a mini-symposium or workshop, depending on the nature of the perceived analytic gaps). The structure of the Focus Group would be invited short papers and open discussion. The discussion will result in a report, including the presentations, to the MORS leadership, with a recommendation for a provisional working group for next year, with the objective of designing a special meeting plan.

Focus Session 2 – Data Analytics

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Data analysis is rapidly growing in importance within the operations research and quantitative analysis community. This field has been energized by the confluence of several factors. Ongoing advances in technology have made available vast computational power at greatly reduced cost, while at the same time, the importance of data collection, storage, and dissemination has been recognized as a critical function of many organizations, resulting in unprecedented volumes and velocities of data available for computation. The combination of vast computing power and accessible large-scale data allows us to break away from more traditional statistical approaches and begin to unlock the promise of technologies such as deep learning and artificial intelligence.

The impact of data analysis on the commercial sector is hard to exaggerate: Companies such as Google, Amazon, and Facebook thrive on the ingestion and computation of massive data. At the same time, there remains some confusion on what is meant by the term, and more importantly to the MORS community, how these evolving techniques can best be applied to solve problems within the Department of Defense and the broader national security community.

We solicit presentations from experienced data scientists and operations research analysts that will shed light on several key issues, primarily in the form of both applied results and discussion of techniques:

- What fields define data science, and what is its relationship to operations research?
- What new and (re)emerging technologies and techniques are ripe for use within the national security community?
- What are some success stories of the use of large-scale data analytics within DoD, and what territory remains yet to be explored?

This focus session is meant to serve as a gauge of the interest in creating a Data Analytics Working Group within the Symposium. We also hope to elicit discussion among participants regarding the scope and objectives of such a working group.