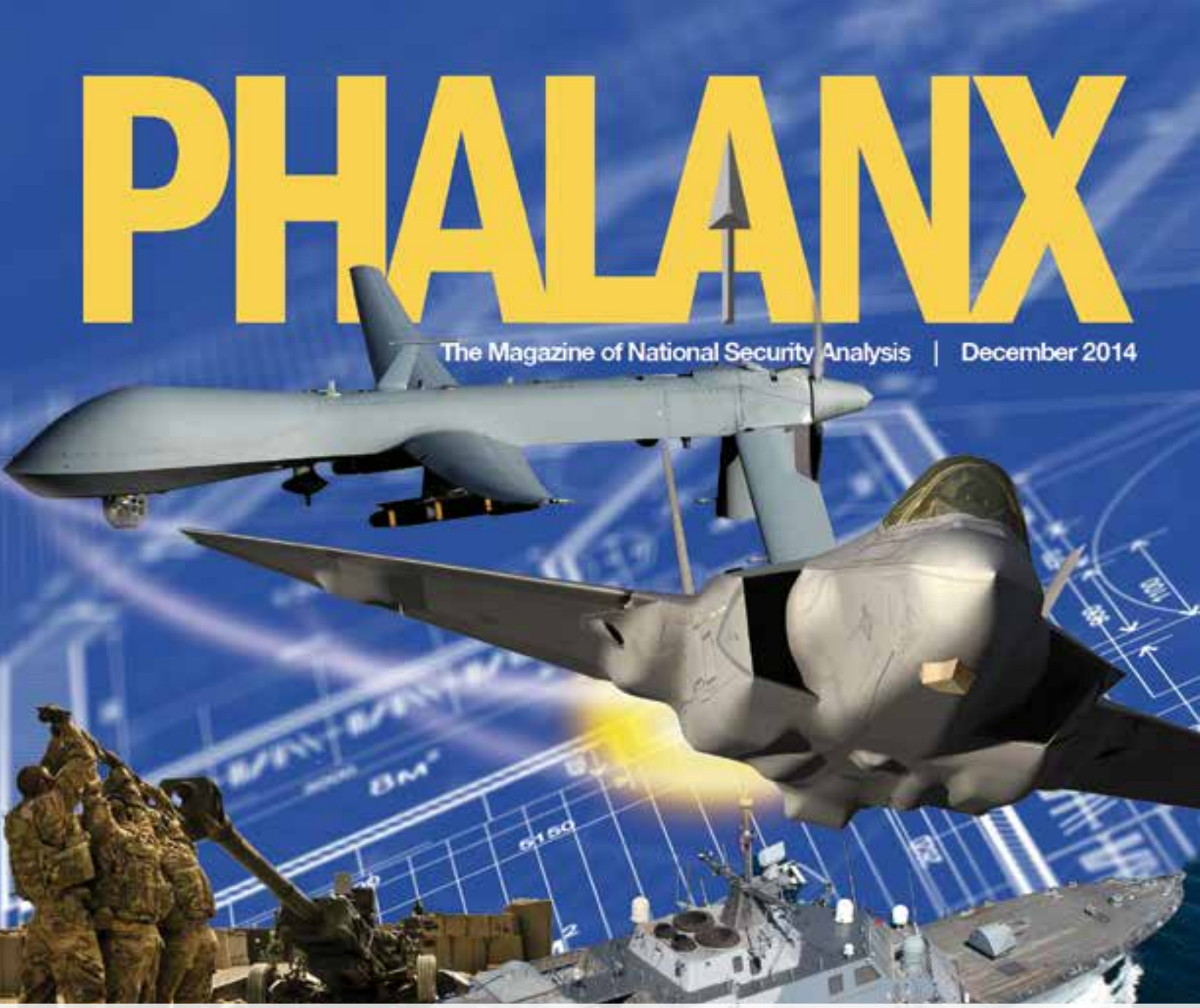
PHALANX

The Magazine of National Security Analysis | December 2014



INDUSTRY AND ITS CONTRIBUTION TO OR FOR NATIONAL SECURITY

Volume 47, Number 4

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Lockheed Martin Operations Research analysts have partnered with the national security analysis community for more than 60 years. Our analyst workforce is vibrant and represents many different backgrounds including military veterans, government civilians, and a range of industry. The intellectual curiosity we share binds us together as the strategic thinker for Lockheed Martin—always asking the why before the what or how. Lockheed Martin is honored to be a partner of the national security analysis community and welcomes exceptional talent interested in joining us to inspire new and meaningful innovations.

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Tribute: Dr. Jacqueline R. Henningsen

Staff, Office of Air Force Studies and Analysis (A9)

On October 6, 2014, the Air Force retired the most senior and certainly one of the classiest operations research analysts to ever walk the fourth floor E-Ring at the Pentagon. To those who know her as Jackie, and the rest of us who know her as Dr. Henningsen, the distinguished government career of a professional icon and a great servant to our country came to an end. The retirement of Dr. Jacqueline R. Henningsen, PhD, SES, as the Director of Air Force Studies & Analyses, Assessments, and Lessons Learned signals an end to an era of analytic leaders who grew up under the institutional legacy and teaching of analytic community greats such as Lieutenant General Glenn Kent and Mr. Clayton Thomas. We will miss her dearly for what she meant to us as coach, mentor, teacher, and friend and we look forward to the role she will continue to play as a MORS Fellow and senior analyst emeritus as she enters a new phase of her life.

Dr. Henningsen began her career in the Air Force after nearly two decades in education. Her path may have been ordained as her first years of life were spent listening to the rumbling "sound of freedom" from the runways of Langley Air Force Base, Virginia, and to the earth-shaking wet-take-off jet engine roar of the SAC bombers at Offutt Air Force Base, Nebraska. From these front-line Air Force bases to her bustling E-Ring office at the Pentagon, she has poured her heart, soul, and her passion into her work. As the Air Force moves through its seventh decade as a separate service, the careers of countless men and women in the analytic and scientific career fields have been touched by her wise council who will forever be in her debt.

During her career on the Air Staff she has served six USAF Chiefs of Staff, including Generals Mike Ryan, John Jumper, Mike Moseley, Norton Schwartz, and Mark Welsh. Supporting and working with these Air Force leaders required brains as well as what Sheryl Sandberg termed, the ability to "Lean In." Her skills at basketball and volleyball might have also given her the necessary "height" to stand toe to toe with these esteemed general officers whom she also calls friends. Running in these high echelons of air power required being accepted into a very exclusive network . . . without a call sign.

Always "speaking truth-to-power" requires the highest ethical character.

On a daily basis Dr. Henningsen would help senior leadership "fireproof" their decisions with a solid analytic body of work, and when they couldn't be defended by solid analytics she would calmly say, "There are many factors that go into a decision and analysis is only one, so I need to advise you that I can't analytically fireproof you in this case." She wouldn't settle for anything less. She retires proud, standing tall on a legacy of important decisions that will guide the direction of the Air Force well into the next decades. Just as importantly, she has faithfully prepared those of us who have grown up under her analytic influence to carry the torch of analytic light forward.

During the late 1960s and 1970s the Air Force studies and analyses branch enjoyed a respected position in contributing to Air Force decisions by leaders who fully understood the value of analysis. Following the first Gulf War, in an era of the "peace dividend," the USAF de-emphasized independent analytic support for decision making by splitting up its analytic team and relegating what remained to lower levels in the headquarters. For the first time in its history, the Air Force's senior analyst did not directly report to the Chief of Staff. For almost a decade, Air Force studies and analyses remained in the shadows on the Air Staff. Following the 1997 Quadrennial Defense Review, a major institutional review of the Air Force called Headquarters Air Force 2002 concluded that lack of a strong, independent analytic function was a major issue. Dr. Henningsen took charge of a reinvigorated Air Force Studies & Analyses Agency as a direct reporting unit to the USAF Vice Chief of Staff, returning analysis to a respected place in the Air Staff. On a daily basis Dr. Henningsen worked with the USAF leadership, providing analytically supported advice in many areas including planning and programming reviews and Air Force contingency issues, including combat in Afghanistan, Iraq, Somalia, Libya, and Syria, as well as humanitarian crises resulting from hurricanes, tsunamis, earthquakes, and events closer to home that have directly affected our airmen. This now includes the deep sequestration cuts as well as the Department of Defense's critical battle in the areas of suicide and sexual assault prevention.

Over her decades of service, Dr. Henningsen has accumulated numerous civilian awards and accolades to include those for meritorious and distinguished service. Most notable is the President's Award for Distinguished Federal Civilian Service she received in 2012. However, she is most proud of the achievements of those who have worked for and with her through the years. She revels in hearing their stories, and enjoys nothing more than a spirited discussion on innovation in the science and art of analytics.

Dr. Henningsen is also one of our most distinguished MORSians, and has held various offices in MORS. Her path is unique, having risen from a MORS director to two MORS vice president positions, to a MORS Sponsors representative at OSD, and finally becoming the Air Force MORS Sponsor. She has been a MORS Fellow for almost two decades. She has been a constant supporter of MORS as a vital component in our career field, which was especially supportive during some uncertain and lean funding years. Her legions of MORS friends look forward to seeing her active in the society for several decades to come.

Dr. Henningsen will pass the analytic torch and the title of senior "Light Shedder" to Mr. Kevin Williams who has been her Deputy for the past five years. We congratulate Dr. Henningsen on a distinguished career and wish her a fantastic and fulfilling retirement as she plans new adventures with her husband, Carl, who has been at her side "making everything possible."

MORS PRESIDENT

Dr. Rafael E. Matos
President, Military Operations Research Society
president@mors.org

Workforce Management Analysis

From Talent Acquisition, Through Force Shaping and Professional Growth, into Knowledge Transfer – *A Focus on a Critical Skill*

The fall season is almost behind us and as we approach winter, we look forward to a set of tremendous events to close 2014 and kick off the new year. First, I would like to highlight our third Industry and Institutions Showcase and Workshop to be held on December 11, at the Hyatt, Crystal City, in Alexandria, Virginia. The theme of this event is "Workforce Development." This is a topic that goes along with our theme this year focusing on the growth of our analysts through professional development and continuing education.

There are multiple areas of workforce management in which scientifically based and analytically rigorous approaches are required. Many experts in military operations research work today on the multiple challenges of managing the size and the quality of the force of the military services and other national security agencies. The efforts required in talent acquisition and recruiting are pivotal to ensure we get the right people, with the right skills, to the right places, and at the right time. Once the workforce skills are present in the right locations, and in the right numbers, organizations need to establish strategies to ensure that the members of their workforce maintain or grow their skills, follow a reasonable career progression path, and in the process, that some knowledge transfer and documentation occurs from the lessons learned.

Workforce development is an approach that attempts to enhance organizational stability and prosperity by focusing on people. These strategies go beyond the comfort of the individuals, identification with the organization, and the integration of a diverse force at all levels. Personnel accessions, flow points, growth, and investment strategies are at the core of a strong workforce.

It would be of great interest to open a dialogue on how government and industry carry out these activities, learn from each other on the successes and failures experienced in past and recent history, and explore future strategies. There are many professional assets in the human resources and human capital management disciplines available to provide in-depth context to rigorous analytic approaches.

For our Industry Day, we are reaching out to professionals in the workforce management area to come and discuss this topic of great interest to both government and industry alike. I am looking forward to seeing you at this great event.

Fellows Nominations

Selection as a MORS Fellow is the highest degree of recognition that MORS bestows on our members. Elections are conducted in concurrence with the December Board of Directors meeting. We have a group of very deserving individuals nominated for this honor this year. I would like to personally thank the Membership Committee and our membership at large for submitting your nominees.

Dr. Rafael E. Matos
President, Military Operations Research Society
president@mors.org

MORS PRESIDENT

Sponsor Retirement and New Sponsor Welcome

On October 6, 2014, our US Air Force Sponsor, Dr. Jacqueline Henningsen, Fellow of the Society, retired from her distinguished service as Director, Studies and Analyses, Assessments and Lessons Learned, Headquarters US Air Force (HQ USAF/A9). I invite you to read the special feature in this edition of *Phalanx* on the tremendous contributions Dr. Henningsen made throughout her career in the US Air Force, as an analyst, and a lifelong supporter of MORS. We are very proud of her support and her dedication to our discipline.

At the same time we welcome Dr. Henningsen's successor and our new US Air Force Sponsor, Mr. Kevin E. Williams (see page 52) and the Air Force Sponsor Representative, Ms. Patricia A. Hickman Deputy Director, Analyses, Assessments and Development. Mr. Williams is a member of the Senior Executive Service, and as Deputy Director, Studies and Analyses, Assessments and Lessons Learned, Headquarters US Air Force, he has been responsible for the development of Air Force-wide policy and guidance that ensures defendable studies, analyses, assessments, and lessons learned processes to support Air Force leadership decisions, enhancing current and future warfighting capabilities. Welcome to MORS, Mr. Williams and Ms. Hickman. We are looking forward to continue our solid relationship with the US Air Force in support of your operations research analysts' force.

Other Upcoming Events

Mark your calendars now to attend our Education and Professional Development (EPD) Colloquium, March 9–10, 2015, at the George Mason University in Fairfax, Virginia. Once again MORS provides the EPD Colloquium at no charge to participants and offers experiences that help them continue to develop professionally.

Do not forget to "lock-in" the dates also for the 83rd MORS Symposium, which will offer the finest opportunities for professional collaboration and networking. Our signature event is scheduled for June 22–25, 2015 at the DoD Mark Center in Alexandria, Virginia. Given the tremendous attendance this year at the 82nd MORSS, we were able to secure additional rooms at the DoD Mark Center to open up opportunities for the working and composite groups in an effort to offer additional openings for presentations. The call for abstracts is still open and I invite you to take advantage of this opportunity to submit your work to be considered to be part of this event. Details on abstract submission and other program specifics are available in the MORS website at www.mors.org.

At the 83rd Symposium this coming June, we will also kick off our 50th year with a range of activities that I am sure will be of great interest, as we gear up to celebrate MORS' 50th Anniversary in June 2016. I am sure many of us are looking forward to this major milestone for our Society.

MAS PRESIDENT

Chris Arney
President, Military Applications Society
david.arney@usma.edu

As is always the case, there are considerable "goings on" in military operations research and much of the action involves the Military Applications Society (MAS) of INFORMS. Thanks to all who participated in the annual INFORMS conference in San Francisco and the activities of MAS during the conference. I will highlight these in the next issue of *Phalanx*. Thanks to all of you who have served in keeping MAS an active, successful intellectual society over these many years. I give my personal thanks to Bill Fox, who as the president of MAS for the past two years kept a steady hand through some turbulent times. Many of the MAS activities were affected by government funding changes and new travel rules and requirements. I hope that most of the restrictions are behind us now. Also, my deepest thanks goes to Greg Parlier, the industrious and wise previous MAS president, who always seems to know exactly what to do next and is amazingly proactive in getting things done. Also, all the members of MAS who were in San Francisco need to thank George Mayernik, who once again secured sponsor donations for our excellent reception at the conference. Finally, I wish to thank Walt DeGrange, who has contributed greatly to the organization and smooth running of the Society as secretary/treasurer for these past few years.

We recently held a MAS election and this will serve as the announcement of the new MAS officers and Council. So in the stead of those mentioned above, Colonel Andy Hall will now serve as the vice president and my successor as president in two years. Colonel Doug Matty will be the secretary/treasurer. Serving on the MAS Council will be: Mahyar Amouzegar, Chad Long, George Mayernik, Aaron Burciaga, Natalie Scala, Jeff Eaton, Amnon Gonen, Chase Murray, Walter DeGrange, Major Jesse Pietz, and Bill Fox as the past president.

Our military operations research community is a complex network of people, societies (like MAS), organizations, military units and agencies, schools, colleges, universities, journals, information, ideas, events, and conferences. I like to think of this network as a kind of a military-industrial-educational operations research complex (MIEORC). The connections in this vast multimodal maze include friendships, communicating, trusting, influencing, collaborating, educating, publishing, and reading. After considering how to report information to you about this wonderful MIEORC complex, I realized that it would always be too much for this column. It is impossible to fully describe all that happens in military OR in a short article. So in my future columns I will try to do my best to find the most important and most exciting activities to highlight and continually remind all of us that much more information is found in the rest of this journal, online

through the INFORMS website, or announced through INFORMS new social media forum called INFORMS-Connect. I must admit that what I love about OR is both its strong network of connections and its bold engagement with the practical (and therefore complex) problems of society. That is to say, OR is wonderfully complex and interdisciplinary! And since the military is also complex and interdisciplinary, OR and the military just seem to go together quite naturally. My own experience and knowledge is sparse in the services outside the Army, so I hope to spend time during my engagement with the MAS community becoming more interdisciplinary in military OR by learning about the roles and elements of OR in the Navy, Marines, and Air Force. Likewise, most of my OR problem solving is the in the form of network modeling, so I will seek to expand my own knowledge and use of OR tools to other models and methodologies. Perhaps this is a role that MAS can play for all

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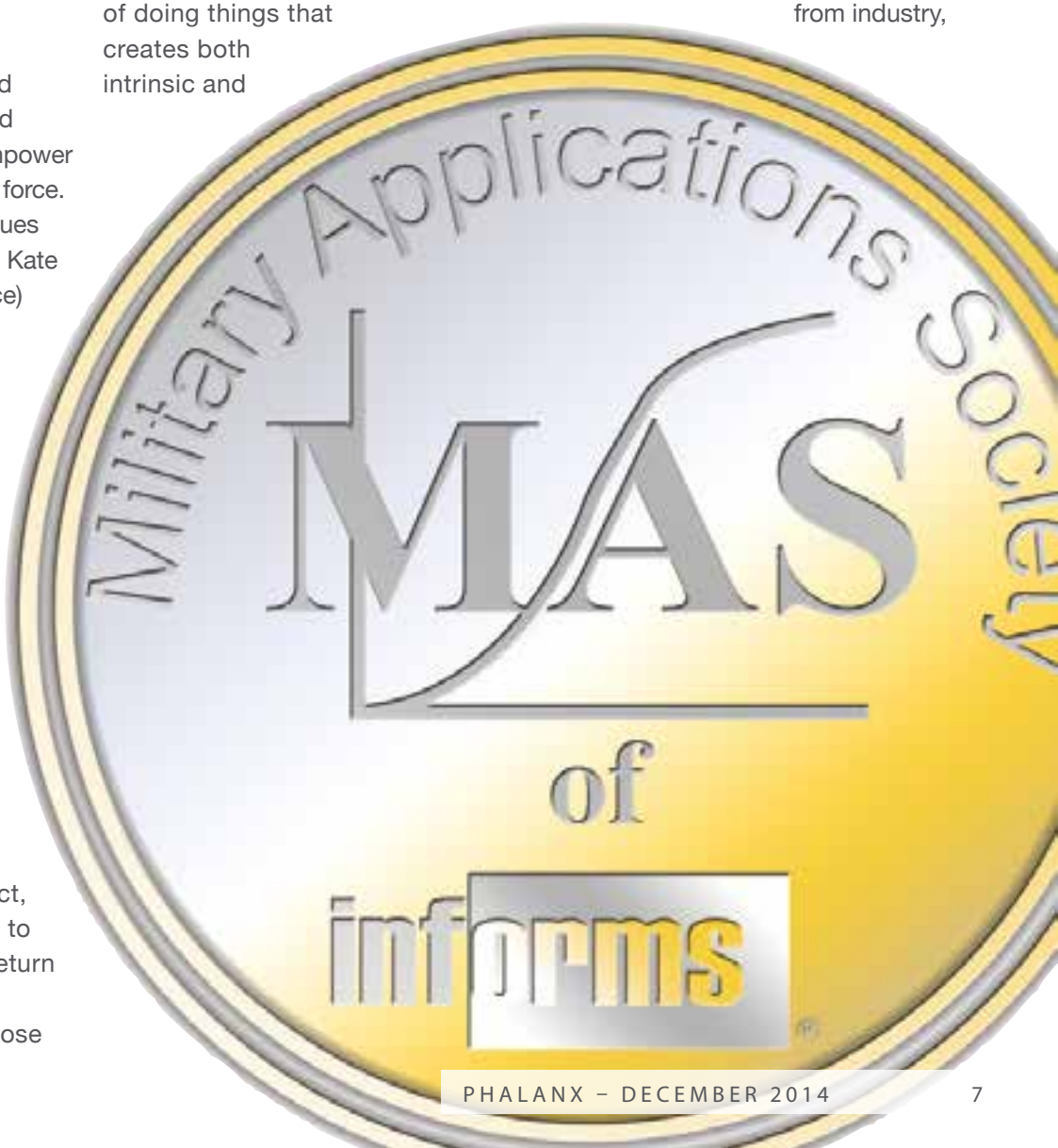
MAS PRESIDENT

members to expand their breadth in OR and management science.

In the military OR community, there are many compelling questions to ask and seek to answer. One basic question is: To build a modern, flexible, innovative force, where and how should the military invest in people and where and how should the military invest in robotics or artificial intelligence (AI) over the next 15–20 years? A well-informed answer would guide investment in people through accessions, retention, talent development, and human capital investment and suggest where the military can profitably apply robotics, AI, and other modern information-based technologies to support its manpower to achieve a flexible, adaptable force. I have been talking with colleagues Kira Hutchinson (TRADOC) and Kate Coronges (Army Research Office) about this enterprise.

Most believe that the future will be unlike any world that we have experienced to date and the rate of change is unprecedented. Like the global marketplace, modern warfare continues to evolve at an accelerating pace. So OR analysts must help the military adapt and innovate. The Army Science Board defines innovation as something that develops or changes a product, system or service, or process to produce greater results and return value. That definition calls for OR to become innovation's close partner. Innovation is the result of changing, improving, adapting, or developing new, nascent, or extant processes or products in an effort to achieve a desired result while simultaneously maximizing return on investment. Incremental innovation takes existing products, systems, services, or processes and improves them; it makes them better and increases their value. Radical innovation (possibly called a paradigm shift) does not merely change an existing product, system, service or process, but creates a completely new way of doing things that creates both intrinsic and extrinsic value for an individual or organization.

Once established, an innovative culture enables the workforce and its partners to help frame and solve difficult problems. Again, this is precisely what OR does for the military and society. OR's best practices provide an opportunity to improve processes and systems, allowing for increased effectiveness and efficiency in both operating and generating forces regardless of changes to the strategic environment and national priorities. Borrowing from industry,



top-performing companies have used OR to fundamentally change their approach to enhance innovation over the past decade via transformational information technology.

Education is extremely important for OR and its role in advancing innovation. We seek to educate analysts on the importance of precisely identifying problems and challenges and engaging appropriate disciplines and interdisciplines to build and identify solutions. Although the introduction of appropriate new OR tools to support innovation initiatives is important, education of analysts and users of OR must be available to support and complement these tools and processes as well.

What we do in OR problem solving, research, and education and in the various support activities of MAS is important in many ways. OR involvement as the driver of innovation provides the opportunity to improve processes and systems, producing increased effectiveness and efficiency in military forces regardless of changes to the strategic environment and national priorities.

I hope all members of MAS and readers of *Phalanx* had opportunity to contribute to this innovation enterprise in 2014 and are preparing for even more achievements in 2015. Happy OR-ing in 2015!

One quick announcement: You may still have time to submit an abstract to the Canadian OR Society (CORS)-INFORMS Joint Meeting in Montreal, Canada to be held June 14–17, 2015. Deadline for abstracts is January 16, 2015.

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(signed) Susan Reardon, Chief Executive Officer, MORS

Third Annual Industry and Institution Showcase and Workshop

The Military Operations Research Society (MORS) Industry and Institution Partnership (IIP) Committee will be conducting its third annual Industry and Institution Showcase and Workshop on December 11 at the Hyatt Regency Crystal City, Virginia. The showcase/workshop provides a forum for government, industry, and academia to understand and build relationships on the issues facing the national security analytic community today. This year's theme is "Developing the Analytical Workforce: Shared Perspectives between Government and Industry."

INDUSTRY DAY SHOWCASE AGENDA Thursday, 11 December 2014 Hyatt Regency Hotel Crystal City	
0800 – 0900	Exhibit and Demonstration Set Up
0830 – 0900	Continental Breakfast
0900 - 0910	**WELCOME** **Mr. Steve Notarnicola,** MORS Industry and Institution Partners Chair **Dr. Rafael Matos,** MORS President
0910 - 0955	**Keynote Address** **Brian E. Wilkerson,** Managing Director at Revolution Advisors, LLC
0955 - 1005	**Break**
1005 – 1050	**Keynote Address** **LTCOL Raphael Hernandez,** National Director of Advertising, USMC Recruiting Command
1050 – 1100	**Break**
1100 -1200	**Panel Discussion** Trends in National Security OR: Government Needs, Industry Response
1200-1345	**Lunch** Industry Exhibits and Demos
1345 – 1430	**Featured Speaker from Industry**
1430 - 1445	**Break**
1445 – 1545	**Panel Discussion** Industry Panel – Challenge of doing Business in the Current Fiscal Environment
1545 – 1600	**Closing Remarks** **Mr. Steve Notarnicola,** MORS Industry and Institution Partners Chair **Dr. Rafael Matos,** MORS President
1600 – 1730	**MORS-hosted Network Event**

The Showcase/Workshop's purpose is to inform and inspire attendees on current and upcoming challenges in workforce development and human capital investments. These challenges focus on two perspectives. First, the

operations researcher's insights on improvements in the corporate and government workforce and the challenges of attracting, educating, and retaining talented personnel as long-term, valuable human resources. The second objective is to better understand and suggest ways to enhance the development and training of operations researchers to meet the analytic demands of government and industry. Through a series of distinguished speakers, panels of experts, discussions, exhibits, demonstrations, and informal interactions, the showcase/workshop will provide government, industry, and academia with an opportunity to learn from each other and share experiences in a nonattributional multifaceted forum.

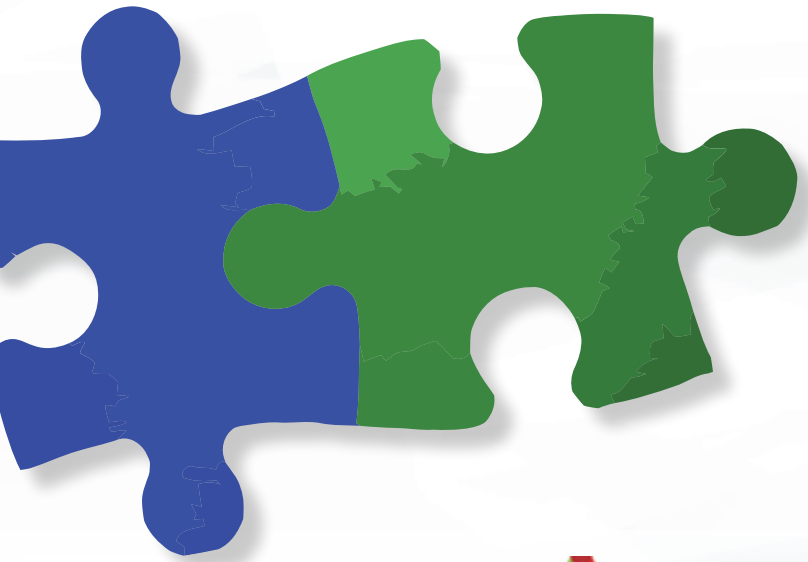
The National Director of Advertising for the USMC Recruiting Command, LTCOL Raphael Hernandez, will deliver the keynote. Topics to be addressed during the workshop portion of the day will include the merits of professional certification, the future government, and civilian analyst mix in the national security operations research community. Best practices for meeting the demands of the future workforce will be highlighted. Participants will enjoy the opportunity to discuss their

MORS
Military Operations Research Society

3rd Annual Industry Showcase

Developing the Analytical Workforce: Shared Perspectives between Government and Industry

11 December 2014 • Hyatt Crystal City



MORS is hosting our **3rd Annual Industry Showcase 11 December 2014 at the Hyatt Crystal City.** The event is an informative program designed to address challenges in Workforce Development and Human Capital Investments. Keynote speakers include Brian E. Wilkerson, Managing Director at Revolution Advisors, LLC and LTCOL Raphael Hernandez National Director of Advertising, USMC Recruiting Command. Panel discussions will examine trends in National Security OR and the challenge of doing business in the current fiscal environment. In addition, there will be the opportunity for attendees to interact with the exhibitors and participate in demonstrations. The Industry Showcase is the perfect forum for government, industry, and academics to learn from each other and share experiences.

To register go to: **www.mors.org**

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own challenges and successes during an informal networking lunchtime event.

The MORS Industry and Institutional Partners have been invited to provide demonstrations of tools, techniques, and applications that they have developed in their efforts to improve the quality of their analytic work. All attendees will observe and take part in the demonstrations.

The MORS Industry Showcase and Workshop is open to all industry, academic, and government attendees. For more information and to register, please visit the MORS website at www.mors.org. If you are interested in becoming a MORS Industry or Institution Partner, please contact Jennifer Ferat at jennifer@mors.org.

Coming Soon in *Military Operations Research*

"Rethinking the Hierarchy of Analytic Models and Simulations for Conflicts"
Mark A. Gallagher, David J. Caswell, Brian Hanlon, and Justin M. Hill

This article documents the rationale for a hierarchy of analytic models to align with the purpose of analysis, applicability to the issues, efficient search of the decision space, and cost. The authors propose adding to the current levels of "engineering and physics," "engagement," and "mission," and "campaign" two more aggregate levels of "defense enterprise" and "government, nongovernment, and coalition instruments of power."

"Analytics in Action at the New York City Police Department's Counterterrorism Bureau"
E.S. Levine and J.S. Tisch

The New York City Police Department's Lower Manhattan Security Coordination Center integrates data from a variety of sources and records. The amount of information received represents a "big data" challenge. The authors describe the analytical processes that the Police Department uses to manage the incoming data and provide information to officers in the field, including alerting, categorical data analysis, and pattern recognition.

"Applying Hughes's Salvo Equations to Engagements between U-Boats and Convoy Escorts"
Brian McCue

In the period 1941-1942, German U-boats successfully engaged North Atlantic convoys in 88 encounters, rederived from summary tables via simulated annealing, as detailed in a recent Phalanx article. These battles' great number, their uniformity in technology and situation, and their diversity of numbers of combatants and merchant vessel sinkings, commend them as a case study for the advancement of military operations research.

"Optimization of the Future Soldier System: An Integrative Approach Based on Agent-Based Simulation and Response Surface Method"
Ingu Lee, Youngjung Geum, Sung-Pil Hong, Subin Lee, and Eui-Jung Choe

This article explores the optimization of future soldier systems using an integrative approach of RSM and agent-based simulation. The authors introduce decision and performance variables and constraints based on a literature review and practical considerations. They estimate the response surface based on an agent-based simulation experiment, as well as the optimal combination of the soldiers' equipment.

A Commitment to Life Long Learning

83rd Symposium Planning Update

Ronda J. Syring, Johns Hopkins University Applied Research Laboratory, ronda.syring@jhuapl.edu

Our commitment to the Society's mission—"enhance the quality of analysis to address real-world national security interests through the advancement of the OR profession"—is as strong as ever. A key contribution to achieving this mission is through the promotion of information exchange, as well as through providing collaboration and professional development opportunities. This promotion facilitates the discussion of the quantitative aspects of national defense and national security in a manner not available under the official channels and processes of the national defense community. The principal venue for such discussions is the annual MORS Symposium. Planning is well underway for the 83rd MORSS, which will be held at the DoD Mark Center in Alexandria, Virginia, from June 22–25, 2015.

Top DoD officials recognize and stress the importance of maintaining technical competence and professional development in order to provide sound analyses, insight, and recommendations to decision maker. With that in mind, the theme for the 83rd Symposium is "National Security Analysts: Growth through Professional Development and Continuing Education." The goal is to provide opportunities to develop or maintain analytic skills and knowledge base at all levels. The next several editions of *Phalanx* will provide details about the plenary session, composite and working groups, special sessions, tutorials, continuing education unit short courses, demonstrations, posters, and other information specific to the 83rd Symposium.

Many volunteers, in addition to the outstanding MORS staff, are working together to organize the 83rd Symposium program. The symposium planning staff is listed below:

- Symposium Chair: Ronda J. Syring
- Symposium Deputy Chair: Sheilah Simberg
- Symposium Advisor: Rochelle Anderson
- CG/WG Coordinator: Jim Treharne
- Deputy CG/WG Coordinator: Randi VanNyhuis
- Virtual Symposium Coordinator: Robert Henson
- Deputy for Special Sessions: Steve Stoddard
- Tutorials Coordinator: Simon Georger
- Continuing Education Coordinator: Darryl Ahner
- Demos/Posters Coordinator: Mike Ottenberg and Rupert Seals
- Prize Session Coordinators: Joe Adams and Chris Linhardt
- Rooms Coordinator: Jim McMullin
- Communities of Practice Coordinator: Mike Ottenberg
- Security Coordinators: Joe Adams and Rupert Seals

The announcement and call for presentations (ACP) can be found on the MORS website at www.mors.org. Please consider submitting an abstract on your relevant analyses—either completed or in progress. It is your personal contribution that will make the 83rd MORS Symposium more professionally fulfilling for all participants.

Vice Admiral (VADM) James D. Syring, Director, Missile Defense Agency, will be the plenary session keynote speaker for the 83rd Symposium. The Missile Defense Agency (MDA) is a research, development, and acquisition agency within the Department of Defense. The MDA workforce includes government civilians, military service members, and contractor personnel in multiple locations across the United States. The MDA is focused on retaining and recruiting a dedicated workforce interested in supporting our national security. As the agency develops, tests, and fields an integrated ballistic missile defense system (BMDS), the MDA works closely with the combatant commands (e.g., Pacific Command, Northern Command, etc.) who will rely on the system to protect the United States, our forward deployed forces, and our friends and allies from hostile ballistic missile attack. The MDA works with the combatant commanders to ensure that MDA develops a robust BMDS technology and development program to address the challenges of an evolving threat. The MDA is also steadily increasing international cooperation by supporting mutual security interests in missile defense. The MDA is committed to maximizing the mission assurance and cost effectiveness of management and operations through continuous process improvement. You can learn more about VADM Syring by reading his biography published in this edition of *Phalanx*.

Additional assistance is always needed. If you would like to volunteer to assist with the symposium and share in this important MORS experience, please contact me at ronda.syring@jhuapl.edu.

83rd MORS Symposium

National Security Analyst: Growth through Professional Development and Continuing Education

Dr. Jim Treharne, Center for Army Analysis, James.T.Treharne.civ@mail.mil

The Department of Defense and our nation stand at a critical crossroads. The challenges and opportunities facing our senior leaders are unparalleled in recent times. On September 30, 2014, at the Council on Foreign Relations in Washington, DC, Deputy Secretary of Defense Bob Work remarked,

> *Decisions we're making every day are really going to shape the Department for the next couple decades and determine in large part on whether or not we have a future that is defined more by peace or more by crisis. So it's an exciting time, I have to tell you.*

It should be an exciting time also for the military operations research community. There have never been so many opportunities for our community to impact the decision-making process of our senior leaders. DSD Work further commented on his thoughts about global posture based on a recent Asia-Pacific trip.

> *It's the deliberate apportionment and global positioning of our forward stationed and our forward deployed forces and the development of supporting global attack, global mobility and logistics, forcible entry, command, control, communications, and intelligence forces, and the supporting security relationships and legal agreements that we make in order to facilitate the rapid concentration of forces in time and space across transoceanic distances.*

No other group is as well-positioned as the military operations research community to address not only global posture issues but also the plethora of other complex and interrelated issues facing the DoD and other federal agencies.

The 83rd MORS Symposium (MORSS) team is well acquainted with these issues and has begun detailed planning to prepare the community to tackle these complex challenges. Our theme this year is "National Security Analyst: Growth through Professional Development and Continuing Education." If you want to learn fast and effectively from some of our nation's top military analysts, then join us from June 22–25, 2015, for four days of education, networking, mentoring, and camaraderie. We are very fortunate to have been able to secure the Mark Center Building in Alexandria, Virginia, for

the majority of our conference activities. Just down the road from both the Pentagon and the Nation's Capital, this great state-of-the art facility is perfectly located and equipped to ensure the success of the symposium and a splendid time for its participants.

The strength, vitality, and success of our MORS symposia are attributable to many factors: a great professional staff, committed government sponsors, a highly supportive private industry, a cutting-edge educational community, and most importantly, its many volunteers and presenters. Our presenters and volunteers are the solid backbone of our world-class organization. We believe that every volunteer and presenter is essential to the success of the organization. We want you to experience the great personal and professional joy of being a MORS volunteer and presenter. We already have a great team in place for the 83rd MORSS. But we still have many excellent volunteer opportunities. Let us know you are willing and able.

This year we will once again have a wide breadth of opportunities to both present and grow as military operations research professionals. We have seven composite groups, 33 working groups, and two distributed working groups (see Table 1). There will also be poster sessions, special sessions, and tutorials. After the main conference, we will have another virtual MORS session. Stay tuned for more details about this exciting initiative that MORS continues to successfully mature. Consider now what analysis you would like to present next summer. The presentation can be classified or unclassified. The work can be in progress or complete. There is no better environment to present your analysis and gain valuable feedback in a great collegial environment. In turn, you will learn methodologies and techniques from peers, subordinates, and seasoned analysts that will prove incredibly valuable to you in your career.

We are looking forward to seeing you this summer

83rd MORSS Group Structure

CG/WG	Description
CG A	**Homeland and International Operations**
WG 1	Strategic Operations National Security Analysis
WG 2	Chemical, Biological, Radiological, Nuclear, and Advanced Explosive Defense
WG 3	Infrastructure Analyses, Protection, and Privacy
WG 4	Homeland Security, Homeland Defense, and Civil Support
CGB	**C4ISR and Cyber Operations**
WG 5	Information and Cyber Operations
WG 6	Battle Management Command and Control
WG 7	ISR and Intelligence
WG 8	Space Acquisition, Testing and Operations
CG C	**Joint Warfare**
WG 9	Air and Missile Defense
WG 10	Joint Campaign Analysis
WG 11	Land and Expeditionary Warfare
WG 12	Maritime Operations
WG 13	Power projection and Strike
WG 14	Air Warfare
CG D	**Resources/Readiness Training**
WG 15	Casualty Estimation and Force Health Protection
WG 16	Strategic Deployment and Distribution
WG 17	Logistics, Reliability, ad Maintainability
WG 18	Manpower and Personnel
WG 19	Readiness
WG 20	Analytic Support to Training and Education
WG 21	Operational Energy
CG E	**Acquisition**
WG 22	Experimentation
WG 23	Measures of Merit
WG 24	Test and Evaluation
WG 25	Analysis of Alternatives
WG 26	Cost Analysis
WG 27	Decision Analysis
CG F	**Interdisciplinary Advances in Operations Research**
WG 28	Modeling and Simulation
WG 29	Computational Advances in Operations Research
WG 30	Wargaming
CG G	**Hybrid Warfare**
WG 31	Operational Environments
WG 32	Special Operations and Irregular Warfare
WG 33	Social Science Methods and Applications
DWG 1	**Human Behavior and Performance**
DWG 2	**Unmanned Systems**

(CG: composite group; WG: working group, DWG: Distributed Working Group)

Vice Admiral James D. Syring Director, Missile Defense Agency

Plenary Session Keynote Speaker for the 83rd MORS Symposium

Vice Adm. Syring is from Muncie, Indiana. A 1985 graduate of the United States Naval Academy with a bachelor of science degree in marine engineering, he received his commission as an ensign. Subsequent to commissioning, he was designated an engineering duty officer. In 1992, Syring earned his master of science degree in mechanical engineering from the Naval Postgraduate School.

Ashore, Syring served in numerous engineering duty officer assignments including: ship superintendent for *USS Port Royal* (CG 73); Aegis test officer for new construction DDG 51 class ships; combat systems, test and trials officer in the DDG 51 Aegis Shipbuilding Program Office; Combat Systems Baseline manager in the Aegis Technical Division; and director for Surface Combatants, Office of the Assistant Secretary of the Navy (Research, Development and Acquisition).

Syring served as the technical director for the US Navy's DDG 1000 Shipbuilding Program and followed that tour as the DDG 1000 major program manager. Upon selection to flag rank in 2010, Syring served as the program executive officer for Integrated Warfare Systems, responsible for acquiring, developing, delivering and sustaining integrated weapons systems for ships, submarines, carriers and aircraft within the Fleet and Joint Force. In November 2012, Vice Admiral Syring became the ninth director of the Missile Defense Agency (MDA), Office of the Secretary of Defense, Pentagon, Washington, DC. In this capacity, he oversees the MDA's worldwide mission to develop a capability to defend deployed forces, the United States, allies, and friends against ballistic missile attacks.

Syring's personal awards include the Distinguished Service medal, Legion of Merit (two awards), the Meritorious Service medal (four awards), Navy and Marine Corps Commendation medal, and Navy and the Marine Corps Achievement medal.

Analytics Rising
Certified Analytics Professionals in the DoD

Col Scott Nestler, US Army, CAP, scott.t.nestler.mil@mail.mil
Maj Aaron Burciaga (USMCR), CAP, MORS Director and Education and Professional Development Chair

The opportunities of a data-driven world have captured the imagination and savvy of businesspersons. Big data is in vogue. It is fueling a new era of business decisions inextricably tied to facts. Analytics increasingly exist by mandate (Kiron, 2014) and offer promises from Vegas to Bethesda—from predicting sports scores (Lewis, 2003) to sleuthing cures to cancer (Helft, 2014).

What kind of analyst will you be? How will you approach the analytic challenges of the Big Data era? We should seek to be, and prefer to work with, experts in the fields of analytics. Education and experience are the hallmarks of such experts. Certification can be a useful tool and an important credential that is also the formal recognition of professional attunement. A credentialed workforce grows to be the chorus of true analytics professionals that supplant corporate pitches, salesmanship, and less-than-thoughtful delivery.

A credentialed workforce grows to be the chorus of true analytics professionals that supplant corporate pitches, salesmanship, and less-than-thoughtful delivery.

There is a clear need to identify and retain the analytic services of professionals who have the knowledge, experience, and discipline to lead data analytics projects. The Institute for Operations Research and the Management Sciences (INFORMS) has designed a Certified Analytics Professional program that aligns with MORS' disciplined approach to excellence in operations research. The CAP® reflects important elements of MORS' analytic method and other best practices. During the 82nd Symposium in June 2014, MORS leaned forward to partner with INFORMS to provide the Department of Defense (DoD) and its partners with an opportunity to be among early adopters by taking the INFORMS Certified Analytics Professional (CAP®) exam at a discounted rate. Shortly thereafter, CIO magazine named the CAP® as the "#1 Big Data certification" (Olavsrud, 2014) (Note: A total of 16 MORS members took the exam at either the symposium or the 2014 EPD Colloquium. Based on reported employers of CAP certificants, about 20 work for one of the military Services. Given that there are about 50 CAPs in the Washington,

NOTE

Under the theme of "Analytics Rising," topics have been selected for upcoming issues and guest contributors have been asked to assist in developing the content to ensure coverage and perspective. As we share , provoke, and facilitate information, conversation, and action regarding the professional development throughout our ranks, we will enhance the quality of operations research within our community.

Table 1. CAP® Experience and Education Requirement

Education Level	Field of Study	Experience Required
Masters, PhD	Analytics-related area	3 years
Bachelors	Analytics-related area	5 years
Bachelors	Non-related area	7 years

Table 2. CAP® Seven Domains in the Job Task Analysis

Domain	Weight
Business Problem Framing	12-18%
Analytics Problem Framing	14-20%
Data	18-26%
Methodology (Approach) Selection	12-18%
Model Building	13-19%
Deployment	7-11%
Model Lifecycle Maintenance	4-8%

DC area, there are likely others working for contractors in the defense industry.)

Because *Phalanx* is a joint publication of the Military Operations Research Society (MORS) and the INFORMS Military Applications Society (MAS), we provide a short overview of INFORMS CAP® and activities that may be of interest to members of both organizations.

The Five Es

To understand the value certifications such as the CAP® offer the DoD, we'll discuss the five components of the CAP®, commonly referred to as the five Es: Education, Experience, Exam, Effectiveness, and Ethics. Although much of the focus from candidates is understandably on the exam, which will be discussed in detail shortly, the other components are equally important and will be highlighted first.

First, the eligibility requirements for CAP include a combination of experience and education, as shown in Table 1. The term "analytics-related area" for field of study is relatively broad, and includes, but is not limited to, analytics, operations research, management science, statistics, engineering, business (marketing, finance, etc.), theoretical or applied mathematics, information technology, computer science, and decision science. Applicants are required to provide a copy of their transcripts to INFORMS as part of the application process.

Additionally, there is a requirement for the verification of effectiveness of soft skills by a current or former employer or client. The CAP doesn't just attest to an analytics professional's technical knowledge, it also includes confirmation of the ability to communicate and be effective throughout the analytics process. Finally, certificants must agree to a code of ethics, which was highlighted in a recent *CIO* magazine article (Pratt, 2014).

The CAP is not designed for new analysts just out of college, but rather, an early-to-mid-career analytics practitioner. The exam is practice-based, which means that many of the skills and much of knowledge tested requires practical, and not just classroom-based, learning. It is 3 hours long and consists of 100 multiple-choice questions, based on typical tasks performed and knowledge applied by analytics professionals. A four-function calculator is provided, so obviously the calculations are not too demanding, even if the concepts tested are challenging. In general, those who have taken the exam (about 250, with a passing rate of roughly 70 percent) describe it as being "tough, but fair." Very few examinees finish in less than 2 hours, but most are not there for the entire time allowed.

Seven Domains

The tasks and knowledge statements are organized into seven domains in the Job Task Analysis (JTA), an analytics body of knowledge outline. As shown in Table 2, the JTA covers the entire analytic lifecycle, starting with the problem, working through the data, and finishing with model deployment and monitoring, thus addressing the challenges of real-world problems. It tests all domains a cogent analytics professional should master. The weight range next to each domain helps to assess each domain, and represents the percentage (and number) of questions in each area on any form of the exam.

The INFORMS CAP® Candidate Handbook (available online at www.informs.org/certification, along with other information about the CAP program) contains a short,

24-question sample exam to give those who may be interested an idea of what to expect. Additionally, INFORMS provides a study guide that is useful in preparing for the exam. It can be downloaded online as a PDF, or you can order a paper copy for the cost of printing and mailing.

Continued Education

Once initial muster is passed on the five Es and CAP certification is earned, it is valid for three years. To maintain the certification, a total of 30 professional development units (PDUs) are required during the 3-year period. There are a variety of ways to earn PDUs—for example, as a student in formal analytics-related education/training programs, potentially including those offered by MORS (a minimum of 8 hours); self-directed learning (a maximum of 10 hours); creating new analytics knowledge or content, such as writing an article for *Phalanx* or Military Operations Research, or serving as faculty at learning events and other volunteer service (a maximum of 10 hours); and working as an analytics professional (a maximum 15 hours). As you can see, CAP is a well-rounded program of continuous professional development, not just a one-time event.

The INFORMS CAP(R) Candidate handbook as well other information about the CAP program is available at www.informs.org/certification.

Conclusion

The era of Big Data Analytics motivates our Services to seek better decisions from better information. Better information requires better analytics. Better analytics requires better analytics professionals. Certifications, such as the INFORMS CAP®, help identify best analytics professionals—those who possess the education, experience, effectiveness, and ethics to lead and deliver the methods, models, tools, and systems that should characterize world-class analytics in defense and security of our nation.

Consider distinguishing yourself to stand a bit taller and apart from speculators, salesmanship, and less-than-thoughtful delivery. By helping MORS raise the bar for analytic excellence, you have the opportunity to ensure a bright future for yourself and the MORS community.

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About the Authors

Scott Nestler, PhD, CAP®, PStat® is a transitioning Army operations research analyst, who also serves as Chair of the INFORMS Analytics Certification Board (ACB).

Aaron Burciaga, CAP®, is an advanced analytics executive for a commercial management consulting firm and also serves as reserve Marine officer supporting CIO Headquarters Marine Corps-Pentagon. His technical interests are at the crossroads of advanced analytics, global logistics, and information management (big data). He has an MS in operations research from the Naval Postgraduate School and a BS from the United States Naval Academy.

SAVE THE DATE

Finally, save the date for the 2015 EPD Colloquium, , March 9-10 at George Mason University, Fairfax, Virginia. Mr. Chuck Werchado, SES, Deputy Director OPNAV N81, will give the colloquium's keynote. Colloquium chair is Darryl Ahner (EPD Cochair). Registration details and other event information will be shared in the next issue of the Phalanx.

2014 MORS Awards and Prizes

MORS Awards

The six MORS awards are the MORS Lifetime Achievement Award, the Wayne P. Hughes Junior Analyst Award, the Clayton J. Thomas Award, the Vance R. Wanner Memorial Award, the John K. Walker, Jr. Award, and the MOR Journal Award.

The MORS Lifetime Achievement Award recognizes those who are approaching the end of a professional career that includes or incorporates a lifetime involvement with and outstanding contributions to the analytical community and MORS.

The *Wayne P. Hughes Junior Analyst Award* recognizes a young operations research analyst who has demonstrated excellence in national security operations research.

The *Clayton J. Thomas Award* recognizes an individual who has, through his or her involvement in the field of national security operations research, exhibited sustained outstanding individual performance and contributions, shared knowledge and talents with others in the field, and provided technically sound options to national security decision-makers.

The *Vance R. Wanner Memorial Award* recognizes a national security operations research professional who has played a major role in strengthening the profession. Winners have distinguished service over time to the profession of national security operations research and have demonstrated sustained excellence as leaders and managers in the conduct of national security operations research, resulting in significant contributions to the security of our nation.

The *John K. Walker, Jr. Award* acknowledges the author(s) of the best technical article published in *Phalanx*, the Bulletin of Military Operations Research.

The *MOR Journal Award* recognizes the author(s) of the best article in *Military Operations Research* (MOR Journal).

The Walker and MOR Journal Awards are based on article submissions. Those wishing to be considered for these awards must submit articles for publication in the *Phalanx* or *Military Operations Research* (MOR Journal). The MORS Lifetime Achievement Award can be presented at any time during the year, includes a special article in the *Phalanx*, and requires initial personal contact with the MORS Executive Council to discuss the nominee. The Thomas, Wanner, and Hughes Awards focus on exceptional contributions to the profession over an extended period of time and require nominations. MORS provides the nomination packets on its website (http://www.mors.org/recognize_excellence/default.aspx). To recommend members of our Society, MORS encourages you to visit the MORS website for nomination packets. The deadline for submission for the 2014 awards is March 1, 2015.

Each year, an important focus of MORS is its efforts to promote and recognize exceptionally outstanding professionals in the national security operations research community. In addition to valuable opportunities available to present work at its special meetings, symposiums, and colloqui, the Society sponsors six awards and two prizes that span the many ways an individual can contribute to the advancement of the analytical profession, the national security decision-making processes, and the Society.

To be eligible for recognition, the Society provides two approaches. One involves documenting your work and submitting it for presentation at the annual MORS Symposium or publication in the Society's periodicals (*Phalanx* and *Military Operations Research* journal). Alternatively, MORS provides those who wish to recognize the achievements of their mentors, peers, or subordinates an avenue to recognize contributions through the nomination process.

MORS Awards provide avenues for the recognition of young analysts who have impacted their organization positively, and also for spotlighting distinguished stalwarts of national security analysis over years of dedicated service. MORS prizes address research projects by groups and individuals as presented

in our professional publications and at the Society's annual symposium. Previous winners of MORS awards and prizes can be found on the MORS website at www.mors.org/recognize_excellence/default.aspx. In addition, each year's winners are listed in the September edition of *Phalanx*.

The executive committee, the directors, and the members of MORS encourage you to consider taking the opportunity to recognize those who have gone the extra mile for our professional community and the security of our nation through their exceptional national security analytical contributions. For more information regarding MORS prize or awards, please visit the MORS website (www.mors.org). Click on the link labeled "Recognize Excellence" and follow to the prize/award sublink of your choice. If you have additional MORS prize or awards questions, please contact Awards Committee Chairman Dr. Arch Turner (arch.turn@gmail.com) for awards and Prize Committee Chairman Joe Adams (jadams@ida.org) for prizes. You can also contact Liz Marriott (liz.marriott@mors.org) at the MORS Office at (703) 933-9070 for further information and links.

MORS Prizes

The Society also annually presents two highly coveted prizes for work presented in conjunction with the MORS annual symposium: the Rist Prize and the Barchi Prize.

The Rist Prize, named after David Rist (an early director) and first presented in 1965, recognizes outstanding analytical studies leading to important implemented applications. The award's criteria include originality and ingenuity, as well as the importance of the problem and the impact of the solution. Nominations are solicited from US Government agencies or contractors and must include a three-page abstract and a letter from a senior (flag, Senior Executive Service, or private sector equivalent) government or industry study sponsor documenting the value of the implemented solution. During the 83rd MORS Symposium, a panel of MORS Fellows and Sponsors will judge finalists. A cash award is given to the first and second prize winners. Nominations are due February 6, 2015. The first place winner will also give an encore presentation at the 83rd MORSS. Nomination packets can be found on the MORS David Rist Prize website (http://www.mors.org/recognize_excellence/david_rist_prize.aspx).

The Richard H. Barchi Prize, named in honor of CDR Richard H. Barchi, USN, a former director, and first presented in 1983, is awarded to recognize the best paper presented at the last MORS Symposium. It rewards methodological advances as well as groundbreaking applications. The 82nd Symposium Working Group, Composite Group, and Special Session chairs nominated presentations for the 2015 award. Nominees have been notified and asked to submit a full paper by the January 6, 2015 deadline. A panel comprised of MORS Board Members and outside experts will judge the papers. The winner(s) will be announced at the 83rd MORS Symposium and will give an encore presentation of the work during the Symposium.

Other MORS Opportunities for Recognition

MORS provides a major commitment to its future—the young analyst. Along with other initiatives, MORS sponsors special awards and competitions in this area.

A prized feature of the MORS Education and Professional Development (EPD) Colloquium, the *Richard E. Rosenthal Student Competition* uses a "quick reaction analysis" approach. Students at the colloquium are randomly teamed up to work on an OR problem together. They are provided a problem set and have five hours to resolve the challenges in that set. On the last day of the Colloquium, each team presents the results of their efforts to a judging panel in an open forum. The winning team receives a special recognition by the Society and each member of the winning team receives an award.

The *Tisdale Graduate Research Prize* recognizes the outstanding performance of an operations research student in the graduating class at the Naval Postgraduate School (NPS). The OR faculty at NPS establish the specific standards for the prize and select the winner for each class.

The *Dr. James T. Moore Graduate Research Prize* provides a graduating OR student at the Air Force Institute of Technology (AFIT) a similar opportunity for recognizing his or her outstanding work. The operational sciences faculty at AFIT establishes the specific standards for the prize and selects the winner for each class.

BE A PART OF THE ANALYTICS REVOLUTION!

Join the World of Certified Analytics Professionals (CAP®)

CAP informs

Top 5 Reasons to Become Certified

1. Certification demonstrates commitment to a profession. Earning a CAP® credential shows your peers, supervisors, clients, and the general public your commitment to analytics and your ability to perform to accepted standards.

2. Certification enhances the profession. CAP® exists to grow, promote, and develop analytics professionals and ensures the public that analytics is a true, time-honored profession.

3. Certification reflects personal achievement. Earning your CAP® shows the world you will not stop learning and will continuously improve your performance in analytics.

4. Certification establishes professional credentials. CAP® recognizes an individual's accomplishment and stands out on an individual's resume or a company's prospectus.

5. Certification improves career opportunities and advancement. CAP® is a clear identifier of those who seek knowledge of changes in the work, technology, business practices, and innovation.

6. BONUS REASON: Studies show that those who hold a professional certification like CAP® earn more over their career than peers who are not certified!

Set Yourself Apart. Join the Analytics Revolution. Become a CAP® Now.

Email us at certification@informs.org with any questions you may have.

Evidence-Based Decision Making

Techniques for Adding Rigor to Decision Support Processes in Complex Government and Industrial Organizations

Dr. Chris Hase, Dr. Rafael Matos, and Mr. Don Styer, Whitney, Bradley and Brown Inc., chase@wbbinc.com, rmatos@wbbinc.com, dstyer@wbbinc.com

Government and industry organizations today are under increased pressure to respond to rapidly changing conditions. Managers must make complex, expensive decisions, riddled with risk and uncertainty. Evidence-based decision making (EbDM) provides results where organizations need to make better-informed decisions, faster. Through the use of collaboration, mathematical, and organizational behavior tools, EbDM combines several technologies and disciplines that add rigor to the decision support process through an emphasis on refining the objective, finding evidence, analysis, visualization, and a taking action framework. From heuristics and optimization to simulation and predictive models, computer-based techniques provided traceable, repeatable methodologies that assist organizations in decision support. Our approach to decision-making support, EbDM, provides empirical and parametric evidence showing how modeling and simulation can provide faster, more accurate reporting, improved decision making, improved customer service, and reduced costs.

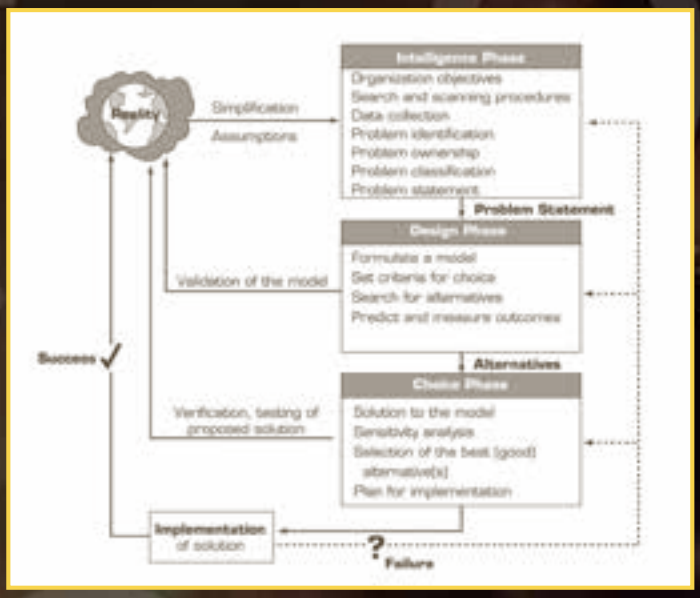
The Art of Decision Making

"Decision making is a process of choosing among two or more alternative courses of action for the purpose of attaining one or more goals" (Turban et al., 2011, 41). In Mintzberg's (1980) foundational research on managerial work, decision making was one of the top 10 responsibilities of managers in the daily performance of their work. Making decisions is part of every phase of an operation, from organizing, planning, executing, and controlling, to closing or completing actions. According to Simon (1977), managerial

decision making is synonymous with the entire management process. Once thought of as an art acquired through years of experience and using one's intuition, decision making in organizations today is far more complex, requiring institutional processes to be able to track, replicate, and defend the who, what, where, and why decisions were made to stakeholders and regulators alike.

Simon identified four phases of the decision-making process; intelligence, design, choice, and implementation (1977). Figure 1 (Turban et al., 2011, 46) provides a representation of those decision-making phases. The decision-making process begins with the intelligence phase. This phase examines the organizational objectives surrounding the decision, initiates problem identification, ownership, and classification. A clearly defined problem statement is an output of the intelligence phase. The design phase is characterized by formulating a model that captures elements of the problem and its relationship to attributes in the system from which it operates. The design phase concludes with potential alternatives that meet the criteria of solving the problem. The choice phase includes examining the alternatives through qualitative and quantitative analysis leading to a proposed solution. The final phase includes implementation of the solution. If implementation is successful, the organization moves forward on to other issues. If implementation is not successful, the decision-making process is returned to an earlier phase to repeat the process.

Figure 1. Decision-making model.



Turban (2011) identified three conditions under which conditions are made. These include decision making under conditions of certainty, uncertainty, and risk. "In decision making under certainty, it is assumed that complete knowledge is available so that the decision maker knows exactly what the outcome of each course of action will be (as in a deterministic environment)" (Turban et al., 2011, 148). In this environment, modeling and simulation have a limited role since the decision maker has all the information he or she needs. There are some conditions that are rule based and automated decision systems can be employed. The second environment in which decisions are made are under conditions of uncertainty. There are several outcomes for each choice and there is usually

insufficient information for the decision maker. Modeling and simulations are key tools that can be used to equip decision makers with the information they seek. Finally there, is decision making under risk, wherein "the decision maker must consider several possible outcomes for each alternative, each with a given probability of occurrence" (Turban et al., 2011, 149). This environment is also ripe for analytic tools that include modeling and simulations.

Framework for Business Intelligence

The concept of business intelligence (BI) has gained acceptance as an information system that contains all of the data an executive needs. Indeed, BI is linked to decision making but a BI system is not a decision system in and of itself. BI is relevant in decision support since it is viewed as an overarching term that includes architectures, tools, databases, applications, as well as methodologies (Turban et al., 2008). BI is based on the concept of transforming data into information from which decisions are made and actions taken. This is done through interactive access to data and real-time data manipulation. BI contains four major components as part of its architecture: a data warehouse, analytical tools, a performance management system for analyzing performance, and a user interface.

According to Thompson (2004), BI is most commonly seen being used in general reporting, sales and marketing analysis, planning and forecasting, financial consolidation, budgeting, profitability analysis, and statutory reporting.

The main benefits of BI are to provide accurate information when needed. Thompson (2004) reported four key benefits of BI systems:

- Faster, more accurate reporting
- Improved decision making
- Improved customer service
- Increased revenue

Traditional BI applications are, too often, large monolithic infrastructures that are inflexible and reliant on an information technology department. These systems often answer only predefined questions, denying the user the ability to satisfy their curiosity and drill down or look across the data in order to answer questions. The focus is too often on data alone, and not on how the data relates to the vision, mission, strategy, operational readiness requirements, and current decision processes. As processes evolve, these systems do not offer users insight to the data in a manner that supports their evolved responsibilities or the revised metrics. If the processes change, if the decisions being supported change, or if the answers suggest additional questions to the user, the business intelligence capability has typically not had the ability to quickly adapt. The inability of the analyst to explore and ask additional questions of the data leads to frustration and does not effectively support a dynamic decision-making process.

Decision Support Systems

In assisting the decision maker, decision support systems (DSS) "were meant to be adjuncts . . . extending their (the decision makers' capabilities but not replacing their judgment." (Turban et al., 2011, 75). Scott-Morton described the major concepts of a DSS in the early 1970s by describing them as "interactive computer-based systems, which help decision makers utilize data and models to solve unstructured problems" (Gorry and Scott-Morton, 1971, 55). Yet others provided many other definitions of a DSS, leading to the conclusion that there is no universally accepted definition of a decision-support system (Alter, 1980; Bonczek et al., 1980; Keen, 1980; and Little, 1970). However, there is general consensus on key characteristics that can be found in a DSS, as shown in Figure 2 (Turban et al., 2011, 77). Power (2002) proposed six classification schemes for DSS that have since been adopted by the Association for Information Systems Special Interest Group for Decision Support, Knowledge and Data Management Systems (AIS SIGDSS):

- Communications driven
- Data driven
- Document driven
- Knowledge driven
- Model driven
- Compound system (integrates two or more DSS groups)

Figure 2 shows key characteristics that not only comprise DSS but BI systems as well. This intersection of DSS and BI systems lends itself to a set of tools and techniques that define business analytics. It is in this arena that computer modeling and simulation can yield the greatest benefits. These benefits include (Turban et al., 2011, 45):

- Manipulating a model (changing decision variables or the environment) is much easier than manipulating a real system. Experimentation is easier and does not interfere with the organization's daily operations.
- Models enable the compression of time. Years of operations can be simulated in minutes or seconds of computer time.
- The cost of modeling analysis is much lower than the cost of a similar experiment conducted on

a real system.

- The cost of making mistakes during a trial-and-error experiment is much lower when models are used.
- The business environment involves considerable uncertainty. With modeling, a manager can estimate the risks resulting from specific actions.
- Mathematical models enable the analysis of a very large, sometimes infinite, number of possible solutions. Even in simple problems, managers often have a large number of alternatives from which to choose.
- Models enhance and reinforce learning and training.
- Models and solution methods are readily available on the Web.

Evidence-Based Decision Making

Today, leaders and key personnel need to be empowered to explore and discover insights from the data, solve problems, and ultimately make informed decisions in a dynamic environment. DSS and BI systems provide an excellent foundation for constructing a framework that is traceable, repeatable, and defendable, yet flexible enough to adapt to changing customer needs. Building on the methodologies and technologies of DSS and BI systems, we designed EbDM, a scientific-based approach and tool set designed to provide our customer's needs. There are five elements of EbDM that are supported by business discovery applications (see Figure 3) that are repeated through a series of sprints (see Figure 4) until decision makers are satisfied that their objectives have been met.

EbDM Element 1: Refine Objective

The first element, refine the objective, begins with an understanding of the objectives of the decision-making process, the strategic context within how it fits in the organization and the desired end result. It is essential to link organizational data to the most important drivers of value and performance. Decision makers must be able to describe they key questions to be resolved, from which key performance indicators (KPIs) are developed. This in turn informs the main hypothesis, relevant metrics, and the data collection plan.

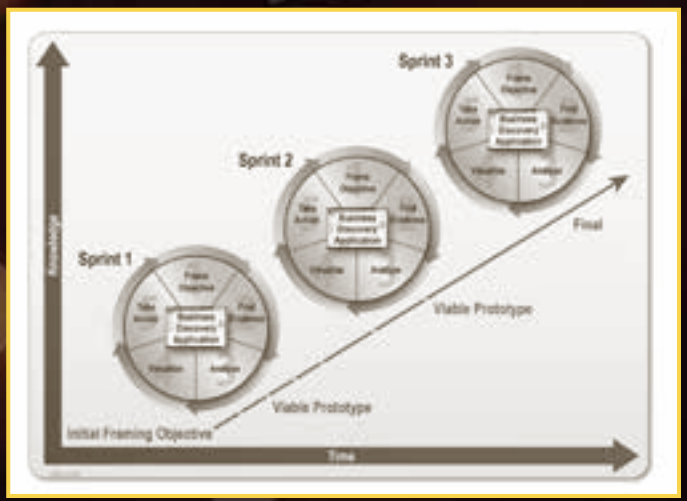
EbDM Element 2: Find Evidence

The second element in an EbDM approach considers finding the right evidence necessary to guide sound decision making. Selecting only the appropriate data critical to addressing the key questions is pivotal to finding the right evidence. By understanding the KPIs, organizations can quickly sift through large amounts of data and focus only on relevant information. Collecting and integrating relevant evidence is not just limited to quantitative data (numerical data) but also qualitative data (judgment information that provides context). Evidence comes in multiple forms that provide context such as numbers, sounds, text, graphics, and pictures. Business discovery applications such as database management systems (DBMS), online analytical processing (OLAP) tools, performance management (BPM/CPM) systems, and group support systems (GSS) are often

Figure 2. Key characteristics of a decision support system.

Figure 3. Five elements of evidence-based decision making.

Figure 4. Employing lean startup methodologies with EbDM.



used here.

EbDM Element 3: Analyze

The third element, analyze, focuses on transforming critical data into actionable knowledge. Many organizations are so focused on the collection and distribution of data that there is little effort placed on meaningful analysis. To overcome these shortfalls a rigorous methodology that includes discovery, diagnoses, prescription and prediction is needed.

Discovery. The analysis starts with developing a complete understanding of the descriptive nature of the data. This builds insights that identify statistical associations among events or observations and help to confirm causal relationships. Looking at the data from different perspectives proves or disproves hypotheses generated during the framing and evidence gathering. The exploration allows for the identification of hidden trends and/or gaps in the data. Discovery is an iterative process of continuous profiling (what it is, who it belongs to, where it is used) and validating (identification and mitigation of flaws) the data.

Diagnoses. The key analytics questions and KPIs provide the foundation of the diagnostics analysis. Through the use of business discovery applications, such as optimization models, mathematical programming, trend analysis, and forecasting, a higher degree of analytics can be achieved. This enables the team to quickly drill into root causes and identify/implement appropriate business rules, algorithms, and mathematical models.

Prescription. Reports and queries are performed against databases to address decision makers' questions and produce prescriptive recommendations. Given the growth of data and the shortened decision cycle time, KPIs are programmed into a business discovery dashboard. This enables the analysts and decision makers to rapidly identify the issues, refine their questions, and develop the necessary information.

Prediction. Data is transformed for use in predictive models and integrated into the business discovery platform. The predictive models are used in trend analysis to generate forecasts with well-characterized accuracies about the future or diagnoses. Such forecasts or diagnoses can be harnessed within procedures that generate recommendations to the analyst on how to react to what the data represents. The cycle of data-prediction-action provides a pervasive decision support capability engendering decision confidence.

The key to EbDM is the ability to rapidly provide a pervasive analytical delivery mechanism enabling a whole new level of analysis, insight, and value to existing data stores with user interfaces that are clean, simple, and straightforward. Using a business discovery platform simplifies the analysis using a variety of user driven interactive and intuitive presentations. The dashboard becomes the "glue" to conducting descriptive, diagnostic, prescriptive, and predictive analysis.

Element 4: Visualize

It is crucial, when analyzing data, to keep the target audiences and their specific needs in mind. EbDM is only fully effective when the right information is delivered to the right people at the right time. Business discovery tools include geographical information systems (GIS), informational portals, multidimensional presentations, and dashboards.

Throughout the previous steps, stakeholders, analysts, and decision makers were identified who interact with the data. The basis for the design of the interactive user interface comes from the decision process models and use cases. This provides context to what will follow and ensures that the charts, graphs, and tables are focused squarely on meeting a critical information need of the target audience. This avoids the trap of focusing on "interesting" rather than "valuable" information.

In traditional models that follow a linear path of analysis, presentation, and decision maker feedback, time is wasted between receiving decision maker feedback and cycling back through analysis and presentation to provide answers to the decision maker's previous questions. In a visualization model that uses adaptive dashboard techniques, the linear model is replaced with a circular model where the decision maker is part of the analysis visualization cycle and instead of waiting for feedback from the decision maker, supporting analysts are more apt to move directly into the "take action" element of EbDM.

Sometimes, decisions must be made under conditions of risk, when there are multiple outcomes each with its own probability distribution function. Or, sometimes there is just insufficient information to make a decision and the data does not exist that can help inform the decision maker. In situations like these, a different approach must be taken to assist the decision maker. One methodology designed for situations like these, called Lean Startup, was developed by Eric Ries (2011). Lean Startup was initially developed for technology-

driven startup companies but has been adapted to industry in general faced with the need to make decisions with less than ideal information. Lean Startup aims to shorten product development cycles by adopting a combination of business-hypothesis-driven experimentation, iterative product releases, and validated learning principles. Applying a Lean Startup methodology to EbDM produces a series of repeated cycles or sprints that each produce a viable prototype and build on lessons learned from earlier efforts (see Figure 4). Users, stakeholders, and decision makers work closely to discover, validate, improve, and pivot, if necessary, throughout each iteration. This drives immediate value and gives stakeholders control over the outcome. The intent is to capture inputs early by starting small, incorporating user collaboration, and then building incremental capability. The process focuses on critical decisions, processes, required data, and KPIs.

EbDM Element 5: Take Action

Adoption of EbDM enabled by a business discovery application provides widespread analytical capabilities across an organization, allowing it to exploit fleeting opportunities in a budget-constrained environment. However, streamlining decision processes often requires active change management that builds successful practices into the beliefs and culture of an organization, enabling faster and more effective reactions to external events. As described in the visualization element, effective use of dashboards depends on using the right business discovery tools and incorporating the correct KPIs and analytics to deliver the information decision makers need to develop a knowledge base sound enough to make a traceable, repeatable, defendable decision. Sometimes this can occur in one event. Alternatively, discovery is made and a different prototype of the model must be developed to address different questions and KPIs. Figure 4 captures this iterative process of building on discovery through the use of repetitive prototypes, each designed to provide decision makers with the knowledge base they require. Business discovery applications that commonly use this element include multicriteria decision making with pairwise comparisons and analytic hierarchy process (AHP) techniques.

Conclusion

EbDM enables government and industry leaders to rapidly achieve a cross-functional advanced analytic capability. This methodology is scientific and aligns data collection to strategic value drivers, and collects the best available evidence. This evidence is then used to extract valuable knowledge and sharing analytics in a way that allows all users to act on those insights. In short, the approach

- Provides evidence-based business discovery that lets users ask questions of data, thus effectively gaining insight from relevant data.
- Installs rapid access to multiple federated data sources to monitor, measure, and manage operational performance, resources, requirements, and project status, as well as the relationships and dependencies among them.
- Provides the analytical tools that support analysts and decision makers, giving them the ability to quickly discover and assess shortfalls in required data, support tradeoff decisions, and assess risk in near real time.
- Quickly collaborate across the organization by sharing content and filtered data, annotating elements, sharing snapshots of their data set, or sharing their session and enabling guests to actively make selections.

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Words from Yesteryear
Quotations, Enunciations and Sayings

Brian McEnany, FS, bmcenany@cox.net; and
Roy Rice, FS, Teledyne Brown Engineering, Roy.Rice@tbe.com

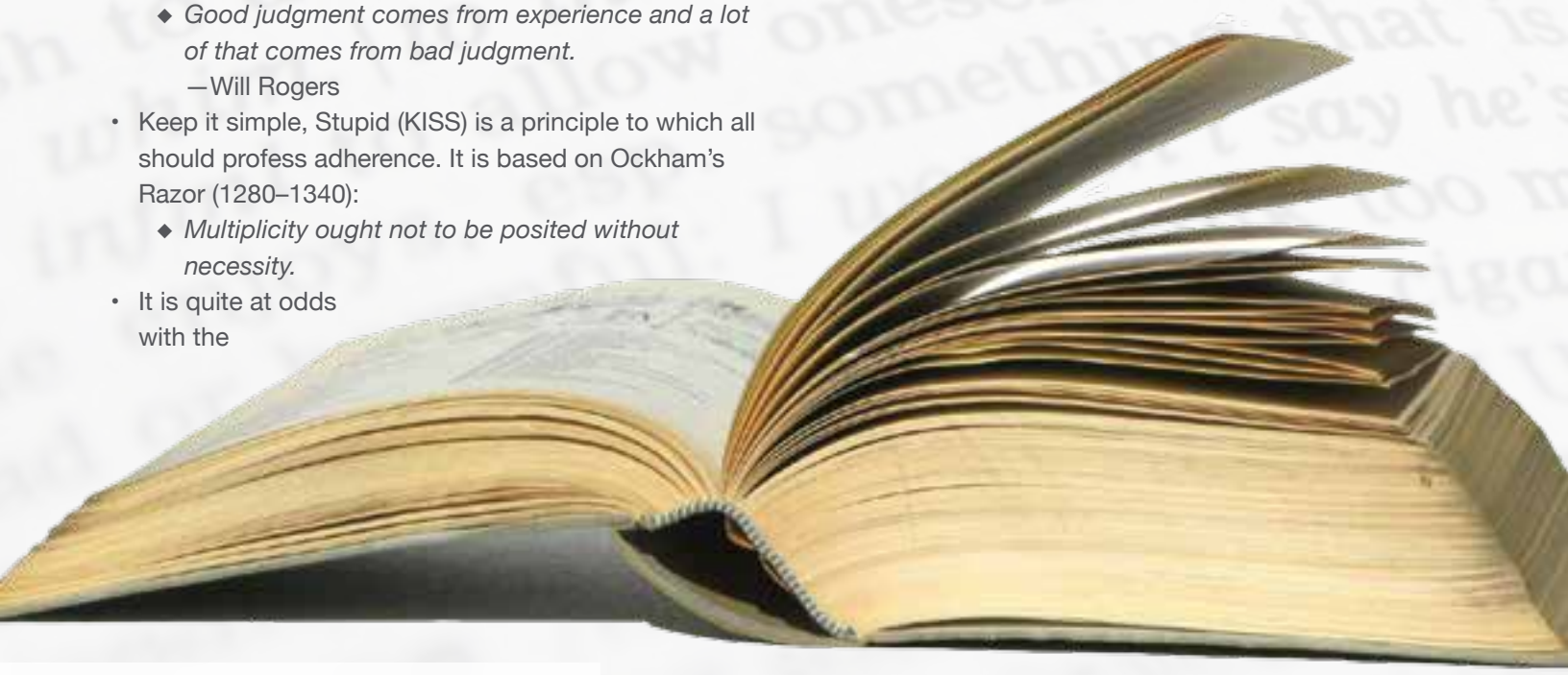
Several years ago, a group of us pulled together a series of sayings that were found in various operations research briefings, papers, and books and published it in the *Phalanx*. Most of those quotes had been used by OR analysts in various presentations over the years. We found that briefings tend to be boring and a little humor helps get things started sometimes. With a little help from the Fellows of the Society and colleagues, Roy and I offer the following update to our collections of OR sayings:

General Comments on Analysis and Research

These quotations were gathered from different projects and briefings. You should ensure their applicability before inserting them into your briefings. (Ignore them at your peril!)

The most important one of all that we must never forget is Murphy's Law: If something can go wrong—it will.

- Who is really an analyst:
  - *Sitting in a room where others run models no more makes you an analyst than sitting in your garage makes you a car.* —Dr. Kirk Yost
- How one gains experience:
  - *Good judgment comes from experience and a lot of that comes from bad judgment.*
    —Will Rogers
- Keep it simple, Stupid (KISS) is a principle to which all should profess adherence. It is based on Ockham's Razor (1280–1340):
  - *Multiplicity ought not to be posited without necessity.*
- It is quite at odds with the weight and heft of some study reports even as we try to explain the unexplainable. Our efforts, sometimes, can be related to a quotation from the Bible:
  - *Come let us go down and there, confuse their language that they may not understand one another's speech.*
    —Genesis 11:7 (Tower of Babel)
- On analysis:
  - *Look for the analogies and identify the similarities and, most particularly, the differences.*
    —Gene Visco, FS
- Study plans are not that dissimilar to military plans and one hears frequently that the military always invokes von Molke's quotation:



- *No plan survives contact with the enemy*.
  —Field Marshall von Molke
- During a Desert Storm briefing in 1992, General Schwarzkopf announced his corollary to von Molke principle: *A plan is liken to a director of an orchestra. It follows the score until some SOB comes out of the orchestra pit and chases the director around the stage with a bayonet.*

- As in all projects, costs and benefits must be weighed.
  - *Nullium gratuitum pradium—there is no free lunch.*
    —GEN Max Thurman

Data and the Use of Numbers

We deal with numbers and data as a matter of course in the analysis of studies, models, and simulations. Often, the mere "tweaking" of numbers causes results to vary widely—and not just because of sensitivity. Several of these sayings may be applicable where the acquisition of data and its conversion into numbers is a major part of the conduct of a study.

- Quantify, quantify, quantify:
  - *Measure what can be measured, and make measureable what cannot be measured.*
    —Galileo
- How much detail and fidelity:
  - *With four parameters I could fit an elephant, with five his trunk would wave.*
    —Poincare (French mathematician)
- What does the data tell us:
  - *Analysts torture data until it confesses.*
    —Vince Roske, J8 (now IDA)
  - *The one thing we expect from the bean-counters is an accurate count of the beans.*
    —Dave Hardison (DUSA, OR)
  - *If all else fails, get the facts.*
    —LTG Bill Richardson, former USA DCSOPS
  - *Gather the facts first, dispute them later.*
    —Mark Twain
- Importance of measurement:
  - *I often say that when you measure what you are speaking about, and express it in numbers, you know something about it, but if you cannot measure it when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind."*
    —Lord Kelvin, 1883
- *Precision of measurement:*
  It is the mark of an educated mind to rest satisfied with the degree of precision which the nature of the subject admits and not to seek exactness where only an approximation is possible.
  —Aristotle

It's better to be approximately right than precisely wrong.
—Anonymous

- Believability:
  - *There are three kinds of lies: lies, damned lies and statistics* —generally credited to Benjamin Disreali
- Predictions:
  - *Every missile on a drawing board has a Pk = 1.0.*
    —Dr. Roy Rice, FS
  - *The purpose of mathematical programming is insight, not numbers."* —Arthur Geoffrion, Interfaces Vol 7, No 1, 1976.

Models, Simulations, and Analysis

The use of M&S is often confused with analysis. Clayton Thomas, FS, once said that we should work toward having Big "A" and little "m&s." In other words, spend more time on analysis rather than just running models and simulations to get results.

- The use of models is too frequently equated with analysis:
  - *Models are for thinking with.* —Sir M.G. Kendall
  - *Models never perform analysis. Analysts do analysis.* —believed to be from Judy Grange and John Battilega
- On making models more user friendly:
  - *If you build a model that even idiots can use, rest assured, idiots will use it.*
    —Dr. Wilbur Payne (DUSA,OR)
- Assumptions and key factors:
  - *To omit such (soft) variables is equivalent to saying that they have zero effect—probably the only value that is known to be wrong.* —Forrester, 1961
  - *Or it's shorter version: To omit a factor is to assume that it is zero.* —Dr. Paul Davis
- Clayton Thomas referred to John Tukey with his words about models and simulations.
  - *All models are wrong; some are useful.*
- On verification and validation:
  - *There is no such thing as verification and validation of models. Models are "corroborated" and "calibrated."*
    —Dr. Wilbur Payne
    (DUSA, OR)
  - *VV&A is not a destination; it's a journey.*
    —Clayton Thomas
  - *Happiness is getting the same answer twice with a deterministic model.*
    —Brian McEnany, FS

- On cost models and cost analysis:
  - *When a technical analyst makes a presentation, everyone but the analyst believes the results. When a cost analyst makes a presentation, no one but the analyst believes the results.* —Anonymous

The Profession

We analysts sometimes have to look hard to find academic programs that foster operations research as a discipline nowadays. Sometimes, we look back to find a clear definition of what the profession is all about. OR definitions should not be limited to 140 characters. Here are a few we have gathered over time.

- Dr. Phillip M. Morse and George W. Kimball, two founding OR analysts who date to work undertaken during WWII, began their book Methods of Operations Research with the following words:
  - *Operations research is a scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control.* (p. 1)
- Prof Robert E. (Gene) Woolsey, at the Colorado School of Mines, stated at one point a pretty distinct definition:
  - *OR is the application of logic and mathematics to a real world problem in such a way that the method doesn't get in the way of common sense.*
- Organizations:
  - *We trained hard—but it seemed that every time we were beginning to form into teams, we would be reorganized. I would learn that later in life we tend to meet any new situation by reorganizing, and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralization.* —Petronius Arbiter, a Roman General, noted in 66 AD
- On the need for military decision leaders to study and reflect:
  - *The nation that will insist on drawing a broad distinction between the fighting man and the thinking man is liable to find its fighting done by fools and thinking done by cowards.* —Sir William Francis Butler, 19th Century British soldier and author
- Russell Ackoff, in his 1962 book, quoted Thomas Huxley, who stated that
  - *Science is, I believe, nothing but trained and organized common sense, differing from the latter only as a veteran may differ from a raw recruit: and its methods differ from those of common sense only so far as the guardsman cut and thrust differs from the manner in which a savage wields his club.*
- Paul Davis wrote in a recent Rand book about a new professional responsibility for analysts: Instead of merely listing assumptions, analysts should
  - *Routinely show how results vary with all key assumptions and disagreements—the opposite of focusing on a standardized case and perhaps running a few excursions,*
  - *Routinely assess options for FARness, showing he value of affordable hedges even in period of austerity when hedges may seem like luxuries,*
  - *Do the above comprehensibly to aid policy makers in converging on decisions and actions.*

Problems and Their Definitions

At the heart of every defense issue lies a real problem that may or may not be understood. It is our task as operations research analysts to understand it, define it, and determine the best approach to reach a solution. The task requires thinking that is not subject to Moore's Law.

All advocates focus on how important the problem definition is in any analytic study project. It is the first and most important step. Both Roy Rice, FS, and Andy Loerch, FS, have given presentations at past MORS symposia and education and professional development colloquia designed to focus attention on the importance of problem definition.

- Understanding the problem:
  - *If you do not know the problem, then you can't analyze or solve it.* —Priscilla Glasow, FS
- Danny Weil, a former MORS member, offered the following statement in 2001:
  - *Fifty percent of all problem solving is defining the problem.*
- Major General Dave Robinson (former J8) and Vince Roske, FS, have put the first step in more common terms. Both advocate the following:
  - *What is the question? What is the real question? What does the final slide look like? What do we know already? How do we get the missing data?* —MGEN Dave Robinson, Joint Staff/J8
- *It seems to be simple common sense, but in the process of defining the problem, other elements must be defined as well. This was captured by an anonymous Chinese philosopher many years ago:*
  - *The beginning of wisdom is to call things by their right names.*
- I added at one point that you must

- *Understand the problem first, and the method for its solution will more easily follow.*
  —Brian McEnany, FS

- The inimical Gene Woolsey, Colorado School of Mines, offered his view based on observation and studies he had conducted:
  - *A manager would rather live with a problem that he cannot solve than accept a solution that he cannot understand.*
- My own observation after dealing with defense issues for many years is that many are cyclic in nature. Analysts must research past attempts to ensure that their view of the problem is better than what was posited before.
  - *If we cannot remember the past, we shall be condemned to repeat it.*
    —George Santayana
  - *Every time history repeats itself the price goes up.*
    —Anonymous
  - *If we do not change the future we shall be compelled to endure it—and that could be worse.*
    —Alec Toffler
  - *What is past is prologue* —engraved over the entrance to the National Archives; Shakespeare; from *The Tempest,* Act II, Scene 1, lines 253–254

Project Management

The analytic process lays out the process and, most importantly, the analyst must spend time and energy on its first step. There are metrics dealing with theoretic timelines for the conduct of an analytic project—for example, the US Army Logistics Management Center at Fort Lee (1989) offered the following: "Forty percent of the time devoted to problem definition and front end analysis, twenty percent to crunching the numbers, and forty percent to examining the answers and packaging the results." Others advocate one-third, one-third, one-third to those same important events. Personally, I have advocated the importance of front-end analysis as a precursor to actual problem solution—as a means of concentrating effort on defining the real problem and selecting an appropriate analytic methodology to solve it. Then a second phase proceeds to the actual solution.

- Time well spent:
  - *Knowing (understanding) what the problem is in the first place is half the project time and reporting the results so that the intended audience understands the results and can act upon them is one third of the project. Analysis is only one sixth of the problem.* —Priscilla Glasow

- Although we do not advocate exceeding executive authority, E.B. Vandiver related that GEN Max Thurman once stated:
  - *While it is true that the meek shall inherit the earth, in the meantime, the bold will run it.*
    —GEN Max Thurman
  - *Max's Rule 13 was, When in charge take charge, and Rule 14 was, If no one is in charge, take charge.*
- An early ORSA practitioner, P.M.S. Blacket, once stated that, [T]hough the research workers should not have executive authority, they will certainly achieve more success if they act as if they had it. I mean by this that when an operational research worker comes to some conclusion that affects executive action, he should only recommend to the executives that the action should be taken if he himself is convinced that he would take the action, were he the executive authority.
  — Blackett provided this message in a variety of forms in a number of his essays after the war; this was one of the cumbersome ways he conveyed the message. From *"The Scope of Operational Research, 1950," Operational Research Quarterly,* Vol 1, No 1, Mar. 1950.

Reporting Results

Reporting results is a vital part of any analytic effort. You must provide the decision maker with information that informs him or her about the issue at hand. In most cases, it may generate more work to examine something that arises from the briefing—and more likely is due in a shorter time frame. As such, quotations and saying about reporting results were hard to come by. We offer the following:

- Results:
  - *A mediocre idea well-presented will be accepted faster than a great idea poorly presented.*
    —Dick Deckro, FS
  - *The very best analysis, poorly communicated, will have no effect.*
    —Greg Keethler
  - *A study not documented is a study not done.*
    —Anonymous
- Annie Patenaude tells us that Dave Hardison (former DUSA,OR) is reported to have said at the start of every Army Science Board study:
  - *Let's write up what we know, and then prove it wrong.*
    —Hardison

Then he would pull out a draft final report.

- Complexity of the report:
  - *One of the key problems of contemporary national security policy is the ever widening gap that has opened up between the sophistication of technical studies and the capacity of an already overworked leadership group to absorb their intricacy.*
    —Henry Kissinger preface to ES Quade (Rand R439 PR, pg. v)
  - Cy Stanick's experience with one project led him to offer that at the beginning the team stated: We are only one week away from success. A year later, the motto had changed slightly: We are only two weeks away from success.
- Study results are often placed in the realm of doomsayers and there is a Law of Doomsaying:
  - *Predict catastrophe no sooner than five years hence but not later than 10 years away. Make it soon enough to terrify but distant enough that people will forget if you are wrong.*
    —Gregg Easterbrook
- Humility in reporting
  - *Be kind, for everyone you meet is fighting a harder battle.*
    —Plato
- Phraseology:
  - *The difference between the all-most right word and the right word is . . . the difference between the lightning bug and the lightning.*
    —Mark Twain

Miscellaneous Quotes

These are to be applied as the reader sees fit.

- *Let us dare to read, think, speak, and write.*
  —John Adams, 1765
- *Reading maketh a full man; conference a ready man; and writing an exact man.*
  —Sir Francis Bacon
- *Artificial intelligence holds great promise—and always will.*
  —Clayton Thomas
- *The beginning of wisdom in operations analysis is that adequate data drives useful results of analysis.*
  —Wayne Hughes, Senior Fellow
- *Only the very strong, or those so weak that they do not chose to compete in terms of power, can enjoy the luxury of acting purely in the name of ideals; the others have to make their compromises.* —George Kennan, probably in the "Long Telegram"
- *The nation that will insist on drawing a broad distinction between the fighting man and the thinking man is liable to find its fighting done by fools and thinking done by cowards.*
  —Sir William Francis Butler, 19th Century British soldier and author.
- *There were gentlemen and there were seamen in the Navy of Charles II. But the seamen were not gentlemen, and the gentlemen were not seamen.*
  —Lord Thomas Babington Macauley
- *Don't go into the clutter alone. You won't come out.*
  —Captain Neil Byrne, Director Tactical Training Group Pacific, circa 1985
- The Wayne Hughes corollary: *The smallest tactical unit (at sea) is a pair.*

Final Thoughts

Roy and I wrote this article in hopes that some of its material can be used to improve the inevitable presentations of analytic findings and studies. As Roy stated in one of his many articles, old analysts sometimes offer advice to younger analysts in hopes they learn and do not make similar mistakes in their careers. These quotations, as stated earlier, should be used sparingly and only after understanding their underlying principles.

About the Authors

Brian McEnany is a former president of MORS (1994–1995) and a MORS Fellow (1999). He graduated from the United States Military Academy and attended graduate school in operations research and statistics at Rensselaer Polytechnic Institute. After several OR assignments with the Joint Staff, Army Programs, Analysis and Evaluation, and Cost Analysis, he retired from the Army and joined Science Applications International Corporation, where he rose to assistant vice president for technology. After a 34-year career as an OR analyst, he retired in 2005 and is now studying Civil War military operations. His book on the West Point Class of 1862 will be published in spring 2015.

Dr. Roy E. Rice graduated from the United States Air Force Academy and served in several key OR assignments with the Air Force. He was President of MORS from 2000 to 2001 and was elected a MORS Fellow in 2003. Dr. Rice was awarded the Barchi Prize twice (59th and 60th MORS Symposia, the Rist Prize (61st MORSS), the Walker Award (76th MORSS), and is a Wanner laureate from 2006. Dr. Rice was selected for the Air Force Analyst Lifetime Achievement Award in 2006. After retirement from the Air Force, Roy joined Teledyne Brown Engineering where he is the chief engineer.

Preparing for Contemporary Analytic Challenges

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The Iraq and Afghanistan wars of the past decade presented a number of highly complex topics for the Department of Defense (DoD) analysis community. Islamic terrorism, counterinsurgency, international development, and other nontraditional challenges left the community scrambling at times for methods and approaches to provide decision makers with insights on constantly evolving problems. As Operation Iraqi Freedom (OIF) came to a close and Operation Enduring Freedom (OEF) began to wind down, there was a brief moment when some believed that DoD would return to near-peer and conventionally oriented challenges. The resurgence of conflict in the Middle East has made it clear that this will not be the case. As if this were not enough, decision makers also face questions about unmanned systems, cyberwarfare, women in combat, shrinking budgets and force structure, military suicides, weapons of mass destruction, mass atrocity prevention, cultural awareness, sexual assault, kidnapped Nigerian schoolgirls, Ebola, and pivots to the Pacific—to name but a few of the current issues of interest.

A number of phrases are used to describe the nature of contemporary challenges: black swans, wicked problems, social messes, problems of the swamp, and complex systems (Taleb, 2010; Rosenhead, 1992; Ritchey, 2013; Snowden and Boone, 2007; Churchman, 1967). A complex system, for example, is dynamic with a whole that is greater than the sum of its parts. It has a large number of interacting elements, nonlinear interactions where minor changes produce disproportionate consequences, a history where elements evolve together, and external conditions and systems that constantly change. These are the types of challenges that DoD decision makers face today, and the analysis community must become skilled at offering insight and analysis on these types of problems.

The Hard Limits of "Hard" OR

Within the field of operations research (OR), the hard limitations of "hard OR" have been discussed now for several decades. There was concern from within the field, as early as the 1960s, that OR models were too narrow and failed to incorporate psychological and social factors (Kirby and Rosenhead, 2005). OR in the US and operational research in the UK during the 1950s and 1960s focused on "high ground" problems: finding technical solutions to "complex but well-defined" problems that were largely about efficiency (Rosenhead, 1992). Traditional OR was argued to be bested suited when: 1) an organization was very hierarchical; 2) few in the organization were analytically sophisticated; 3) there was a general consensus on priorities; and 4) the organization's activities were well defined, repetitive, and generated reliable data. Uncertainties were dealt with primarily as mathematical probabilities (Rosenhead, 1992). Traditional OR dealt well with routine functions such as logistics, forecasting, manpower planning, and project planning (Rosenhead, 2006). Even some of the best examples of OR success in World War II, such as U-boat searches, were relatively well-defined problems with agreed-upon priorities and available quantitative data.

Russell Ackoff, a professor of OR at Case Institute of Technology and then of management science at Wharton, and a former president of the Operations Research Society of America, was a prominent internal critic of OR by the late 1970s (Kirby and Rosenhead, 2005). Ackoff argued that whereas the nature of OR was driven by the nature of the problems it faced in the first two decades of its existence, it became technique driven rather than problem driven (Ackoff, 1979). As a consequence, the "problems that OR analysts dealt with were relegated to lower levels of corporate management" during the 1970s and 1980s, since OR "had little to contribute to strategic planning" (Ackoff, 1987). In fact, there was a "glass ceiling" for traditional OR that relegated it to "tame" problems (Rosenhead, 2006).

Jonathan Rosenhead, the chair of OR at the London School of Economics, wrote of the "internal crisis" in OR during the 1970s and 1980s over the limits of traditional OR. The difficult problems, those most vexing to an organization's top leadership, were messy social problems that defied technical solutions. They resisted easy characterization and there was uncertainty over what set of factors, at least for the moment, were at the core of the problem. Potential solutions had to take diverse interest groups, as well as technical feasibility, into consideration. For these "problems of the swamp," optimization-driven OR offered "no appropriate handle" (Rosenhead, 1992).

Alfred Brandstein, previously the Senior Executive Service (SES) senior analyst for the Marine Corps, appears to have seen this same relegation of OR to minor problems within DoD as well. In his 2004 MORS oral history, he argued that OR was used to justify decisions already made in DoD and that "Kabuki dance" came to mind:

"For minor decisions OR works great. The more important the decision is, the less a role that OR's going to play in that decision. And just think of any of the major decisions that have been made within [DoD]…in the last 10, 20 years…the higher the level military decision was, the less likely that OR plays a role. You want to know something about the logistics trade and how they get things quicker or faster from one place to another, then you use OR" (MORS, 2004).

These remarks were made a decade ago, and it is even less clear today what contributions OR has made to the most difficult problems during the past decade of war.

The Rise of "Soft" OR

Although US OR stayed the course on "high ground" problems, OR outside the US took a different track. Notably, Ackoff published his dissent with the field of OR in the British Journal of the Operational Research Society, and it was British OR that took up his challenge of dealing with wicked problems. Rosenhead remarked:

"The practitioner must choose. Shall he remain on the high ground where he can solve relatively unimportant problems according to prevailing standards of rigor, or shall he descend to the swamp of important problems and non-rigorous inquiry?" (Rosenhead, 1992).

In British OR, the solution came in the form of "soft OR," or problem structuring methods (PSMs) (Mingers, 2009). PSMs attempt to assist in analytic problems where there are multiple actors, differing perspectives, partially conflicting interests, significant intangibles, and high degrees of uncertainties (Churchman, 1967; Rosenhead, 2006). PSMs are structured but nonmathematical, and ultimately rely on the analyst helping to structure stakeholder and expert input. Examples include Checkland's Soft Systems Methodology (SSM), cognitive mapping, and the strategic choice approach (SCA) (Mingers, 2009).

NATO operational analysis (OA) adopted a similar approach, with its 2012 release of the *NATO Code of Best Practices for Judgement-Based Operational Analysis in Defence Decision Making* (NATO, 2012a). The code was awarded the 2013 NATO Science and Technology Organization (STO) Scientific Achievement Award. Judgment-based OA is sometimes referred to as "soft OA," and appears to be somewhat broader than the PSMs that were developed by British OR. The analyst document discusses the "soft OA" method and the analyst role in dealing with facilitators and experts. The selected list of judgment-based methods include SSM, SCA, and cognitive mapping; as well as causal mapping, influence diagrams, Delphi, analytic hierarchical process (AHP), scenario building, and hypergames, among others (NATO, 2012b). Although some of the techniques involve quantification, the commonalities of this large class of methods lie in the use of structured expert facilitation in order to get at the contours of extremely difficult problems.

This raises the issue of a new skill set that modern OR analysts require if they are to be successful at employing such methods: understanding and using expertise. There is literature on experts and expertise that discusses the types, limitations, and appropriate uses of expertise (Collins and Evans, 2007; Tetlock, 2006). There are also a number of practical considerations, such as the identification, recruitment, facilitation, and logistics of employing experts. It is beyond the scope of this short article to discuss these matters, but they are significant given the prominence that PSMs and judgment-based methods give to expert and stakeholder input.

Multidisciplinary: The Missing Piece

To address the complex contemporary challenges, the analysis community should once again become a more multidisciplinary community. The multidisciplinary roots of OR are often invoked but rarely replicated: two of the forefathers of American OR, Philip Morse and George Kimball, recruited operations researchers during World War II from physicists, chemists, mathematicians, biologists, psychologists, and economists

(Morse and Kimball, 1951). Returning to multidisciplinary OR, your grandfather's OR, is vital now for the community. As analytic challenges become more and more complex and begin to span multiple disciplines, there is an urgent need for the analysis community to be able to meaningfully access knowledge and methods from across disciplines in order to be relevant. Although this will not prevent the community from being surprised by new events and challenges, having diverse intellectual backgrounds among its members would allow it to start examining new challenges with a greater sum of collective knowledge.

Ackoff argued in 1979 that the rise of OR professional societies and OR academic programs effectively stripped OR of any vestiges of its multidisciplinary past, and that he shared in the blame as a previous head of an OR professional society and OR faculty member (Ackoff, 1979). Yet we have recent examples of what multidisciplinary reach can bring to the table. One 2009 RAND study, sponsored by Mr. Jim Bexfield at what was then the Office of the Secretary of Defense (OSD) Program Analysis & Evaluation (PA&E), evaluated the literature on terrorism across multiple fields of study (Davis and Cragin, 2009). The resulting report illustrates the multidisciplinary capability required even to review the existing research on a complex problem such as terrorism.

When asked during his MORS oral history whether the analysis community should be taking the multidisciplinary approach on one hand, or the OR curriculum approach on the other, Brandstein responded:

"Definitely multidisciplinary . . . . You need math. That's clear. And you need to have a liberal arts education perhaps in order to think. You may have one or two OR courses, but if you have the math you can pick up the rest. If you don't have the sociology background or human psychology background or at least know what's going on in those fields, it's much more difficult to pick up. That's the way our OR forefathers were" (MORS 2004).

Table 1. National Science Foundation (NSF) Survey of Earned Doctorates, 2012.

Field	Number of Subfields	Doctorates in 2012
Life sciences	81	12,045
Physical sciences	61	8,952
Psychology and social sciences	40	8,353
Engineering	30	8,427
Education	42	4,802
Humanities	49	5,503
Other	30	2,926

The 2012 results from the annual "Survey of Earned Doctorates" in Table 1 shows the number of major academic fields and subfields that exist in the US today. There are 333 listed subfields of study. Subtracting the three times that OR manages to be listed, this leaves 330 subfields outside of OR (NSF, 2012).

How many of these 330 other subfields can the analysis community meaningfully access? The current community has access to OR, statistics, applied math, and closely related fields, but is still extremely narrow in its overall range. Neither should the community dismiss humanities: they include Middle Eastern languages, Middle Eastern history, and religion. The last decade underscores their significance. The "other" field listed in the NSF table includes communications and management, subfields that are also helpful in the understanding of modern military operations. The spread of quantitative methods into a whole range of fields also makes it perfectly possible to hire analysts for the 1515 series from a vast number of subfields, while going well beyond the modest math and science requirements set for that occupational field.

At the same time, because of changes in higher education, there has never been a better time for the defense community to hire from a broad range of disciplines. The increasing number of PhDs, declining number of tenure-track faculty positions, and increasing numbers of adjuncts (estimated to be 70 percent of college instructors) has created a large number of highly educated individuals that could be recruited into the analysis community (June, 2014).

A Practical Example

Combining the multidisciplinary approach, methods developed for wicked problems, and a practical understanding of experts and expertise is not a hypothetical proposition. This has existed in areas such as management consulting and European defense analysis—in some cases for decades. Closer to home, the Marine Corps Operations

Analysis Division (OAD) used this exact recipe for the Joint Irregular Warfare Analytic Baseline (JIWAB) study. JIWAB was a three-year effort that departed from the modeling and simulation (M&S)-based approach that dominated irregular warfare (IW) in the analysis community during the height of the Iraq and Afghanistan wars. It was a response to Dr. George Akst's direction to OAD to find an alternative to the M&S-dominated methods used for conventional campaign modeling. Although developed outside the regular Support to Strategic Analyses (SSA) process, it produced an SSA-affiliated scenario, interagency CONOPS, wargames, and a set of capability analyses.

One JIWAB hallmark was a high level of collaboration from the very beginning with knowledgeable interagency participants, recognized regional experts, conflict experts, and skilled facilitators in the PSMs and other methods used in the study. Participants in the study came from five different Department of State (DoS) offices, five different US Agency for International Development (USAID) offices, US Department of Agriculture (USDA), US Institute of Peace (USIP), four separate nonuniversity research centers, three nongovernmental organizations (NGOs), faculty from 10 different universities, and a similarly lengthy list of DoD organizations.

However, simply being able to list a large number of outside participants is not the correct metric of success. The real test of meaningful collaboration is the extent to which outside participants also feel they gain from the process and the extent to which their input shape the final products. This often takes the form of requests for the study products, positive referrals from others in their organization who had previously participated, requests to disseminate study results to a broader audience, and feedback on their own new insights gained as a result of participating in the study. In JIWAB's case, this included requests from DoS and USAID for study products ahead of strategy and policy decisions for the geography in question.

Similarly, a study's analytic rigor or purported innovations are not self-assessed, but validated through the feedback and responses from those already recognized as experts in the methods used. The highest praise for JIWAB's analysis came from one methodology expert who said that the team had taken his method and "ratcheted up the rigor." Another, a wargaming expert, called a new proposed method of wargame analysis "a breakthrough" and JIWAB team members "pioneering." The professional PSM facilitators asked team members to coauthor papers, resulting in publications in peer-reviewed journals. The developer of another method who quietly adopted the adaptations that the team had made for JIWAB. In short, the mere adoption of new methods is not enough: there should be testimony of their skillful application by others who actively practice the methods.

Conclusion

The analysis community is facing an era of more and more complex analytic challenges. To stay relevant at a minimum and to thrive if conditions are right, there is a pressing need for the community to become more multidisciplinary, to adopt established methods from OR and other disciplines designed specifically for wicked problems, and to become deft at collaborating with a very wide range of experts. This would require an active strategy to acquire multidisciplinary capability, a deliberate effort to develop analyst skills in expert-driven methods, and conscious management of organizational cultures that gives subconscious, automatic primacy to traditional OR methods. To illustrate the power of organizational culture over professed mission statements: MORS in 2009 released a five-year plan stating that the society would no longer "limit topics to traditional operations research" but reach out to other disciplines (MORS, 2009). Yet it unfailingly awarded nine out of 10 Barchi and Rist prizes from 2009 to 2013 to analysts using traditional OR methods such as optimization, forecasting, and M&S.

Many challenges currently stand in the way of this proposed path: a community culture that defines analysis and analysts extremely narrowly, education pipelines and hiring practices that institutionalize a relatively few, dominant sources for new analysts rather than encouraging diversification of academic backgrounds, and the general risk-aversion that characterizes bureaucracies (Wilson, 1989). Bureaucracies are designed to resist innovation. When they do take on new tasks, such as the analysis of wicked problems using methods outside traditional OR, these are often seen as peripheral tasks. Yet real innovation happens when core tasks, rather than peripheral ones, change. The longer agencies exist, the harder and more costly it is to change their core tasks. This, noted the late political scientist James Q. Wilson, is why bureaucratic innovation is rare (Wilson, 1989).

The analysis community at this moment has an opportunity to take stock of its future and its past. It faces both a generational turnover in its ranks, and new pressures to show relevance in bringing analytic

insight to difficult problems. Can the pressures to adapt in meaningful ways overcome institutional inertia and the comfort of the familiar? Its choices now will set the tone for another generation of analysts.

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About the Author

Dr. Yuna Huh Wong is an operations research analyst at Marine Corps Operations Analysis Division (OAD). She was the methodology lead for the Joint Irregular Warfare Analytic Baseline (JIWAB) study. She is a previous the head of the MORS Social Science Community of Practice (CoP), and former chair of the MORS Social Science Methods and Applications working group. She holds a BS in political science and a BS in economics from MIT, an MA in political science from Columbia, and a PhD in policy analysis from the Pardee RAND Graduate School.

MORS Heritage Pages 2002–2005

As we continue the countdown to the 50th Anniversary of MORS, we would like to revisit our proud history and highlight the past leaders of the Society and key accomplishments over those years. Each edition of *Phalanx* will provide insight into several years of history. Enjoy reading about these individuals and what they have accomplished. More information on the Past Presidents (PP) can be found on the MORS website, including their oral histories.

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Significant Events

August 2002: MORS President, Edward Smyth, represented MORS at the 19th International Symposium of Military Operational Research (ISMOR) conducted at Eynsham Hall near Oxford, UK. In addition to briefing ISMOR on MORS activities an invitation was extended for ISMOR members to publish in *Phalanx* and to attend unclassified MORS special meetings.

September 2002: The MORS office moved from the Duke Street location to the office suite on N. Beauregard Street.

2002: MORS also gained permission from UK officials to republish a book entitled *Operational Research in the RAF* as another volume in the MORS Heritage Series of publications.

2002: The educational forum went "on the road" for the first time and was held at NPS with a number of West Coast civilian schools in attendance. Mike Garrambone served as the program chair for the event that featured a team competition for students in attendance.

2002–2003: Formed an ad hoc committee of the BoD under the leadership of Lana McGlynn to review the existing composite group/working group structure. Changes to the composite group/working group structure were implemented during the 72nd MORSS in 2004.

2002–2003: Implemented the sponsor hot topics segment of the annual symposium beginning with the 71st MORSS.

2003: Implemented the Sponsor's Corner in *Phalanx* in which the MORS sponsors wrote articles on various topics, starting with Jackie Henningsen in June 2003.

2003: During the 71st Plenary, MORS President signaled the need for MORS to engage with the then newly created Department of Homeland Security and to pursue that department as a potential MORS sponsor.

2005: MORS Executive Vice President, Brian Engler, represented MORS at the 22nd International Symposium of Military Operational Research (ISMOR) conducted at New Place, near Bishop Waltham, Hampshire, UK.

71st MORS Symposium, Marine Corps Base, Quantico, Virginia, June 10–12, 2003. *Military Operations Research for Tomorrow's Warrior.* Dr. Roy E. Rice, FS and Dr. Robert S. Sheldon, FS were inducted as Fellows of the Society. Natalie Crawford received the Wanner Award. Joseph Bolmarcich received the Thomas Award. Thomas Lucas and William Vinyard received the Walker Award. Elisabeth Pate-Cornell and Seth Guikema received the MOR Journal Award for "Probabilistic Modeling of Terrorist Threats: A Systems Analysis Approach to Setting Priorities among Countermeasures," *Military Operations Research,* Volume 7, Number 4.

72nd MORS Symposium, US Naval Postgraduate School, Monterey, California, June 22–24, 2004. *OR Support for Tomorrow's Force.* Michael F. Bauman, FS and Dr. Priscilla A. Glasow, FS were inducted as Fellows of the Society. David M. Maddox received the Wanner Award. Stuart H. Starr, FS received the Thomas Award. MAJ Rob Kewley and LTC Larry Larimer received the Walker Award. David P. Kierstead and Donald R. Del Balzo received the MOR Journal Award for "A Genetic Algorithm Applied to Planning Search Paths in Complicated Environments," *Military Operations Research,* Volume 8, Number 2.

73rd MORS Symposium, US Military Academy, West Point, New York, June 21–23, 2005. *Balancing Risk for an Uncertain Future.* The following individuals were inducted as Fellows of the Society: Dr. Thomas L. Allen, FS; Dennis R. Baer, FS and Edward A. Smyth, FS. Vernon M. Bettencourt, FS received the Wanner Award. Alan R. Washburn received the Thomas Award. Peter A. Davidson received the Walker Award. Seethal Mishra, Rajan Batta, and Robert J. Szczerba

received the MOR Journal Award for "A Rule Based Approach for Aircraft Dispatching to Emerging Targets," *Military Operations Research*, Volume 9, Number 3.

MORS Presidents

37th MORS President: Edward "Ted" Smyth, 2002–2003

Edward Smyth served as Secretary in 1999–2000, Vice President for Professional Affairs in 2000–2001, and President-Elect in 2001–2002. He served as MORS President in 2002–2003. He was elected a Fellow of the Society in 2005.

Mr. Smyth is a 1966 graduate of the US Naval Academy with a BS in engineering and a major in history. He subsequently received an MS in operations research in 1970 from the US Naval Postgraduate School and an MA in history from Old Dominion University in 1975.

He is a former Marine Corps Colonel with 30 years of active service during which he commanded Marine Corps units at the company/battery, battalion, and regimental level. During his Marine Corps career his primary occupational specialty was artillery/fire support with subspecialties as a military operations analyst and historian. As an operations analyst he held a number of varied assignments, including service as an operations analyst at Headquarters, Fleet Marine Force Atlantic, Norfolk, Virginia; an assistant professor of operations research, US Naval Academy, Annapolis, Maryland; the senior Naval operations analyst, Combined Forces Command, Seoul, Republic of Korea; professor of Naval science at Norwich University; and Director, Marine Corps Studies and Analysis Division, Quantico, Virginia.

Mr. Smyth possesses considerable teaching experience in the use of quantitative methods, operations research, and systems engineering and has served on the faculties of the University of Virginia, US Naval Academy, George Washington University, University of Maryland, Webster University, Norwich University, and Johns Hopkins University. He is also the coauthor of *Naval Operations Analysis* (US Naval Institute Press, Annapolis, Maryland, 1977).

Since joining JHU/APL in 1995 he has served as Director, Campaign Analysis Team of the Surface Combatant 21 Cost and Operational Effectiveness Analysis, employing campaign-level simulations to assist in discriminating among surface combatant alternatives. He has coordinated efforts in support of OPNAV sea strike analyses, served as the technical lead of the Advanced Land Attack Missile AoA, provided analytical support to the deputy assistant secretary of the Navy for littoral and mine warfare, developed and organized a three-day symposium sponsored by MORS on the subject of "Analysis of Urban Warfare," and has served as the senior JHU/APL analyst in support of the National Security Agency's Signals Intelligence Requirements Office. He is currently the technical branch supervisor in the National Security Analysis Department.

38th MORS President: Dr. Willie McFadden II, 2003–2004

Dr. Willie McFadden served as Vice President Professional Affairs in 2001–2002 and President-Elect in 2002–2003. He was President of MORS in 2003–2004 and was elected a Fellow of the Society in 2008.

Dr. McFadden earned a BS degree in engineering from the United States Military Academy at West Point, an MS degree in operations research from the Naval Postgraduate School, and a PhD in engineering management from Old Dominion University.

Dr. McFadden also served 23 years active duty in the US Army. He was commissioned in the field artillery and has served as Commander, Headquarters & Headquarters Battery VII Corps Artillery at Augsburg, Germany and Southwest Asia and Commander, C Battery 1st Battalion 36th Field Artillery Regiment, 17th Field Artillery Brigade, VII Corps Artillery at Augsburg, Germany. As an operations analyst, he has filled assignments at the Joint Venture Task Force XXI Operations

& Organization Division, Office of the Deputy Chief of Staff for Combat Developments and Plans, Analysis and Evaluation, Office of the Deputy Chief of Staff for Resource Management, Training and Doctrine Command, Ft Monroe, Virginia. Additionally, Willie served as a permanent military professor at the United States Military Academy, West Point, New York. While there, he served as the Engineering Management Program Director for the Department of Systems Engineering and the director of the Lifecycle Acquisition Management Institute at the Academy. Willie was promoted to the rank of professor of engineering management while serving as a tenured military professor at the Academy.

Dr. McFadden is currently the director of Integrated Systems Frameworks at Teledyne Brown Engineering. He leads and manages the objective simulation framework (OSF) contract and program for TBE and provides engineering leadership throughout the company. Before joining Teledyne Brown, he served as director of Army programs at the ARES Corporation from 2010–2012, where he provided strategic direction and planning to support ARES's growth through business opportunities. As a senior associate at Booz Allen Hamilton from 2006–2010, Dr. McFadden was responsible for developing the vision and strategy to capture multiple opportunities in Missile Defense Agency (MDA), Space and Missile Defense Command (SMDC), Civil, and Aviation and Missile Research, Development, and Engineering Center (AMRDEC) elements and leading the Booz Allen Huntsville office modeling simulation, wargaming, and analysis (MSW&A) capability offering and management and leadership of the MSW&A team members.

Dr. McFadden is also Past-President and Fellow of the Society for the American Society for Engineering Management (ASEM).

39th MORS President: Dr. Andrew Loerch, 2004–2005

Dr. Andrew Loerch served as Vice President Finance and Management in 2002–2003 and President-Elect from 2003–2004. He was President of MORS from 2004–2005 and elected a Fellow of the Society in 2008.

Dr. Loerch has a BS in mechanical engineering from the Polytechnic Institute of Brooklyn, an MS in operations research from the Naval Postgraduate School, and a PhD in operations research from Cornell University.

He is currently an associate professor in George Mason University's Department of Systems Engineering and Operations Research. Andy joined George Mason University in 2000, following a 26-year career in the US Army. At GMU, he directs the operations research subprogram and teaches and performs research in operations research methods and applications. During his Army career, Andy held numerous operations research analyst positions and represented the Army in several joint studies. His last position was Chief, Force Strategy Division, Center for Army Analysis. Andy retired with the rank of colonel.

Dr. Loerch was the recipient of the Dr. Wilbur B. Payne Memorial Award for Excellence in Analysis (three awards) and was named LMI's inaugural Distinguished Visiting Scholar.

Review of Are We Winning?

A Brief History of Military Operations Assessment

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One of the intriguing aspects of Ben Connable's book *Embracing the Fog of War: Assessment and Metrics in Counterinsurgency* (Rand Corp., 2012; http://www.rand.org/pubs/monographs/MG1086.html), especially to those of us grappling with how to do operations assessments, was the chapter on assessments during the Vietnam War. It put what we were doing under a different light. We were not doing, as many of us felt, something that had never been done before. There was historical precedent.

Are We Winning? A Brief History of Military Operations Assessment, by Emily Mushen and Jonathan Schroden (http://www.cna.org/research/2014/are-we-winning), published in August 2014, is just as intriguing. *Are We Winning* sets forth a historical continuum and takes the reader from Vietnam through the Cold War and the following Information Age to the current post-9/11 period. Mushen and Schroden state that one of the purposes of *Are We Winning* is to serve as a foundation and source of encouragement for the research and production of a more complete history of operations assessment.

The authors are highly qualified to report on these issues. Mushen has deployed to Al Anbar multiple times and has worked as an analyst in both Iraq and Afghanistan. Schroden is also a veteran of multiple deployments to Iraq and Afghanistan, and an author of several journal articles on assessment issues. Mushen and Schroden trace operations assessment back to the roots of operations analysis in World War II. They consider two historical periods, the Cold War and the post-Cold War Information Age, as significant to the evolution of operations assessment. Additionally, *Are We Winning* explains the status of operations assessment at the beginning and end of several conflict periods (starting from the outset of the Vietnam War) and points out factors that have affected the development of operations assessment during each period. Their perspectives are thought-provoking and definitely set the case for further historical research.

The authors term the history of assessment as an "oscillation" between the primacy of quantitative measures and primacy of qualitative judgments. The rise of effects-based operations in the late 1980s and the advent of information technologies led to expectations that assessors could gather, organize, and analyze the quantitative data necessary to fuel a comprehensive understanding of even complex environments. This swung the pendulum toward quantitative primacy, but experience in Afghanistan has proven that a too-quantitative schema has inevitably missed something important or aggregated away the understanding that assessors and commanders were seeking. The numbers, without informed interpretation, have lost the context and nuance critical to understanding what the authors term "highly relevant complexities" of the operational environment, and "obscured underlying causes and effects." The good news is that emerging doctrine has explicitly recognized the inherently qualitative nature of assessment by acknowledging that human judgment

is required to make sense of the hard data.

The idea that assessment's purpose is to "measure progress" appears throughout the history. Although it is probably not accurate to say the authors advocate this point of view, it may be accurate to say that this point of view is an error prevalent in the assessment community, but one that we have recognized and are correcting. Assessment does provide a measure of progress in operations and campaigns, but that is not its purpose. The knowledge of "where we are" in an operation or campaign is of little value unless commanders are using that information to sustain, modify or terminate activities to achieve objectives. Therefore, assessment's purpose, stated explicitly in emerging assessment publications, is to "make operations more effective."

The authors also posit that assessment must serve two "often competing" audiences. The "external" audience is policymakers and senior leadership, and assessment serves a secondary purpose of providing accountability to these groups so they can determine whether to support a theater commander's recommendations. The authors also acknowledge that a senior commander may use assessment products as part of "messaging efforts" to "bolster the position he intends to defend" with policymakers. The authors acknowledge that this might have implications for the integrity of the assessment. The "internal" audience is the unit and its subordinates. These folks are interested ultimately in achieving their objectives effectively, and assessment serves its primary purpose of making operations more effective. The integrity of the assessment is critical to this goal.

The art of operations assessment for 21st Century warfare is still developing and, as Mushen and Schroden point out, warrants further study. By surveying trends and developments in operations assessments over the years, *Are We Winning* serves as an introduction to operations assessment for readers from both inside and outside of the military community who are unfamiliar with operations assessment. At the same time, it provides valuable insight to those who are generally familiar with operations assessment as well as those who are grappling with how to do operations assessments.

Those of us still grappling with how to do operations assessments are now focusing on the next fight. Our task is to consider where we are today with regard to operations assessment in order to determine where we should be going tomorrow. Many analysts have worked on operations assessments during the post-9/11 period, and a clearer picture of where we are today on operations assessment seems to be taking shape out of our collective experiences. Taking it one step further, realizing where we were, yesterday and in the years previous, is equally essential to determining where we should be going with operations assessment. This, unfortunately, is out of the realm of our collective experiences. This is why *Are We Winning* is so intriguing. Operations assessment has a history, and *Are We Winning* causes us to understand that it is a largely unwritten history.

Dr. Adam Shilling is the Center for Army Analysis representative to efforts to revise joint assessment doctrine. He is a veteran of deployments to Iraq, Afghanistan, and the Horn of Africa as both a serviceman and civilian assessor.

Mr. Steve Stephens has worked in assessment cells in Iraq and Afghanistan.

PUZZLOR

& Thinking Analytically

BY JOHN TOCZEK

Fighters!

Four different fighters are having an all-out battle to determine who among them is the strongest. The image above shows those four fighters: Allan, Barry, Charles, and Dan.

Each fighter has varying attack and health abilities. At the start of the battle, they have differing health points: Allan has 10, Barry has 12, Charles has 16, and Dan has 18. Also, each fighter has differing attack points: Allan has 4, Barry has 3, Charles has 2, and Dan has 1.

The battle takes place over multiple rounds, each round consisting of a single attack. In each round, one random attacker and one random defender are chosen. When the attacker attacks a defender, the defender loses health points in the amount equivalent to the attacker's attack points. For example, if Allan is the attacker and Barry is the defender, Barry would lose 4 health points.

The fighters continue to randomly attack and defend in subsequent rounds until there is only one fighter left, who is then declared the winner. A fighter is removed from the battle when his life points become zero (or less).

Question: Question: Which fighter is most likely to win the battle?

Send your answer to puzzlor@gmail.com by December 15, 2014. The winner, chosen randomly from correct answers, will receive a $25 Amazon gift card. Past questions can be found at puzzlor.com.

John Toczek is the Sr. Director of Decision Support and Analytics for Aramark Corporation in the Global Operational Excellence group. He earned his BSc. in Chemical Engineering at Drexel University (1996) and his MSc. in Operations Research from Virginia Commonwealth University (2005).

MORS' Young Analysts
The Next Generation of Leaders

LT J. Benjamin Peterman, USN

The future of operations research and the national security community depends on new analysts taking the helm. MORS' Young Analyst Initiative facilitates this process by providing paths for emerging analysts to engage with MORS through publishing, meeting participation, volunteering, mentorship and recognition.

To highlight the achievements, interests and aspirations of young analysts, we turn the spotlight on one deserving individual in every issue of *Phalanx*.

To learn more about the Young Analyst Initiative, connect with other young analysts, see past featured analysts and learn how you can nominate a deserving analyst, please visit

www.MORS.org/YA

When did you join MORS?
I joined MORS in early 2014, shortly after starting my master's in systems analysis (MSA) through the distance learning program at the Naval Postgraduate School.

What was your childhood ambition?
When I was a child, there was no shortage of things that I wanted to do with my life. Astronaut, competitive athlete, police officer, and pretty much any other thing a kid dreams of being were all on the list, yet strangely, I did not strongly consider entering the military until my senior year in high school. Six years later, after I earned my wings as a Navy helicopter pilot, one of my junior high school teachers said to me, "I always knew you wanted to be a pilot." Somehow, I had gone after my childhood ambition without even realizing that it had been my dream for so long.

Why did you become an operations analyst?
Like many of the things that have shaped who I am, luck played a significant role. When the time came for me to select where I wanted to go for my shore tour, with some helpful encouragement and advice from my former OIC, I chose to head to Washington, DC and join the N81 team of analysts. Once here, my boss and mentor encouraged me to further challenge myself and develop my skills as an operations analyst by pursuing an MSA, and it has been one of the best decisions I've ever made.

Where do you see yourself in five years?
In the next five years, I look forward to returning to flying out in the fleet, with hopes of returning to an operations analysis billet sometime after.

How has your MORS membership benefited you? What do you value most about your membership?
My MORS membership has given me a consistent tie to the greater analytic community through channels such as the MORS symposium and *Phalanx*. I think that all too often, we get scope locked on our immediate work, and it becomes easy to lose touch with the big picture and the world around us. MORS helps us maintain that connection, which, to me, is the most valuable aspect of my membership.

31st ISMOR

Ted Smyth, FS

The 31st International Symposium of Military Operational Research (ISMOR) was held July 29–August 1, 2014, at Royal Holloway, a constituent college of the University of London and located approximately 19 miles west of central London in Egham, UK. Officially endorsed by the UK's Ministry of Defence, ISMOR was founded by the late Professor Ronnie Shephard and has grown into the world's foremost international conference on defense-related operations research. This year's attendees numbered close to 100 and included representatives from Australia, Canada, Israel, South Korea, Singapore, Sweden, Switzerland, Turkey, the UK, and the USA.

Whereas the 31st ISMOR purposely chose not to focus on a central theme, the presentations and discussions covered a wide variety of global, military, and national security challenges common to virtually all of the attendees. To that end the keynote speaker, Major General Nick A.W. Pope, CBE, the current Director of General Capability at UK Army Headquarters, shared his views of the global environment and the challenges faced by the British military. Not surprisingly, General Pope identified many challenges that are shared by the US military and its allies. Faced with significant personnel and budgetary reductions in an extremely uncertain threat environment, British forces are attempting to balance and reconcile current operational and training needs with projected future requirements and capabilities. General Pope highlighted the reality of attempting to accomplish these tasks while experiencing an increasing set of military roles and missions that now include the conduct of small-scale expeditionary operations, the provision of homeland defense and security support, the conduct of alliance reassurance operations, and preparations to conduct divisional-level warfare. To deal with these challenges General Pope is relying extensively upon the analytical community for their support.

Following General Pope's keynote address, other briefings and papers addressed a wide range of international defense and analytical topics to include the need to develop an agile, networked-enabled command-and-control structure; development of a method to estimate the risk caused by debris resulting from successful missile intercepts; methods to optimize the assignment of military personnel to training courses; provision of an analytical framework for operations planning; modeling human reasoning in time-constrained environments; a concept for development of a cyberconflict campaign-level wargame; development of a risk-based method to assess investments in cybersecurity; analysis of asymmetries in air combat; a capability-led approach to collaborative technology planning;

inclusion of artificial intelligence algorithms in wargame simulations; methods to measure fleet readiness; an historical analysis of the relationship between energy use and military capability; and the impact of time latency of information in networked operations. Lunch breaks featured briefings on a variety of topics offered in a poster session format. These included development of a toolset to assess naval platform design; a method to estimate the lifespan of major defense equipment; an historical look back at 30 years of operations research contributions; methods to improve logistics modeling; and an overview of initiatives to implement national security through technology.

Of note was the inclusion in the 31st ISMOR of a daylong session devoted to Cornwallis Group issues that focused on the analysis of commercial and market force roles in conflict management and mitigation. Recognizing that private companies, Civil Services Organizations (CSOs), military services, and defense agencies increasingly partner in the prevention, settlement, and transformation of conflicts, Cornwallis XIX posed the question as to how analysis has been used to produce a blended solution plan of action to improve the effectiveness of the overall response. As such, presentations in this session included papers on: balancing the mix of regular and non regular forces; the impacts of embedded operations analysts in military and civilian organizations; efforts and methods to redeploy materiel from the Afghanistan theater of operations; the impact of contractor support on operational risk; and the use of value engineering (VE) as a method to reduce the cost of products and services.

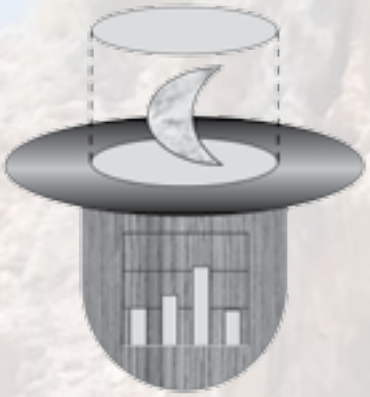
Evenings at ISMOR proved to be both enjoyable and informative. Informal presentations provided the opportunity for attendees to interact socially as well as to receive a briefing on the patterns of global piracy, where the main piracy risks reside, and a brief history of Chinese military operations research. By tradition the third evening of ISMOR is reserved for a semi-formal dinner, followed by the Professor Ronnie Shephard Memorial Address. Selection of a speaker to deliver the Shephard Address is reserved for a notable operations analyst who has made significant contributions to the state of operations analysis on either a national and/or international scale. The overwhelming selection for this year's honored speaker role was Mr. Gene Visco, FS, known to all MORSians and the greater international operations research community. As is his norm, Gene delivered a humorous and eloquent address in which he shared his personal reminiscences on the contributions of Professor Shephard, the history of how operational research was "invented" and crossed the Atlantic to become operations research, and the challenges that still remain for the practitioners of operations research.

The 31st ISMOR was my fourth opportunity to engage with colleagues from the international community. As with my other visits, I found the briefings and papers to be exceptional in both topic and content. As first time attendee Bill McDaniel from JHU/APL noted, "A benefit of this type of international forum is the insight gained on similar struggles and successes in military analysis among allied countries. For instance, it seems that most countries' military planners and analysts are struggling with the complexity of the operating environment and are using more "soft OR" approaches, including qualitative measures, to supplement their analysis."

I enthusiastically recommend that if you have the opportunity to attend the 32nd ISMOR scheduled for late July 2015 that you do so. Briefings from the 31st ISMOR as well as information on the 32nd ISMOR are posted on the ISMOR website (www.ismor.com).

The Pseudo-Analytical Agenda

ARE WE WINNING?



BY B. CRATCHIT

Location: a cave in an ungoverned region.

Time: evening, after a dinner of captured MREs.

Attendees: the Revolutionary Operations and Plans Group

Bill: OK, let's get this going. How did we do today? Who wants to go first?

Bob: I can cover mobile ops.

Bill: Please do.

Bob: We drove around five villages in some Humvees we stole. We timed it so that we were out for every other hour around the clock.

Joe: .....And ... ?

Bob: Well, that forced them to keep two E-8C JSTARS orbits going. At $22,800 a flying hour, that's costing them about $1.1M a day. One of the villages is near the coast, so they have to keep an E-2C up – that's another $14,000 per flying hour, so that's another $336K a day.

Pete: Did we lose anyone?

Bob: Well, a 2-ship of F-15E's got one of them, but they dropped 10 GBU-39 Small Diameter Bombs to do it. The F-15E's were flying 6-hour sorties at $21,000 an hour and the bombs cost $214,000 each, so that cost them another $2.4M.

Bill: Where are we supposed to get another Humvee?

Bob: I already got a replacement. Had to promise the guys who stole it a couple of chickens, though.

Henry: Look, I told you to go easy on giving out the chickens! What, do you think I'm some billionaire international chicken rancher?

Bob: Calm down – we didn't have to pay the chickens we promised to the guy who got bombed.

Henry: Well, didn't his family want them?

Bob: No, we just told them the guy was working for the cause. I gave them some flyers, though. They were mad enough that they might steal another Humvee for us.

Pete: OK, enough. How about air defense?

Joe: The boys managed to turn on that radar we found. We have no idea what it does, but we fiddle with dials and move it a couple of times a day. We figure that forces them to maintain two E-3 Sentry orbits around the clock at $14,200 an hour, plus a RC-135 U/V RIVET Joint at $23,200 an hour. So that's another $1.2M a day.

Pete: Don't they shoot at you?

Joe: Well, we usually wire together a bunch of microwave ovens we found at dump and turn them on when we leave. We did get them to drop a GBU-32 JDAM on one pile of them, but that only cost them about $30K.

Pete: We need to do better there. See me afterward. How about fixed targets?

John: Well, I've got some real good news.

Pete: What's that?

John: We managed to get the power on in that old fertilizer factory, and used those trucks you got us to run back and forth for a couple of days. And guess what they did?

Pete: I give up – what?

John: they fired 17 BGM-109E Tomahawk cruise missiles at the building, at $1,120,000 each! Plus they put 3 MQ-9 Reaper drones up for 12 hours prior to watch it, at $1000 a flying hour! $19M!

Pete: Not bad. Did they get any of the trucks?

John: We left one there, but it threw a rod and we couldn't get it running anyway.

Henry: I'm not General Motors either! What am I supposed to do for another truck?

Pete: Relax, that was one of those Eastern Bloc things we can never get parts for anyway. If they want to shoot it with a $1M cruise missile, that's fine by me.

Henry: Easy for you to say, but I've gotta get another truck! Do you know how much bad liquor I have to drink with those guys to get them to sell me one?

Bob: Well, let me talk to them – I like that stuff they drink.

Henry: That's because you're an idiot with no taste.

Pete: OK, enough. Not a bad day – they spent at least $24M that we know about. You guys all set for tomorrow?

John: All except Henry.....

Henry: I still don't know where I'm going to get more chickens ...

Member Milestones

Dr. **Jacqueline R. Henningsen** retired October 6 as the Director of Air Force Studies & Analyses, Assessments, and Lessons Learned. Dr. Henningsen is a MORS Fellow and Past-President of the Society. Look for a special tribute to her in this issue.

Mr. **Kevin Williams** has been named the US Air Force Director of Studies & Analyses, Assessments, and Lesson Learned. As such he become the Air Forces senior operations analysts and MORS sponsor.

Dr. **Priscilla Glascow** has retired from the MITRE Corporation, completing a 36-year career as an operations analyst. Her work has included being the DoD expert on simulation credibility assessment at the Defense Modeling and Simulation Office, retiring as a Naval Officer, and the last 17 years at MITRE. Priscilla has served in many different leadership capacities with MORS over the years, including twice serving on the Board of Directors and as Secretary-Treasurer and the first Vice President for Finance and Management. She is Fellow of the Society. Priscilla intends to enjoy her time swimming, working on family genealogy, and travelling.

MORS Directors **Aaron Burciaga** and **Harrison Schramm** have been invited to join the INFORMS Business Analytics . Each will lead the development of one of the eight highly selective tacks ranging from Supply Chain Management to Marketing Analytics. For more on the INFORMS Business Analytics effort, see https://www.informs.org/Attend-a-Conference/Analytics-Conference.

MORS President **Rafael Matos** and Past President **Mike Kwinn** crossed paths during the Marine Corps Marathon, when Raf stopped long enough to visit Mike's The Friends4Michael Foundation booth. So far, no commitment for both to run the race together next year.

MORS Past President **Terry McKearney** recently spent a week at sea aboard the USS *George Washington* (CVN-73) as a guest of his daughter LT **Jennifer Bridges.** The *Washington* is homeported in Japan and Jennifer is the Intelligence Officer (N2) for Commander, Destroyer Squadron FIFTEEN embarked aboard the carrier. It took his daughter to get Terry, a lifelong Surface Warfare Officer, to break his vow never to sail on a "bird farm."

Meet Kevin Williams: New Air Force Sponsor

MORS welcomes Kevin Williams as the new AF sponsor. He became the Director of Studies and Analyses, Assessments and Lessons Learned, Headquarters US Air Force, Washington, D.C AF/A 9, replacing Dr. Jackie Henningsen in early October (see article on page 2 of this issue on Ms. Henningsen's retirement). In this position he is responsible for the development of Air Force-wide policy and guidance that ensures defendable studies, analyses, assessments, and lessons learned processes support Air Force leadership decisions to enhance current and future warfighting capabilities. Prior to joining the senior executive service, Mr. Williams had a distinguished Air Force career as an operational fighter pilot flying the A-10, F-16 and F-111 and as a staff officer with assignments as Director of the US Strategic Command Global Innovation and Strategy Center; Director of the Air Combat Command Commander's Action Group; Chief of the Information Operations Division at US Northern Command; and National Defense Fellow in the Secretary of Defense Strategic Studies Group. He has a Master of Science degree in electrical and computer engineering from the University of Texas, and a Master of Airpower Art and Science degree, from the School of Advanced Airpower Studies at Maxwell AFB, Alabama.

Let's Think Outside the Box So We Can Matter More to Our Customers

John Lawson III, Contractor, US Marine Corps Combat Development Command's Analysis Directorate, john.r.lawson.ctr@usmc.mil

Does military operations research (OR) matter as much as it should . . . or could?

The Marine Corps Modeling and Simulation Management Office recently sent me to the 2014 Game Developers Conference (GDC), and no matter what the topic of a particular session was, there was a good chance I was going to hear the game industry guys crow about the value of "analytics" (they never say "OR," and they rarely say "analysis").

If you thought the conference would emphasize things like killer graphics in a new Batman video game, you thought wrong. This was a conference with more than 20,000 attendees, and even though precious few of them were analysts, they couldn't help but praise "analytics."

Are the customers of military OR that enthusiastic? If they don't value analysis as much as we think they should, are there things we should be doing to change that?

Let's think outside the military analysis box for a bit.

Admittedly, there are huge differences between the game industry and the Department of Defense (DoD). Their business involves the PlayStation, the Xbox, and so on. Ours involves bombs, bullets, and so forth. Their ultimate metric is profit. Ours is "victory" (a term that's often the subject of fierce debate). Sure, there are many differences between them and us. But thinking about what they do is a great way for us to get outside the box for a bit.

The gaming industry's revenue is well over $50 billion annually. The industry deserves at least a little bit of our attention if for no other reason than it's successful. Over the past 10 or 15 years, it has improved in dramatic and innovative ways (and hasn't suffered frustrations equivalent to our Afghanistan and Iraq experiences).

There are many facets of the gaming industry: programming, artificial intelligence, marketing, network management, quality assurance, etc. Talent from all segments of the industry attends the GDC, and if a professional conference is an indication of an industry's health, game development is doing quite well. When I was an Air Force contractor and attended the 2004 GDC, there were about 10,000 attendees. This year, as a Marine contractor, I was among more than twice that many people.

So, let's look at some ways analysts make themselves invaluable to the gaming industry.

Analysis Is Frequently Organic (It's Rarely an Appendage)

For many game development teams, analysis is one more part of an organic whole. It's not an appendage or an outsider. Analysis isn't like a doctor you go to when you're sick, nor is it like a lawyer you go to when you've been sued. It's like the offensive line, which blocks for the quarterback, blocks for the halfback, blocks for the fullback, and blocks when a receiver runs a reverse.

Because analysis is integral, rather than external, it is intimately aware of what things need to be tracked and how those things need to be tracked. Analysis teams know how they need to segment and identify customers. They know how to distinguish between the way some users play a game and the way other users play the same game. They know how to make connections between customers' gaming habits and their spending habits.

When it's time to make a new game, analysts are often involved at the outset. They establish metrics and ensure appropriate data collection for those metrics. Many game development projects are born with metrics in mind. It's not unusual to identify 10,000 metrics when a game is in its embryonic stages, according to one speaker.

And metrics aren't a bunch of things for someone to ponder while holding a pipe in one hand and a glass of Chablis in the other. Many are real-time metrics that feed the maintenance and operation of the game during its life.

Analysis Helps the Project, the Project Helps Analysis

For many games, especially the bigger ones, almost everyone involved is actively using analysis. And the analysts are working with almost all of the team's groups to ensure that each group has the analysis it needs to make the game successful.

Naturally, analysts want data that supports metrics so their analysis will be good. And everyone in the game business wants good analysis. Marketers want good analysis so they can make the game popular. Folks in customer service want good analysis so they can prevent complaints or handle complaints swiftly and efficiently. Folks in quality assurance want good analysis so they can address problems before customers even notice them. Designers want good analysis so they can tell which aspects of a game hold the customer's attention and which aspects of a game cause the customer to bail out. Developers want good analysis so they can push out good updates and, if the game is successful, make version 2 better than version 1. Finally, network managers want good analysis so they can allocate servers wisely.

One of the most interesting things about the 2014 GDC was the fact that game developers might talk for several hours without uttering the name of a single game. They had so much to say about "analytics" that they often forgot to mention "Madden NFL" or "Call of Duty."

And chew on this: A decade ago, at the 2004 GDC, very few voices had much to say about analysis. In other words, analysis has earned a central seat at the table. It didn't inherit a seat at the table. It didn't get by on tradition or old achievements. It powered its way to a prominent position in less than 10 years.

The More Analysis Gets Involved, the More Analysis Gets Involved

The more the game industry uses analysis, the more new ways the industry discovers to use analysis. Analysis tells game developers who is playing the game and when they're playing the game. Then analysis identifies users and creates segmentation schemes to bin users. Then analysis looks at the differences between how people in Groups A, B, C, etc., play the game. Experiments with centralized control are also possible. These approaches lead to immediate payoffs in games that include advertising or selling accessories. And these approaches lead to long-term payoffs during the development of subsequent games.

It's not surprising that Amazon and Google were heavyweight sponsors of the 2014 GDC, even though they were practically invisible at the 2004 GDC. Those two companies know how to crunch data. Clearly, they have identified the gaming industry as a growth area for businesses that Excel (pun intended) at analyzing phenomena in high-tech settings.

The Emphasis Is on Now and the Future

While I'm suggesting that we should contemplate how the gaming industry uses analysis, I would like to stretch this trip outside the box just a little bit further. Let's not only think about how game developers use analysis. Let's think about game development in general.

Thanks to math, computer science, engineering, physics, and the other subjects that tend to define military analysts, we have a tendency to regard ourselves as scientists. Science is usually associated with progress. Are we committed to the future? Are we even committed to the present day's state of the art? Are we a little too old-school?

In the gaming industry, the past is in the rearview mirror. I'm 47 years old. Of the roughly 24,000 people at the 2014 GDC, I only saw about 30 people who were definitely older than I am. When I go to a DoD meeting, I'm usually right around the median age. In DoD, we're very credential oriented. Credentials, of course, are something you accumulated in the past. The gaming industry, however, wants to know what you're doing right now. The gaming industry openly wonders what the expiration date is for academic preparation. During the conference, one professor of game development said that curricula are constantly in flux because "what I knew six months ago may be out of date today." As a result, the industry emphasizes what potential hires have produced rather than what they've studied.

Whether it's DOD analysis, DOD Modelling and Simulation (M&S), or DOD in general, it's pretty easy for us to go to a meeting and see PowerPoint presentations that resemble the ones we saw in 2004. In the gaming industry, 2004 might as well be the era of biplanes. In the past 10 years, the industry has seen PC games go from central to marginal; phone games go from marginal to central; tablet games go from unimagined to very popular; networks

for console games go from new and promising to wildly successful (tens of millions of users); game storage go from discs to downloads and clouds. And it's easy to imagine more change in the near future. No one at GDC 2014 seemed quite sure how Google Glass will enter the gaming mix, but there was plenty of agreement that such hardware will soon join the gaming party.

Conclusion

Yes, I know that many aspects of the gaming industry don't apply to DOD in general or to DOD analysis in particular. There are numerous reasons to look at the gaming industry and say, "That doesn't apply to us." Maybe a lot of it doesn't. But before we climb back into the box and stick with business as usual, let's red-team how we do business. Is the national security analytical community structurally optimized to deliver the best service? Are our customers greedily consuming what we give them, and are they craving more? Are we, as a science-oriented profession, on the cutting edge? (This PC I'm using to type this article certainly isn't.)

As it stands, we as analysts are doing a good job. But we're in a profession that revolves around the word "optimize." Optimal is more than just good. Optimal is the best. Are we doing the best we can?

I want to be clear: I'm not talking about analytical techniques. I'm talking about increasing the opportunities we have to be relevant. The more involved we can be with customers and potential customers, the better. This is outside-the-box thinking. If there's a rap on the analytical personality, it's that we tend to be introverts – introverts who believe they can be quiet because the facts will speak for themselves. We need to speak more for analysis, promote analysis, and connect analysis more strongly to DOD activities.

Whether I've put my finger on a minor problem (going from A- to A+) or a major problem (going from C to A), what I've attempted is a first stab at framing a problem. Obviously, you can't have a solution until you know that the problem exists. And you've got to be able to describe the problem.

Having said that, here are some examples of possible opportunities for structural optimization in our profession:

Sometimes military OR adheres to a study schedule that no longer addresses the customer's needs by the time work is done. This is like having the perfect game plan for February's Super Bowl, but handing it to the coach in April.

We all have stories about how we came up with the right answer, but it was disregarded. This is a problem that requires fixing, not complaining.

We often have trouble getting the data we need, even when we know the data exists. Doctors don't have trouble getting X-rays, accountants don't have trouble getting tax records, so why do we have such problems?

Sometimes the customer isn't committed to strategic goals, and sometimes the customer's subject of interest is in flux, yet we lock ourselves into an approach that is slow and likely to fall out of synch with both the customer and the topic. A lot of work on irregular warfare fell into this trap.

Sometimes we're more interested in an advisory role than a participatory role, which makes it harder to contribute because we are outsiders. This may make it easier to be objective, but it makes it more likely that key players will treat us as strap-hangers or nuisances.

I felt a little envy for the analysts who serve the gaming industry. Their customers are addicted to them. Let's get our customers addicted to us.

About the Author

John Lawson III is a contractor who works for Group W and serves as an analyst for the Marine Corps Combat Development Command's Analysis Directorate. Before that, he was a contractor serving several Air Force entities as an analyst. In the 1990s, he was a newspaper reporter, mainly for the Tampa Tribune; he is also the author of *Tom Landry and Bill Walsh: How Two Coaching Legends Took Championship Football from the Packer Sweep to Brady vs. Manning.* Lawson served in the Marine Corps Reserve for nine years and reached the rank of staff sergeant. He has a BS in mechanical engineering from the University of Maryland; a BA from Washington & Lee University for a double major in history and English; and an MA from the University of Florida in mass communications.

The Last Word
It Ain't Your Father's Analysis

Dr. George Akst, Marine Corps Combat Development Command, george.akst@usmc.mil

About five years ago, I was invited to participate in a seminar hosted by the Johns Hopkins University Applied Physics Lab on Unrestricted Warfare (Akst, 2009). I believe that event was a turning point in my thinking about many of the types of nontraditional analyses that are addressed in articles in this *Phalanx* edition by Dr. Yuna Huh Wong and Mr. John R. Lawson. Interestingly, this symposium predated the Marine Corps' foray into the non-traditional analysis that has come to be known as the Joint Irregular Warfare Analytic Baseline, or JIWAB. Although I will not repeat the details of that Hopkins'presentation here—I refer the reader to the documentation in the reference—I will point out the five principles that I used in that presentation, known as Akst's Axioms:

- It ain't your father's enemy
- Focus on the model . . . not the simulation
- It's the data, stupid
- Processes may themselves be changing from deterministic to stochastic
- Most (DoD) analyses are not predictive

You'll note the plagiarism in the title of this article from my first axiom, and for those faithful readers of *Phalanx*, you'll note other acts of plagiarism as well. (I have no issues with plagiary, at least when the target is myself. Others may say I have had no new ideas in years.)

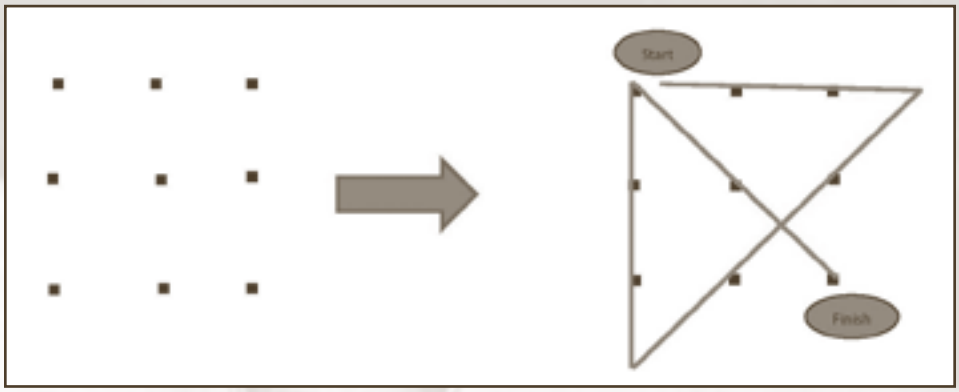
The idea behind this article is to acquaint the reader to some potentially new ways of thinking about analysis, and to introduce the two associated articles in this edition by Wong and Lawson. Many traditional defense analysts have had similar experiences in the field of operations research (OR), beginning with some sort of formal training (often a master's in OR), followed by a series of jobs training the analyst to use his or her skills to address important operational questions. I have often seen these problems addressed by going through one's "catalog" of analytical tools and choosing the one that seems the most appropriate. However, with the types of problems we are often facing today, we probably need to open the aperture wider than simply the toolset that our master's degree armed us with. To quote a cliché, we need to think outside the box. I often use the 9-dot matrix problem to illustrate how most of us have difficulty thinking outside the box (Figure 1). In this problem, the

subject is asked to connect all nine dots with a total of four straight lines, without lifting the pencil from the paper (e.g., the beginning of each subsequent line is the end of the previous one). Most people agonize by drawing, or visualizing, lines that stay within the boundaries of the original box, but the problem cannot be solved without thinking (going) outside the box.

So, back to the title of this article. Often, the analytical problems we are seeing lately do not fit nicely into the toolbox of existing techniques. More and more, we need to reach outside this toolbox and develop new approaches. For some of us, this may be pushing ourselves outside of our comfort zones, and perhaps even

stretching the definitions of defense analysis techniques. So, although it may not be your father's OR, perhaps it is closer to your grandfather's OR. Recall all of those pioneers back at the dawn of the defense OR era during World War II; none of them had formal training in OR, or a handy toolbox to rely upon. They had to think about problems and develop appropriate techniques on the spot, often in multidisciplinary environments.

Figure 1. 9-Dot Matrix Problem



As I move into the twilight of my career, and watch many of my colleagues retiring to lives of leisure, I realize that often words of wisdom from a waning generation may not ring true with our younger readers. With this in mind, let me present an example that may be more meaningful to this generation. For more than a century, baseball managers, owners, and scouts relied on their tried-and-true toolbox of statistics to craft winning teams: runs batted in, batting average, stolen bases, etc. Then came the revolution immortalized in Moneyball (Lewis, 2003). Closer scrutiny to success indicators showed that there were better (and cheaper) indicators of success, such as on-base percentage and slugging percentage. And thus began a revolution that changed the way that an entire profession began to think about the game. So, I encourage all of you young analysts out there to write the next version of Moneyball for defense analysts, with the focus on how we can think about the tools and techniques of our profession in a manner that is perhaps more focused on the 21st century.

I'll conclude with just a brief word about the work of two of our bright young analysts who have tried to think outside the box with their articles in this edition of *Phalanx*. Wong's article does a good job of addressing the history of OR, and the potential role of "soft OR," and the more multidisciplinary nature of our current techniques. Wong also discusses the JIWAB approach, which is but one example of how we have stretched the boundaries of OR. As anyone familiar with baseball's Moneyball revolution knows, there were diehard baseball geeks who had devised new and better ways to understand the game. But for all their intellectual horsepower, these geeks did not matter until someone formally incorporated their thinking into the day-to-day operations of a baseball team. Though Lawson doesn't mention Moneyball, to put his argument into Moneyball terms, he argues that whereas the military values OR more than baseball used to value its geeks, the military doesn't value OR as much as baseball currently values its geeks. He says we need to change that.

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About the Author

Dr. George Akst is the senior analyst for the Marine Corps Combat Development Command (MCCDC), Quantico, Virginia. Akst graduated cum laude from the City College of New York and received his PhD in mathematics from the University of Illinois in 1974. He was professor of mathematics at New Mexico State University and the California State University at San Bernardino prior to joining the Center for Naval Analyses (CNA), where for 19 years he was a research operations analyst and study director for numerous projects, including Cost and Operational Effectiveness Analyses (COEA) on Sea-Based Tactical Ballistic Missile Defense, Tomahawk Baseline Improvement Program, Unmanned Aerial Vehicles, and Advanced Amphibious Assault Vehicle. He directed analyses of Marine Corps Ground Operations in Desert Storm, and led all of CNA's efforts to support both the Navy and Marine Corps in the Quadrennial Defense Review. He also served as the scientific analyst to Headquarters, Marine Corps (Plans, Policies, and Operations [PP&O] and Programs and Resources [P&R]), MCCDC, and the Navy Staff (Director of Assessments (N-81)); and as the field representative to the Fleet Marine Force, Pacific.