Effects-Based Information Operations: Some Observations[1]

Larry K. Wentz and Lee W. Wagenhals

The C3I Center, George Mason University,
Fairfax, Virginia, U.S.A.
e-mails: lwentz@gmu.edu, lwagenha@gmu.edu

Larry K. Wentz is a Research Scientist at the George Mason University (GMU) Center of Excellence in C3I and an independent consultant. Prior to joining GMU, he was the Director of the ASD (C3I) Command and Control Research Program (CCRP) and sponsored the lessons from Kosovo study. He held a similar CCRP position in 1996-1998 on a special government assignment from the MITRE Corp to the National Defense University (NDU) and conducted the lessons from Bosnia study. Mr. Wentz has extensive experience in Civil-Military support to Peace Operations and US, Coalition JTF, and NATO Command and Control and C4ISR research, architectures, systems, operations and exercises and training.

Lee W. Wagenhals is a Research Associate Professor with the Center of Excellence Command, Control, Communications, and Intelligence at George Mason University in Fairfax, Virginia. He is associated with the System Architectures Laboratory. Dr. Wagenhals' research interests include the design and evaluation of C3 and information systems architectures to distributed decision- making systems.

ABSTRACT

Information Operations (IO) has become a primary war-fighting capability and is now considered a military core competency. The military Services are establishing IO as a military career field equivalent to other war fighting fields. Transforming doctrine into an operational reality has, however, proven to be a challenge and the training programs and operational planning and assessment tools have been slow to materialize. Components of the Department of Defense (DoD) have been exploring the means for incorporating effects based thinking into their IO planning, execution, and assessment activities of the command and control process and the research and development (R&D) community have developed some effects based tools that support the development of analytical models that relate IO actions to effects.

Researchers from George Mason University (GMU) have used some of these tools in several war games and have evolved new modeling techniques and uses for these tools. This paper explores some of the challenges of executing and assessing effects based IO courses of action. The authors believe that the lessons learned from the war gaming experience can provide guidance to the further development of tools to support effects based operations, the procedures for incorporating these effects-based IO concepts into the command and control

[1] This work was supported by the Office of Naval Research under grant No. N00014-00-1-0267 and by the Air Force Office of Scientific Research under grant No. F49620-02-1-0332

processes, and provide examples to support the education of the forces in effects based IO thinking.

INTRODUCTION

The establishment of Information Operations (IO) as a primary war fighting capability has set in motion a number of doctrine, procedure, organization, and capabilities initiatives to institutionalize it as a military core competency. The military Services are establishing IO as a military career field equivalent to other war fighting fields and they are developing supporting education and training programs to create a pipeline of trained and experienced information operations warriors. Transforming doctrine into an operational reality has, however, proven to be a challenge and the training programs and operational planning and assessment tools have been slow to materialize. Recent real world operations in the Balkan's, Afghanistan, and Iraq have afforded the military the opportunity to actively conduct IO and to document experiences and lessons from these operations. However, in spite of the intellectual attention and operational experiences, in the authors' view, the principles of application continue to be largely ad hoc and unevenly applied.

Effects-Based Operations (EBO) is not a new concept. However, with the emergence of network-centric thinking and the realization of advanced C4ISR capabilities and precision weapon systems that have significantly improved the military's ability to achieve information superiority and conduct time sensitive precision strikes, it has become a "cause du jour" supporting military transformation. As a result, much has been written about the subject but little has been done to provide the operational tools to plan and assess effects-based actions. Unlike the Industrial-Age warfare that focused on attrition and territory and used destruction of the enemy and linear movement of battle lines as measures of effectiveness, EBO emphasizes a comprehensive understanding of the adversary as a complex, adaptive "system-of-systems" and examines the causal linkages and effects through which nondestructive means are emphasized over destructive means to obtain the desired outcome or effect. EBO and the supporting IO concept strive to negate the will and ability of the opponent to oppose friendly force actions. The intent is to shape the adversary's opinions, behavior and decisions. EBO does not, however, make warfare in the classic sense obsolete—the Balkans, Afghanistan and Iraq are cases in point where military force was the major player in achieving the desired outcome.

There is no existing effects-based culture and no agreed common understanding of what it really means; hence, institutionalizing EBO and IO has become a complex undertaking that requires the development of new doctrine, the education of the forces in the EBO and IO concepts along with the development of a common lexicon of terms, the adaptation of the current command and control processes, and the development and use of tools that support effects based planning and analysis. There are some who view the adoption of an effects-base perspective as being largely driven by the relegation of attrition warfare to an exception rather than the rule while others view it as thinking differently regarding achieving superior knowledge and innovation.[2] In any case, modern information technology has certainly been an enabler by allowing the commander and his staff to do real-time collaborative planning and execution thus improving the quality and timeliness of decision-making and use of

[2] "Effects-based Operations," Gene Myers, JFCOM, Armed Forces Journal, June 2003.

national power to achieve desired outcomes in a complex and multifaceted environment of the new world order.

The DoD components have been conducting experiments and war games to develop and test approaches for making effects based operations and IO work in the real world environment. The scenarios employed are typically upper level small-scale contingencies with the potential for escalating into major theater war. They have both war fighting and post-conflict humanitarian assistance and reconstruction dimensions. The region of interest is usually situated within an area of critical world strategic and economic importance and is a complex ethnic and political landscape that presents challenges to friendly forces in terms of geographic access; political, social and economic considerations; and supporting civil infrastructure. The opposing force is a credible adversary who possesses modern land, sea, and air military capabilities, including Weapons of Mass Destruction (e.g., Chemical and Biological) that might be use in extreme situations. There are also asymmetrical threats from terrorist, militant, and criminal elements that need to be dealt with.

There have been few tools specifically designed to support effects-based IO thinking and execution. Organizations such as the Air Force Research Laboratory, IF Division at Rome, NY and George Mason University have developed prototype tools for relating actions to effects in a quantitative manner to support the development of models of situations that can be used to perform trade-off analysis in IO course of action development and selection. The Navy Title X war games, Global 2000 and 2001, and the Joint Forces Command (JFCOM) J9 Joint Experiment, Millennium Challenge 2002 (MC02) explored new military concepts and tools for supporting future operations that used EBO and IO means of national power to influence adversary behavior and actions. GMU had the opportunity to use its developmental effects-based course of action planning and assessment tool, called CAESAR II/EB, in these war games. The GMU team worked with both Blue's Red Cell and the IO planning cell during much of these activities. As experience was gained in using the tool, the team was challenged to see if the tool could be used to answer an expanding set of questions. As a result, the GMU team expanded its repertoire of uses for the CAESAR II/EB tool beyond the manner for which it had been originally designed.

A CAESAR II/EB modeling and analysis overview, including a couple of hypothetical examples of CAESAR II/EB use in war games, follows. The remainder of the paper provides some of the authors' professional views of the challenges of implementing effects-based IO. Included is a short overview of JFCOM's operational concept, Rapid Decisive Operations (RDO), and some of the related enabling concepts, such as, the Collaborative Information Environment (CIE) and Operational Net Assessment (ONA) that were tested during MC02. Real world instantiations of some of these enabling concepts, such as CIE, are the CENTRIX collaborative information environment used by USCENTCOM in support of Operation Enduring Freedom and the USCENTCOM and DISA-provided Global Information Grid (GIG) and its extension in support of Operation Iraqi Freedom. In both of these cases, Service and Agency C4ISR reachback capabilities, and theater extension of related DISN services including Secure Video Conferencing, GCCS collaborative planning tools, and a Common Operational Picture (COP) that included real-time UAV video and sharing of integrated imagery, intelligence and Battle Damage Assessment were employed as well.

CAESAR II/EB THE TOOL

The CAESAR II/EB tool was originally designed to support the analysis of an adversary's actions and reactions to Blue's activities so that COA options could be evaluated in a rigorous manner. It was inspired by the need to support the development of IO influence planning and its integration with traditional military operations. The tool incorporates influence nets as a probabilistic modeling technique and a discrete event system modeling technique, Colored Petri Nets (CP net), to support the temporal aspects of COA evaluation. These two techniques enable the modeler to create the structure of actions, effects, beliefs and decisions and the influencing relationships between them. The strength of the influencing relationships is also captured. The influence net provides a static equilibrium probabilistic model that indicates the probability of effects given sets of actions. A mapping has been established and an algorithm has been encoded for automatically converting the influence net to a CP net. After an influence net is converted to a CP Net, temporal analysis can be conducted that provides the probability of effects over time given a timed sequence of actions. This tool was designed to develop and assess COAs at the operational and strategic level.

The influence net provides an environment for modeling of the causal relationships between actions by our forces (Blue) and effects on the adversary (Red). It uses a graphical representation comprised of nodes that represent actions or effects and causal relationships between the nodes. In addition to the network structure of the model, estimates of the "strength" of the causal relationships is added and enables an underlying probabilistic model base on Bayesian mathematics to be used for analysis. The construct shown in Figure 1 is used. Starting from the set of desired and undesirable effects that reflect the goals of the mission, analysts work backwards to relate the effects to actions that are under our control. Once the Influence net has been completed, it can be used to evaluate the impact of actions on the effects (decisions) of interest using its underlying Bayesian mathematics.

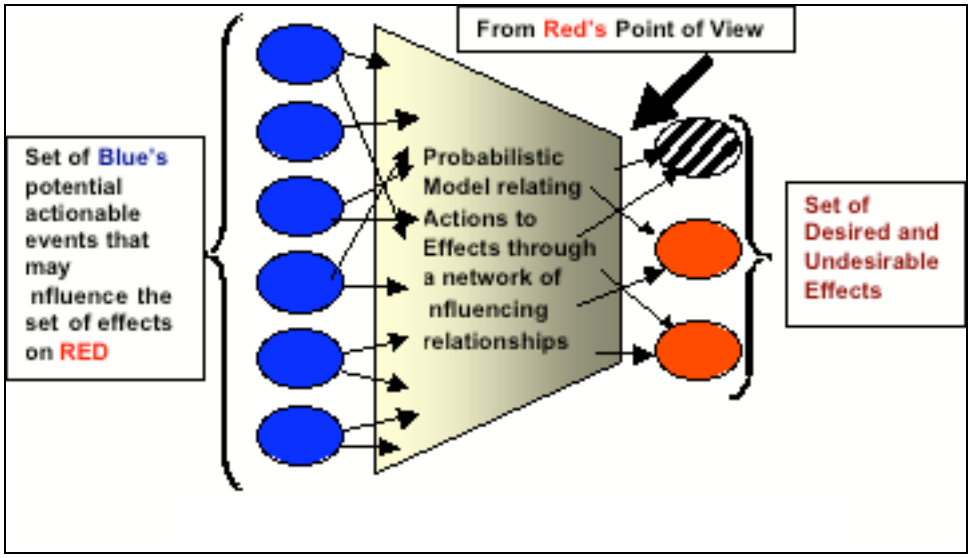

Figure 1: Modeling Actions and Effects.

Once the analysis of the Influence net has been completed and the actionable events for the COA have been selected, planners assess the availability of resources to carry out the

tasks that will result in the occurrence of the actionable events. The resultant plan will indicate *when* each actionable event will occur. Clearly, it is not only the selection of the set of actions that will lead to achieving the overall desired effects while not causing the undesired ones that is important. The timing of those actions is critical to achieving the desired outcomes.

An algorithm has been implemented[3] that converts an influence net into a discrete event dynamical system model. The particular mathematical model used is that of CP Nets and their software implementation in Design/CPN [4]. The nodes in the Influence net become transitions in the CP Net and the places hold tokens that carry the marginal probabilities. Since the Influence net does not contain temporal information, it must be provided as an input to the CP Net.

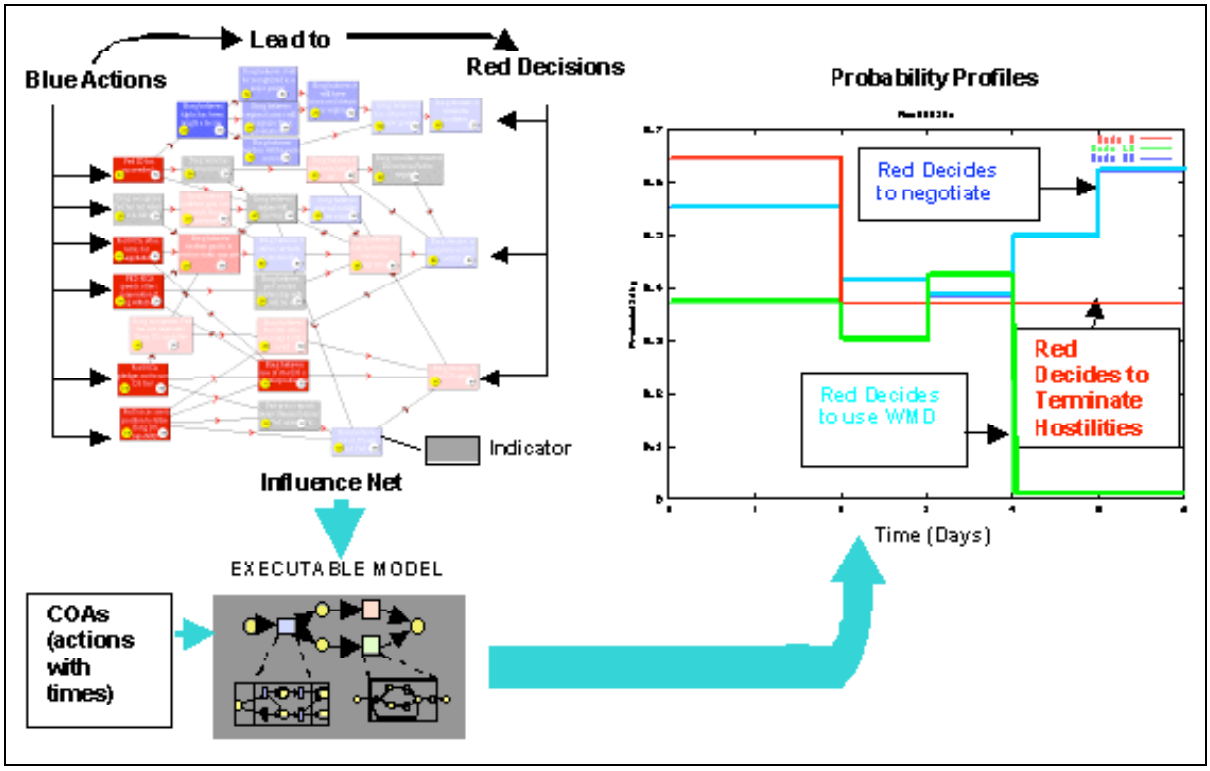

Figure 2: CAEAR II/EB Products.

Figure 2 shows the combination of models and results produced by the CAESAR II/EB tool. An Influence net model for a given situation is shown in the upper left of Figure 2. Each node represents an action, event, belief, or decision. A declarative sentence in the form of a proposition is used to express the meaning of each node. The directed arcs between two nodes mean that there is an influencing or causal relation between those nodes. The truth or falsity of the parent node can affect the truth or falsity of the child node. The Influence net has been arranged with potential Blue actions on the left and the key Red decisions on the right. This is to indicate visually that the effects of the actions are expected to propagate to

[3] Wagenhals, L. W., Shin, I., and Levis, A. H. (1998). "Creating Executable Models of Influence Nets with Coloured Petri Nets," *Int. J. STTT,* Springer-Verlag, Vol. 1998, No. 2, pp. 168-181.

[4] Jensen K. (1997). *Coloured Petri Nets: Basic Concepts, Analysis Methods and Practical Use. Volumes 1, 2, and 3. Basic Concepts.* Monographs in Theoretical Computer Science, Springer-Verlag, Berlin, Germany.

intermediate effects over time until their impact reaches the key decisions. This captures the cascading and accumulation of effects. There are six actionable events on the left side of the Influence net. These are candidate actions (or results of actions) that can comprise a COA that can impact the three Red decisions of interest.

Once the analysis of the Influence net has been completed and the actionable events for the COA have been selected, the Influence net is automatically converted to an executable model (CP net) so that a temporal analysis of the COA can be performed. Using the executable model, the analyst is able to generate the probability profiles that show the marginal probability for any node in the net as a function of time. These profiles can indicate how long it will take for the effects of the actionable events to affect various nodes in the Influence net. The analyst will most likely concentrate on the probability profiles of the key decision nodes, the nodes with no children. The probability profiles shown in Figure 2 were generated for the COA proposed by the planners. The annotations have been added to indicate the three separate probability profiles. Different timing of the actions can alter the probability profiles. As a result, some will be more desirable than others while others may be unacceptable, so the planners will try to adjust the scheduling of actions.

CAESAR II/EB MODELING EXAMPLES

In this section we describe three techniques for using the capabilities of the CAESAR II/EB tool to support effects based operations. Each case study is described using a fictitious scenario that has been created by the authors to highlight the capability of the technique. They are not exact examples from any of the war games.

CASE 1: INTRODUCING FORCES WITH CHEM/BIO THREAT

We introduce this case to demonstrate the COA option generation and comparison capability and techniques of the CAESAR II/EB tool. We use a scenario in which a rebel force occupies a territory, perhaps an island, and potentially possesses chemical or biological weapons. The Blue objective is to land forces in the territory to cause the rebels to either surrender or be captured. The rebels have a leader who can authorize the use of the chemical or biological weapons of mass destruction (WMD). This leader believes that he can set conditions that will favor his long-term cause. He believes that if he either threatens or actually causes unacceptable casualties to Blue or a high level of casualties to the civilian population, Blue will be dissuaded from continuing to threaten him and the rebel cause. He has two ways of using the WMD weapons, chemical in this example. In the first, he can mount them on short range Tactical Ballistic Missiles (TBMs) to be fired at the Blue Forces, but this may expose his TBMs to air strikes. If he is unwilling or unable to use the TBMs, his rebel forces may release the chemical or biological agents to cause the casualties.

The Rebel Leader must have good situational awareness of the territory (island) that he occupies. Blue has some control over this. The Rebel forces must be willing to follow the Rebel Leader's direction, including the possible release of the chemical weapons that may cause casualties not only to Blue, but to the Rebels and the civilian population. Thus Blue may be able to persuade the Rebel forces to not take this action. Blue plans to provide

humanitarian assistance (HA) (and potentially Disaster Relief (DR) if there are many casualties) to the civilians in the territory as soon as Blue is able.

The influence net model that captures the features of this situation is shown in Figure 3. It has as the overall effect of interest, "There are Many Causalities on X" (X is the territory or island). The objective is to keep the probability of this undesired effect low. On the left side of the influence net is a set of actionable events that are the potential elements of the COA. These actions include Information Operations to limit Rebel Leader's situational awareness of Blue and X, actions to discredit the Rebel Leader in the eyes for the Rebels, offering safe passage to the Rebels if they do not follow the Rebel Leader, and the reporting of the impending HA/DR intentions and actions of Blue. The landing of the forces is also an actionable event.

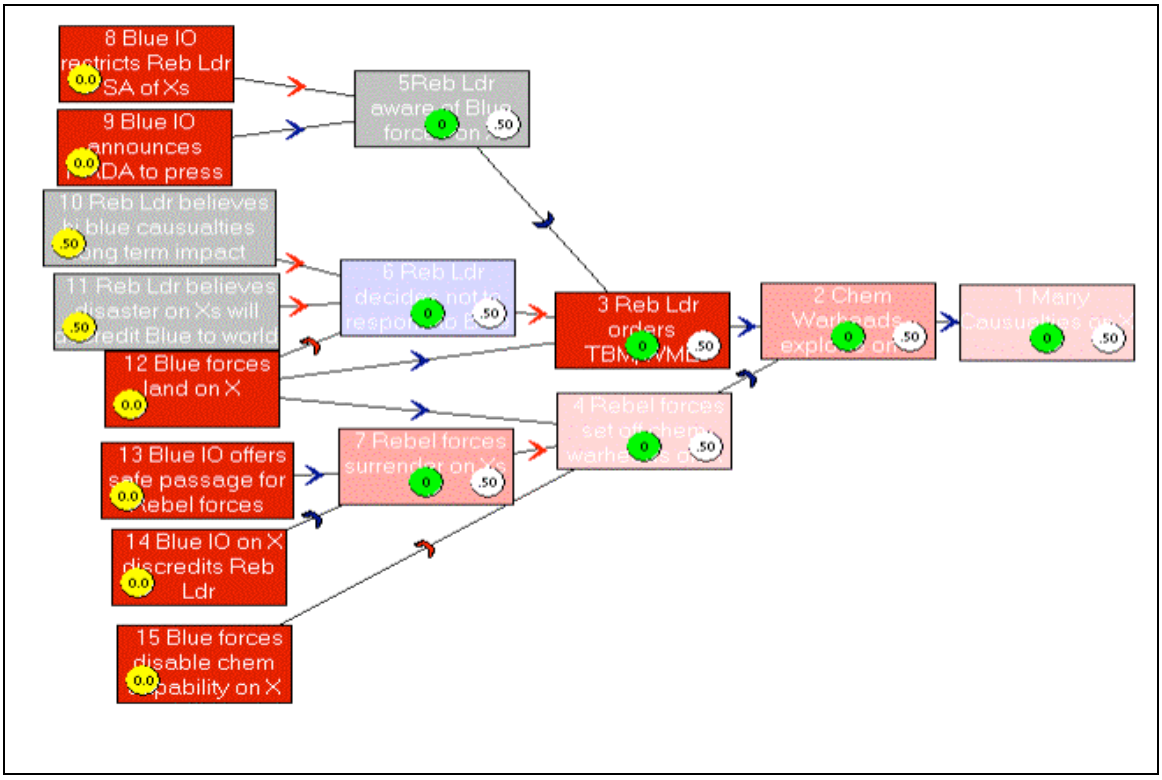

Figure 3: Influence Net for Dealing with Chemical Weapons.

Five timed sequences of the actionable events that comprise different COAs were analyzed to see the impact of the timing on the probability of the effects. COA 1 was based on Blue Forces landing on X on day 10 followed by an aggressive IO campaign composed of the IO actions. The result, shown in Figure 4, is a 3 day window when the probability of casualties due to the release of chemical weapons increases significantly. We can examine the "cause" of the probability profile by superimposing on the same chart the probability that TBMs are used and the probability the rebels release the chemical agents (Figure 5). Alternate COAs that adjust the timing of the IO actions in relationship with the landing and related probability profiles can be used to assess relative impacts. Some reduced the window of vulnerability such as the profile in Figure 6 that shows a "better" COA. Figure 7 shows the "best" COA that contains early use of IO to restrict the Rebel Leaders Situation Awareness of X and IO to discredit the Rebel Leader to the Rebel forces, while it delays the announcement of the Humanitarian Assistance (that may tip off the Rebel Leader) until just

before the landing. The result is the elimination of the window of vulnerability. Further analysis, not shown shows that when the forces land, they must react quickly to disable the chemical systems to minimize the time they are available for release by the Rebels. Figure 8 shows a composite comparing the original COA 1 with the "best" COA. Such a figure could be used to support the argument of accepting the "Best" COA.

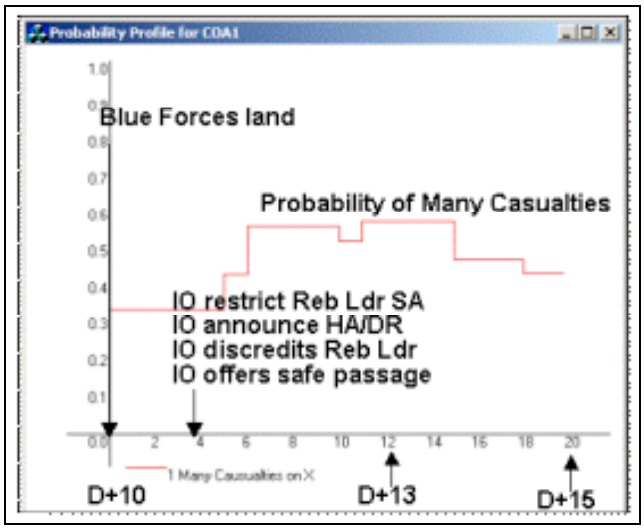

Figure 4: Initial COA.

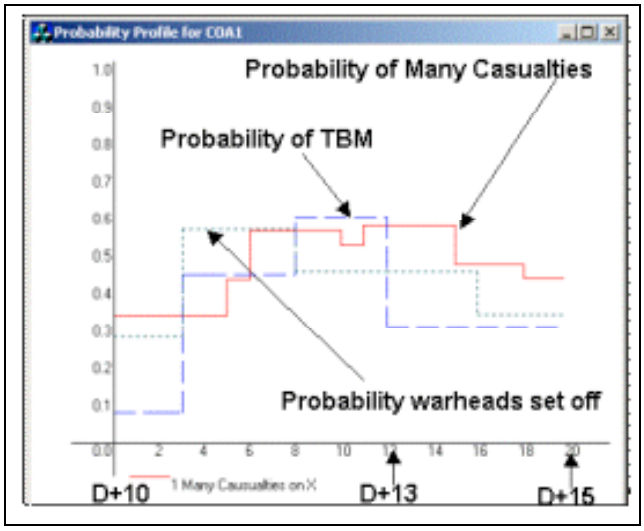

Figure 5: Initial COA Detailed.

CASE 2: INCORPORATING EVIDENCE FROM ISR INDICATORS

Our second case is designed to illustrate how incorporating evidence from ISR observations can enhance assessment of progress of a COA toward achieving overall effects. Incorporating this capability in CAESAR II/EB required adding a backward probability propagation algorithm to the existing forward propagation algorithm. The algorithm has two variants, an un-timed version and a timed version.

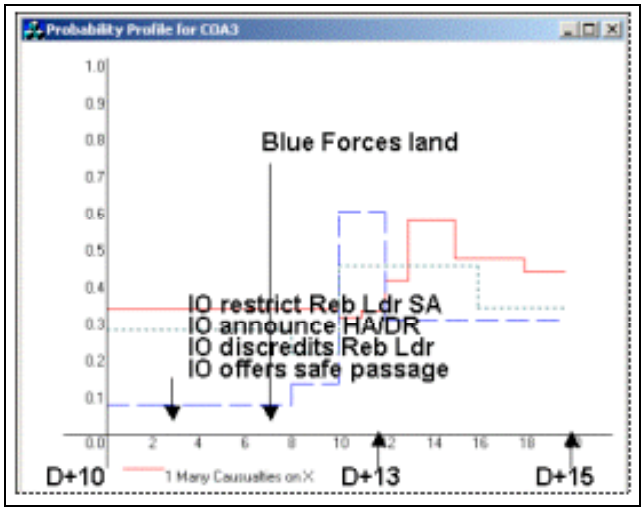

Figure 6: "Better" COA.

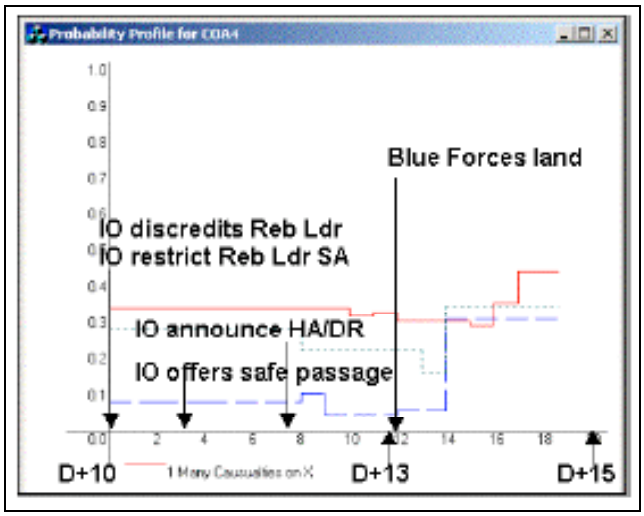

Figure 7: "Best" COA.

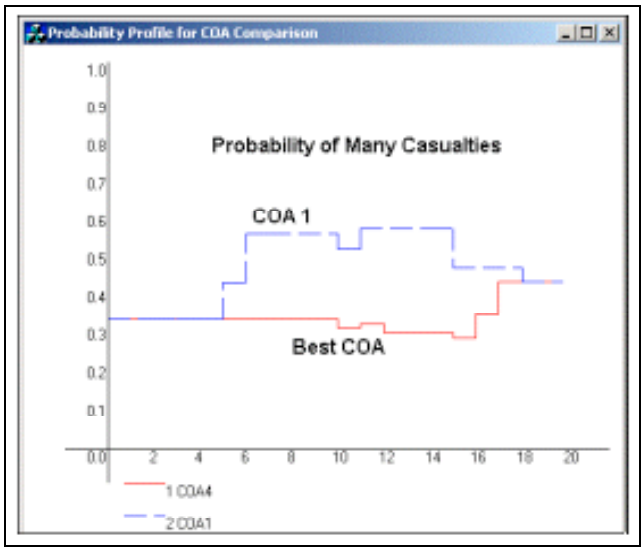

Figure 8: COA Comparison.

To use the capability, certain indicator nodes must be incorporated into the model. These are nodes that represent events or conditions that may be observed by sensors. These indicators must have a causal relationship with at least one other node in the influence net model. For example, there may be a condition that should occur if the COA is working toward achieving an effect, but that condition may be difficult or impossible to observer directly. However, if that unobservable condition does occur (or does not occur) it may in turn cause (with some probability) another event that could be observed. If we observe this event or condition, then we can infer the state of the unobserved event that caused it. In general, if such evidence is incorporated in the model, it will reduce the uncertainty in the results.

We illustrate this capability by modifying our example of the Rebel Forces on X. Figure 9 shows a more detailed influence net representing the situation. The overall desired effect is that the Rebel Forces no longer occupy X militarily. The model has 15 actionable events that could comprise a COA to achieve the effect. Several actions are non-lethal including both IO actions and maneuver of Blue force capability. Assume that initially, non-lethal and lower risk actions are taken in the following manner. On day one, Blue begins an IO campaign to encourage individual members of the Rebel Forces to leave X, and at the same time the IO campaign discredits the Rebel Leader's cause. On day two, Blue IO sends messages to the Rebels indicating that they will not have any reinforcements if they engage Blue. A little later, Blue offers safe passage to any Rebels willing to leave X. On day three, Blue issues a demarche to the Rebels that included terms for surrender.

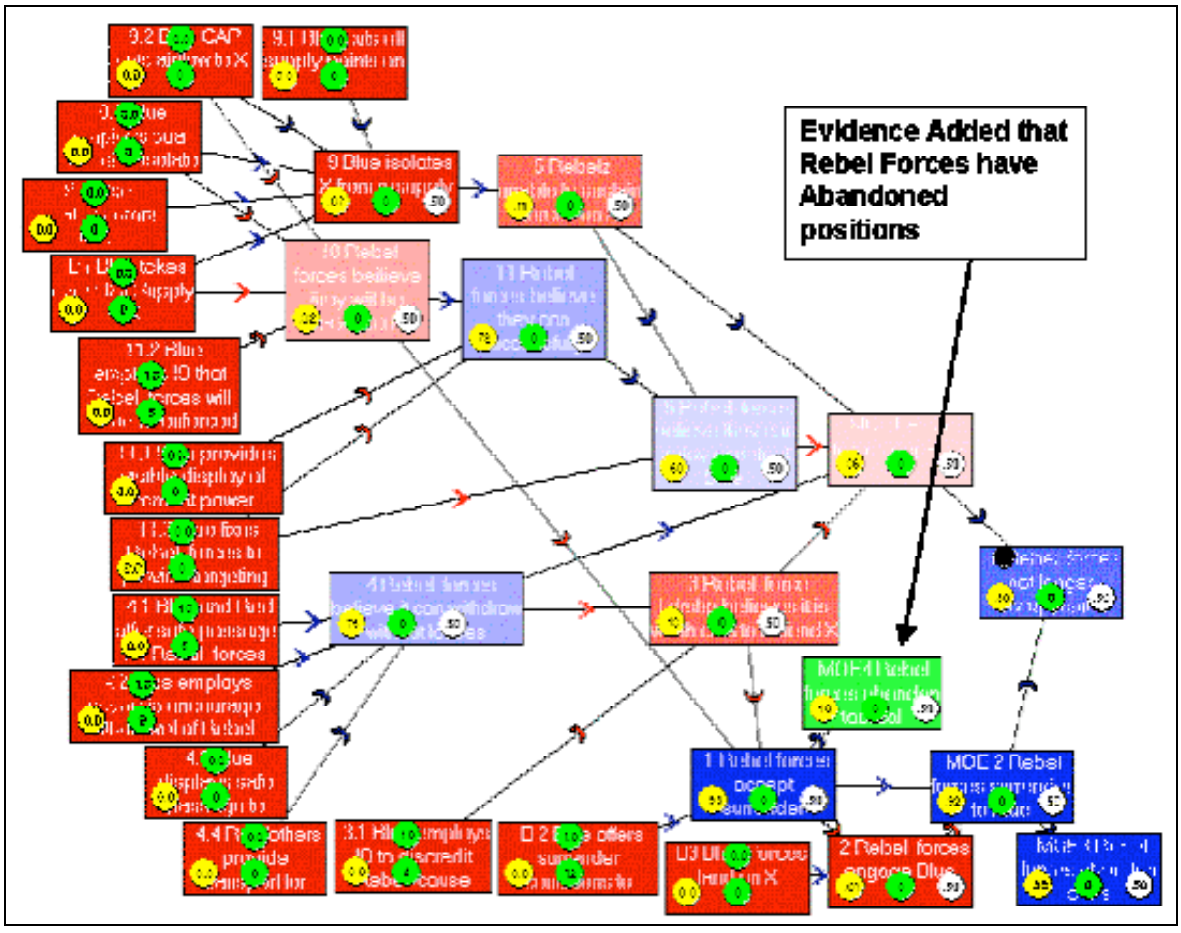

Figure 9: Influence Net with Evidence of an Indicator.

A number of indicators are included in the model. These include the Rebel Forces leaving their tactical positions and the Rebel Forces abandoning their arms. The former is an indication that the rebel forces have accepted the conditions for surrender, but have not yet surrendered. Suppose that ISR observes the first indicator on day five. In Figure 9, we have pointed out the node to which the evidence has been added. In the tool, the node becomes green in color that indicates that this evidence has been included in the model. When this evidence is incorporated into the model, the probability profile changes significantly (Figure 10). Prior to inputting the evidence only a portion of the COA had been executed. The probability profile showed progress was being made toward achieving the effect of the Rebel no longer being in control of X reaching a maximum probability of 45% by day seven. When the evidence is included in the model, the probability jumps to 80% by day seven. This means that there is much stronger indications that the COA is working. Indeed, it may be possible to alter the COA and not conduct some of the actions that were being contemplated. Additional evidence could re-enforce or contradict this judgment. In any case, having the ability to add evidence to the model can enhance its support to the assessment of progress.

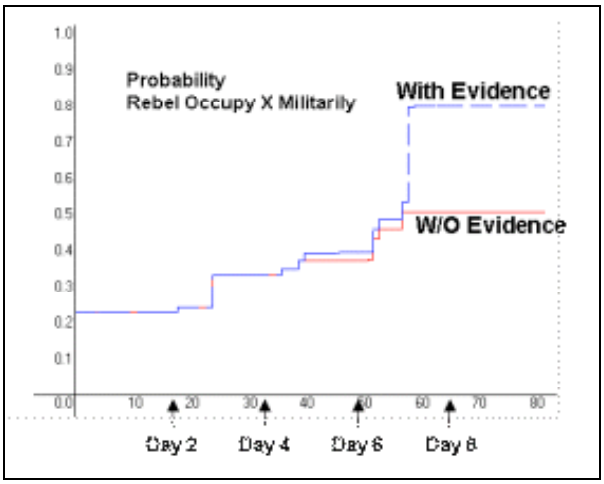

Figure 10: Probability Profile Comparison.

CASE 3: EBO MODEL DRIVEN ASSESSMENT

Our last case is motivated by the need for commanders and their staff to be able to assess the progress that is being made across levels of command for several desired effects. In many cases, this assessment is part science and part art. In general, military planners rely on Measures of Performance (MOPs) and Measures of Effectiveness (MOEs) for these assessments. The MOPs usually are associated with traditional Bomb Damage Assessments (e.g. was the building hit with the correct ordinance at the correct time?). MOEs tend to be more related to higher-level objectives or the expected result of cascading effects from tactical actions. The objective is to assess MOPs and MOEs to come to a consensus about the progress that is being made toward the objectives and how long it will take to achieve those objectives.

With an effects based approach, commanders are looking for assessments of how the COA is doing toward achieving the desired overall effects. Currently, this is done with the

same combination of evidence and indications of MOPs and MOEs, and a subjective judgment as to how close the force comes to having the effects occur overtime.

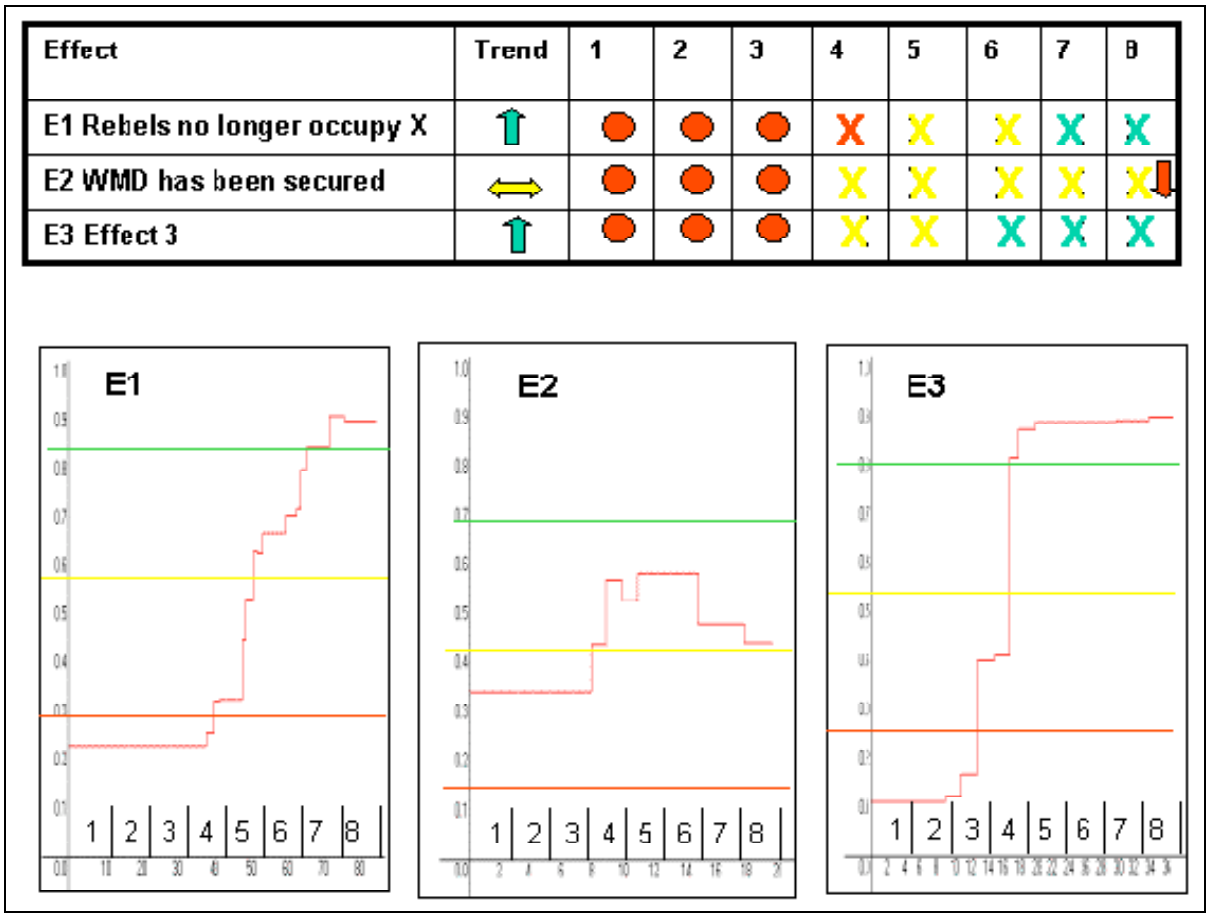

Figure 11: Creating anEffects-Based Assessment Matrix using CAESAR II/EB Models.

Given that effects-based models have been created for the effects that are to be achieved and these models have been used to select a COA, it seems quite straightforward to use these models to provide the assessment picture. If each desired effect has such a model, the probability profile generated by that model can be used to assess both the trend toward the effect and how long it may take before the effect is achieved. By applying threshold levels for measures of goodness to the probabilities of each effect, the probability profile can be converted into an easy-to-visualize graphical picture. Figure 11 illustrates the concept. The top of Figure 11 shows a notional Effects-Based Assessment Matrix. The left-hand column lists a set of primary effects of concern to the organization using the matrix. The second column provides a graphical depiction of the trend, that is, a summary how the COA is progressing. Up arrows mean that probability of achieving the effect is increasing. A horizontal arrow means the probability is not changing by much. A downward arrow would mean the situation is degrading; an indication that the COA should be re-examined. The remaining columns reflect a time line. Each column represents a time period, for example hours, days, and weeks, etc. The symbols in each of these columns reflect the assessment of the probability of achieving the effect in the time interval. The color of the symbol, red, yellow, or green, indicates that the probability, low, medium, or high, respectively, of the effect being achieved in that time interval. There are two types of symbols, circles or “Xs”

The circle, in this example, represents a previous assessment. The "X" indicates the current and future assessments. As shown in the row for the second effect in the eight-time period, it is possible also to incorporate an indication that the trend is reversing during this time period. In this case a downward arrow has been added. Again, this may be a flag for examination of the COA.

The overall concept is that the assessments could be driven quantitatively by the probability profile of an underlying CAESAR II/EB model for the effect. Three notional probability profiles provided by the CAESAR II/EB tool are shown below the Matrix. Each probability profile has been annotated with the time interval associated with the columns in the Matrix. In addition, threshold levels for determining the assessment value have been established for each effect. Note that the thresholds do not have to be the same for every effect. Some effects may have lower thresholds than others.

We envision this technique being used in a command and control system that has multiple models supporting the effects based process. At each echelon models supporting the effects of concern at that echelon are developed and maintained. The models are used not only to support COA analysis and selection, but also to drive the Assessment Matrix that the commander and staff can access. The Assessment Matrix functions as a quick look visualization of the overall COA and its past, current, and projected execution over time. The focus is on the desired effects. The command and staff can focus on those effects and the COAs designed to achieve them. It is easy to see the COAs that may be not performing to expectations as well as those that are working better than expected. If the underlying effects-based models have the indicators as was shown in Case 2, the arrival of an indicator observation could cause a significant change in the Assessment of the effect. This could be immediately reflected in a change to the Assessment Matrix.

GMU TEAM AND THE CAESAR II/EB TOOL

GMU has experience with using the CAESAR II/EB tool suite in the Naval War College Global 2000 and 2001 war games and the Joint Forces Command (JFCOM)-sponsored joint experiment Millennium Challenge 2002 (MC02). The GMU team has worked with the JTF HQs IO Cell, Blue's "Red Cell" and the Effects Assessment Cell to build models to examine the use of CAESAR II/EB to support EBO and IO COA planning and assessments.[5] In the war games and experiments, leading edge advanced technology information workstations were used as the key means for accessing the collaborative planning and the information-sharing environment. Use of the workstations provided staff the ability to actively participate and continuously monitor briefings, chat rooms, and planning conferences that related to the operation in general and the IO Plans Cell activities in particular.

Unfortunately, due to the limited availability of these workstations and the large number of participants, the GMU team did not always have access to the collaborative information environment and related ongoing activities when it needed to have access. The limitation of

[5] Wagenhals, L. W. and Levis, A. H. (2002). "Modeling support of Effects Based Operations in War Games," 7th Command and Control Research and Development Symposium, Naval Post Graduate School, Monterey, CA, June 2002.

not having on-demand access to the information environment had an impact on the team's ability to timely collect insights to build models in support ongoing planning and assessment activities of the IO cell. An additional influencing factor was that the GMU team, for a number of different reasons, was not invited to fully participate from the outset of the war game planning and this introduced an up front learning phase when the team jointed the start of the war game. Challenges included acceptance and integration of the GMU team members into the established JTF IO cell—did not participate in the team building process up front—and getting up to speed on the war game related operational activities including IO strategy and course of action planning.

A couple of clear lessons noted throughout our participation were that in order to participate effectively in any future war game or experiment, any team that is introducing Effects Based Course of Action technology should be engaged early on including the planning phases and in particular, the development of databases and related effects assessments. The team should also be included as a full member of the organizational element to which it is assigned. Full participation needs to include the provision of an information workstation dedicated for use by the team members.

THE CHANGING ENVIRONMENT

The information age has changed the way the military organize, train, and fight. Advanced information technology offers the opportunity to improve the ability to achieve information superiority to reduce the fog and friction of crisis and warfare. Information superiority facilitates military execution of operations that employ all elements of national power to achieve national policy objectives. Concepts such as IO, EBO and network-centric operations are ways of thinking and systematically planning, executing and assessing operations designed to attain specific effects through a cohesive and synergistic application of lethal and non-lethal means. Therefore, in order to take full advantage of the emerging operational concepts and processes, the planners and decision makers of the future must begin to think in terms of what it is they are trying to accomplish and the actions that might need to be taken, including likely second and third order effects of these actions. They must be given the authority to direct the resources needed to take the required actions and tools necessary to enable them to more effectively plan, execute, and assess how well the proposed actions contribute to achieving the desired effects need to be developed. To make this transformation, however, the military needs to significantly improve the level of interoperability and synergy in the areas of doctrine, organization, training, material, leadership and education, personnel, and facilities (DOTMILPF).

In the authors' view, the military have historically characterized and analyzed war games, experiments, exercises and real world operations as force-on-force. The friendly and adversary strengths and vulnerabilities of the attrition-based domain are understood and the military doctrine, weapons systems and infrastructure to be attacked are modeled reasonably well. The deliberate and crisis action planning process that supports military operations is largely attrition based and therefore, challenges arise when excursions, such as those set forth in the EBO and IO concepts, are made to consider employment of means other than military power. Here the strengths and vulnerabilities and interactions and relationships between Political, Military, Economic, Social, Infrastructure, and Information (PMESII) centers of gravity seem to be less well understood and there are few models and processes that support

effects based planning and assessment of multi-disciplinary approaches to achieving national policy goals—the military comfort level tends to favor forceful actions, not changing the adversary's behavior by other means. In fact, the latter is harder to assess and model since the outcomes are more systemic, psychological and sociological rather than physical.

To a hard kill, action-oriented military, the soft PMESII effects that take long periods of time to be realized adds complexity to balancing the use of limited resources to achieve near term visible results. There is also an uncertainty in the willingness of the military to adopt and operationally consider the use of diplomatic, information and economic means. In spite of perceived resistance to change, the new world order driven by real world asymmetrical threats, the globalization of information, and the realization of military oriented network-centric capabilities has set the initial conditions for a military mind set change to one that appears to be more willing to incorporate new concepts such as IO and processes that address not only the use of lethal military power but other means of national power (DIME—Diplomatic, Information, Military, and Economic) to achieve the desired effects.

Military operational plans now reflect the new concepts but the "will" of senior leadership to make the commitment to execute remains a challenge. For example, the Center for Strategic and International Studies reports[6] on recent operations in Afghanistan and Iraq note that IO, and Psychological Operations in particular, can provide an advantage for US forces but that uncertainties about the extent of that advantage might make it somewhat risky for US planners in future conflicts to count on it as a reliable substitute for a certain amount of conventional US combat power. They further emphasize that although actions such as leaflet drops and Commando Solo broadcasts helped persuade the adversary not to fight or defect or surrender, that IO in the broader sense may have been less successful, especially in regard to supporting public diplomacy and explaining the US intentions to not only the local populations but to the US public and the international community. Availability of trained and operationally experienced IO decision makers and warriors is a challenge as well. Military culture change is slow and operationalizing IO to achieve its full potential is still work in progress and much remains to be done to educate and train the forces and bridge gaps in policy, doctrine, CONOPS, TTPs, supporting C4ISR capabilities, training and education, and tools.

A new operational concept being experimented with and tested is Rapid Decisive Operations (RDO). The Joint Forces Command (JFCOM) recently sponsored the joint experiment Millennium Challenge 2002 (MC02) that explored the military's ability to conduct RDO against a determined adversary where RDO included the use of EBO and non-lethal means such as those contained within the IO suite of actions (e.g., PSYOP use of leaflet drops and Commando Solo radio and TV broadcasts). For the MC02 experiment, JFCOM defined RDO[7] as follows:

> *Rapid Decisive Operations is a joint operational concept for future operations. A rapid decisive operation will integrate knowledge, command and control, and effects-based operations to achieve the desired political/military effect. In preparing for and conducting a rapid decisive operation, the military acts in concert with and leverages the other*

[6] Center for Strategic and International Studies, www.csis.org.

[7] "A Concept for Rapid Decisive Operations," RDO White Paper Version 2.0, Joint Forces Command, Suffolk, VA.

> *instruments of national power to understand and reduce the adversary's critical capabilities and coherence. The United States and its allies asymmetrically assault the adversary from directions and in dimensions against which he has no counter, dictating the terms and tempo of the operation. The adversary, suffering from the loss of coherence and unable to achieve his objectives, chooses to cease actions that are against US interests or has his capabilities defeated.*

The RDO concept is based on attempting to initially influence and deter the adversary by using national and theater level diplomatic, information, and economic instruments of national power supported by relevant military flexible deterrent options before considering the use of a broader range of national capabilities. If deterrence fails, then the broader range of national power, including military force, would be employed rapidly and decisively to coerce, compel or defeat the enemy. There are several enabling functional concepts[89] that help set the military conditions for conducting RDO. One of the key functional concepts is EBO that includes the use of IO. Other important RDO enabling concepts are the Collaborative Information Environment (CIE), the Operational Net Assessment (ONA), the Joint Interagency Coordination Group (JIACG), the Standing Joint Forces Headquarters (SJFHQ), and the Joint Intelligence, Surveillance, and Reconnaissance (JISR) capability.

Lieutenant Colonel Ted Uchida, AF/XOCW, in his Military Operations Research Society (MORS) paper[10] on analysis of effects based operations points out that there are a myriad of definitions for the enabling functional concept EBO. He notes the US Air Force defines EBO as a methodology for planning, executing and assessing operations to attain the effects required to achieve desired national security objectives and that the MORS workshop on analyzing effects based operations terms of reference put EBO in the context of a strategy and operational framework that combines military operations with other elements of national power such as economic and political actions. Additionally, he noted that JFCOM J9 views EBO as a process for obtaining a desired strategic outcome or effect on the adversary through the synergistic and cumulative application of the full range of military and non-military capabilities at all levels of conflict, where effect can be physical, functional, or psychological outcome, event or consequence that results from specific military and/or non-military actions.

EBO emphasizes a comprehensive understanding of the adversary as a complex, adaptive "system-of-systems" and examines the causal linkages and effects through which military and non-military actions lead to obtaining the desired outcome or effect. Unintended outcomes are examined as well. The integration of IO into EBO provides the commander a flexible means to manipulate, influence or control an adversary's will, perception and understanding and make him ineffective in his ability to act or react. A major challenge in implementing EBO and effects-based IO is developing and assessing courses of action (including both lethal and non-lethal means) and then predicting the likelihood of achieving the desired behavioral changes and/or effects over some period of time, especially in the face of friction, ambiguity, uncertainty and an adaptive adversary.

---

[8] Kernan, Gen William F. and Cash, MG Dean (2002), Commander US JFCOM MC02 Lessons Learned Press Briefing, Pentagon Briefing room, 18 July 2002 and 17 September 2002.

[9] Joint Forces Command (2002), "Pamphlet for Future Joint Operations," Joint War Fighting Center Pam 1, Suffolk, VA.

[10] Ulchida, T. T. (2002), "Analysis of Effects-Based Operations—The road Ahead to Doing Business Differently," MORS workshop at BAH, McLean, VA.

The enabling concept CIE provides an improved information environment that includes capabilities such as a Common Operational Picture (COP), a Common Relevant Operational Picture (CROP), and collaborative planning and networking tools to facilitate information discovery and sharing, improved shared situation awareness, and enriched collaboration among users that are geographically and organizationally separated. The CIE is built as a coherently joint C4I system that networks the knowledge and decision centers, such as the regional combatant command headquarters, the JTF and components, and external agencies. CIE-like capabilities supported both Operations Enduring Freedom and Iraqi Freedom. For example, CENTCOMs coalition wide area network, CENTRIX, was used to support Operation Enduring Freedom and provided a coalition information environment that facilitated collaboration, coordination and information sharing among the coalition military partners.

In order to extend CIE services to commander's on the move, the joint en route mission planning and rehearsal system – near term (JEMPRS-NT), a joint airborne collaborative planning capability, can be employed as an integral part of the CIE and it allows a JTF commander to continue to participate in the collaborative environment (capabilities such as VTC, intelligence updates, streaming video, chat rooms, collaborative planning and execution) from airborne platforms.

The ONA provides a database and visualization and analysis capabilities that serve as the foundation of knowledge and understanding of both the adversary and friendly. It provides knowledge in sufficient detail to apply integrated diplomatic, information, military, and economic (DIME) friendly actions decisively against an adversary's political, military, economic and social, infrastructure, and information (PMESII) systems. Additionally, the ONA can incorporate the information database on the adversary's PMESII nodes and linkages with a CIE reachback capability, allowing planners and targeteers access to Centers of Excellence, Academia, Industry, and Government Labs to determine what targets should be neutralized or destroyed in order to ensure that the JTF's desired effects can be achieved with a minimum of collateral damage and loss. The knowledge base includes systems analyses that identify critical adversary vulnerabilities and potential friendly DIME actions with the goal of causing desired effects. The database is a product of collaboration among a wide variety of organizations and can be used to inform decision-makers from strategic to tactical levels. The ONA can provide a joint task force commander and components visibility of effects-to-task linkages supporting effects-based operations.

The JIACG is a process and capability that facilitates coordination of interagency operational planning and provides the JTF commander and his staff the ability to access country, political, social and economic subject matter experts (SME) through the use of both reachback capabilities and collocated expertise. The challenge in this regard is tailoring the JIACG support mix to meet the needs of the JTF commander. Tailoring may require both SMEs collocated with the JTF staff and access to SMEs in other geographic areas through the use of reachback capabilities and the CIE to share information and conduct collaborative planning and analysis.

The SJFHQ provides a regional combatant commander with a trained and equipped, in-place, joint C2 capability specifically organized to reduce the time required to establish a fully functional JTF headquarters when activated and deployed. It enables seamless planning and operations and facilitates the transition of the JTF headquarters element to operational status and helps reduce the ad hoc nature of JTF-HQs operations.

The JISR is a network-centric approach to the management of ISR platforms and sensors in order to better support the quick-paced demands of EBO. JISR emphasizes collaboration between producers and users to provide rapid and responsive mission focused ISR. Planners and operators share information rather than working through and around cumbersome "stovepipe" capabilities, tactics, techniques, and procedures. JISR-like capabilities served to significantly enhance the ability to conduct time sensitive targeting and execution in Operations Enduring Freedom and Iraqi Freedom.

Although IO is now viewed as a combat multiplier, lessons from real world operations, exercises, and experiments suggests that the military commanders are still somewhat reluctant[11] to fully exploit the integrated capabilities of IO to realize the synergetic effects to achieve desired outcomes for both winning the war and winning the peace. The commanders seem to be more comfortable with limiting IO actions to using public affairs as the commander's honest broker and spokesperson and traditional PSYOP capabilities to do leaflet drops, Commando Solo broadcasts, local radio/TV broadcasts, posters and handbills, and loud-speaker operations. The bridge between policy, doctrine, and tactical capabilities and applications has yet to be fully refined. It is also felt that IO and its integration into EBO will take some time to meet operational expectations.

The planning for and transition from warfighting to post conflict reconstruction is viewed by the authors as a missing link in IO planning and execution. It is necessary to shape the environment by preparing the target country, its people, the regional nations around it, and the world for post conflict reconstruction, i.e., winning the peace. In the authors opinion, IO plans and operations tend to focus mainly on winning the war without giving appropriate and adequate attention to preparing for winning the peace, see Figure 12.

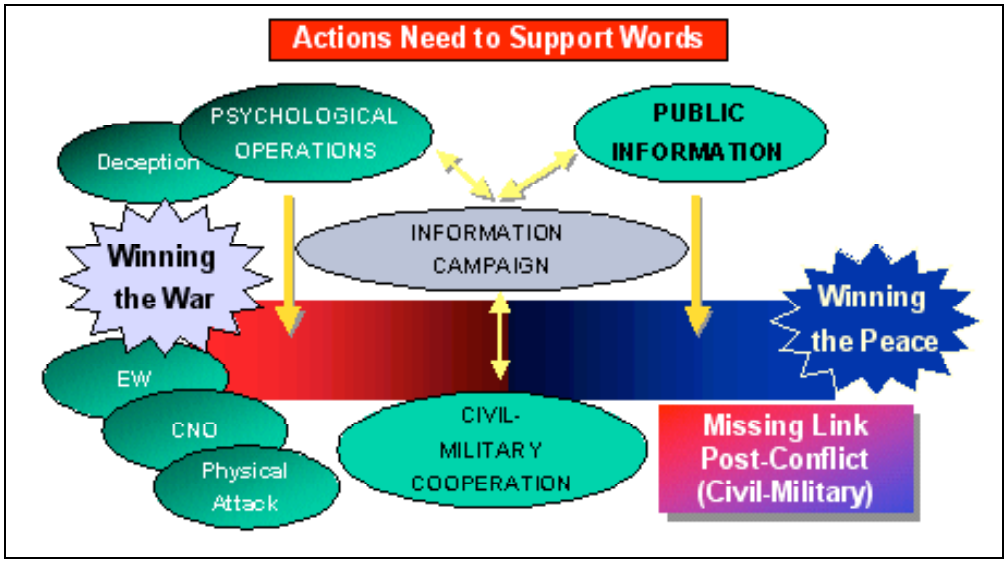

Figure 12. IO Conflict Spectrum.

A lesson emerging from recent operations in Afghanistan and Iraq is that the advances in military C4ISR technology and warfighting capabilities that allow reductions in the combat presence on the ground and minimize civilian casualties and collateral damage have not yet

[11] Author's observations based on experiences in the Balkans, exercises, experiments, and interviews with IO warriors from the Balkans, Afghanistan and Iraq operations.

been applied to improving capabilities and training and equipping the military forces to win the peace aspects of the overall operation. In regard to the IO aspects, the US and other coalition members cannot afford to ignore the fact that an era of asymmetric warfare will also be an era of political warfare in which true victory means defeating enemy ideologies and political groups by creating stable successor governments and societies. The US needs to commit itself to shaping the peace in ways that win the approval of the peoples of the nations they defeat, the nations around them, their coalition partners, and the world. The role of the military in support of post conflict reconstruction and the use of IO to support establishing legitimacy, conducting public diplomacy and in the end winning the peace still needs focused attention to improve our ability to respond and meet the needs of peace operations.

Some other IO-related short falls include education and training (including general officers), availability of experienced information operations warriors, and modeling and simulation tools to help plan and assess courses of action and to assess the synergic effects of IO and EBO actions. Additionally, from the authors' observations, the PowerPoint briefing techniques used by the staff for visualization and presentation of IO and EBO effects do not appear to adequately address the JTF commander's needs for fully understanding the implications of the decisions to be made and the results of the actions to be taken. There is a need for creative thinking to develop more effective approaches to IO visualization. User-friendly tools to facilitate building influence nets, link and node assessment diagrams and to conduct predictive assessments that include 2nd and 3rd order effects and trend analysis are needed as well.

The ONA tool suite tested in MC02 included analysis and visualization capabilities, such as, Verona, GENOA (included SIAM™[12]), Analyst's Notebook, and ArcView/ArcIMS that have potential for, and in some cases have supported, real world operations. However, these tools are not generally widely used or understood by IO planners and warriors at the JTF level. As was experienced in the Balkans and exercises and experiments, it is the authors' impression that the current tools are still too cumbersome to use in the JTF operational environment—not user friendly enough (an art not a science) and too complex to use in a high OPTEMPO and stress environment. The tools have been used successfully to help build databases such as the ONA prior to the start of the MC02 experiment and Intelligence Preparation of the Battle Field for real world operations but have not been as helpful in maintaining currency of databases during the execution phase. In addition, there are other tools that support visualization and analysis such as the Air Force IW Planning Capability, Global Command and Control System-Intelligence, Imagery and Information (GCCS-I3) capability and the Automated Deep Operations Coordination System (ADOCS) and these too have been used to support recent real world operations.

Real world operations in the Balkans, Afghanistan, and Iraq and war games and experiments all tend to use elaborate PowerPoint briefings with creative icons, embedded pictures, images and streaming video, and detailed graphics for visualizing and sharing information, including intelligence. In Bosnia, staffs preparing these briefings were referred to as "PowerPoint Rangers." While the pictures, images, and complex diagrams are informative, there were few words documenting the information conveyed by them—the words of explanation behind the pictures were missing for the stored information. Many of these briefings were stored on the homepages and databases of the collaborative information

[12] SIAM is a software application called the Situation Influence Assessment Module that is owned by SAIC, Inc.

networks and accessible by those who may have not heard the voice track accompanying the briefing and therefore, derive understanding from their knowledge or perceptions of the situation and the visual information provided—offers an opportunity for a possible misunderstanding or misinterpretation. A voice track or written description would be very useful to provide a more complete understanding of the message and points made in the briefing—this is not normally a part of the information stored.

Another favorite simple visualization technique that has been used both in war games and real world operations is the stop light charts (red, yellow or green) to illustrate progress or lack of progress and to identify and emphasize success and issue areas. Other icons such as arrows have been used in combination with words and other graphics to illustrate changes. For example, as was illustrated in the CAESAR II/EB example presented in Figure 11, a down arrow represented a shift to the negative and a horizontal arrow no change. The use of color-coding and multiple charts to illustrate changes and trends over time are other techniques used as well. Illustrative charts and analysis can be developed with the Analyst's Notebook and other tools. Color coded node and link diagrams can illustrate connectivity and influence implications, e.g., political, terrorist and religious leader links with the adversary commander and/or second and third order effects related to taking an action to physically destroy infrastructure such as a power plant which as a second order effect may disrupt the regional water distribution and sanitization systems or local hospital operations.

Identifying windows of opportunities and vulnerability and unanticipated and unintended consequences is an important EBO and IO analysis consideration. For example, while participating in Multinational Brigade East in Kosovo, one of the authors observed the Commander continuously asking his planning staff if they had considered the second and third order effects of courses of action proposed and throughout the MC02 experiment, the authors both observed the JTF commander frequently reminding the planning staff to think about the effects they were trying to achieve and to think through the intended as well as the possible unintended consequences of their proposed courses of action. Future JTF commanders can be expected to ask for, or more likely will expect analysis of, the second and third order effects of proposed actions.

The collaborative information environments used in exercises and real world operations today have demonstrated the utility of collaborative planning and information sharing and the ability to disseminate timely, fused and relevant information to establish and maintain information superiority. These information environments are enabled by secure, high-speed fully networked information systems. Electronic collaborative planning tool suites are used to virtually link the JTF, the components, and other organizations separated by geography, time and organization boundaries. The COP/CROP has proven to be an effective means for rapidly disseminating important situational awareness information. In the future, however, there will be increasingly more useful information available on these environment and this means that information discovery tools must be improved to assist the user in searching the network for relevant information and to track search actions so that sources of information can be more easily retrieved later.

Experience has demonstrated that over time as more operational information populates the databases and web sites it becomes increasingly difficult to determine the most recent source of information for the subject area being researched and to find the nugget relevant to the area being researched—one also begins to suffer from information overload. An observed intended but also unintended consequence of the improved information environment is that

the staff spend a lot of time on the collaborative information environment monitoring presentations and briefing refinement activities and conducting general surfing of the network. This suggests the need for improved procedures and tools to discipline the use of the shared information environment. On the other hand, it has been observed that once the staffs become familiar with the collaboration tools they are used extensively for building briefings, sharing information, establishing and using chat rooms and coordination of planning and assessment activities.

INFORMATION OPERATIONS OBSERVATIONS

Contrary to popular perceptions and beliefs, Information Operations are more than leaflet drops and Commando Solo broadcasts. These techniques have received the most visibility in the media coverage of the Afghanistan and Iraq conflicts but there are other techniques that include both lethal and non-lethal means to create desired effects or outcomes that influence an adversary's behavior, will, perceptions and understanding. IO attacks not only the mind of the opponent but his systems as well—actions need to support words. Joint Publication 3-13[13] defines Information Operations (IO) as "Actions taken to affect adversary information and information systems, while defending one's own information and information systems." Draft revisions to DoDD 3600.1[14] suggests changes to the definition of IO that includes influencing and defending "decision-making" and describing IO in terms of *core capabilities, related capabilities* and *supporting capabilities*.

Core IO capabilities include operations security (OPSEC), PSYOPS, military deception, electronic warfare (EW), and computer network operations (CNO—attack, defend, and exploit). *Supporting capabilities* include information assurance (IA), physical security, physical attack and counterintelligence. IA protects and defends information and information systems by ensuring their availability, integrity, identification and authentication, confidentiality, and non-repudiation. It also includes restoration of information systems by incorporating protection, detection, reconstitution, and reaction capabilities. *Related capabilities* include public affairs (PA), and civil military operations (CMO). These may very well be elevated in importance given that we, the US, engage in peace operations and related post-conflict reconstruction activities about every two years and CMO, in particular, is an important supporting capability for winning the peace. Globalization of information and the 24x7 cable network news cycle places increased importance on informing the public and world leaders and their supporters about these operations. PA communicates accurate, balanced, and credible information to critical leaders and the public. CMO establishes relations among military forces, international organizations, NGOs, the public, local businesses, and local and regional civil authorities to exchange information, build understanding and trust, and gain information. They also support humanitarian assistance and reconstruction activities. All of the IO capabilities lie on a solid foundation of intelligence support.

Today's global information environment is a complex operating space for the IO warriors and more specifically, for the roles and relationships between the military and the media. It

[13] Joint Chiefs of Staff (1998), "JP 3-13: Joint Doctrine for Information Operations."
[14] Deckro, Dick and Hathaway, Melissa (2002), "Information Operations Workshop Summary," MORS workshop at BAH, McLean, VA.

is no longer simply dealing with one's national media and the local media in the area of the conflict, now it is necessary to deal with the regional and international media who impact perceptions and influence shaping the information environment as well. The adversaries control their media and in many instances employ professional propagandists to conduct internal and global perception management (propaganda). During crisis situations both the adversary and friendly forces generate disinformation and both use the media extensively to disseminate information to mold local, regional, national, and international perceptions and opinions to help shape the landscape. Even the media has been accused of incorporating a version of disinformation by demonizing the adversary and predicting war is inevitable while the politicians are calling for diplomacy and only warn of military retaliation.[15] The 24x7 international media cycle has placed additional demands on public diplomacy initiatives and need to more effectively coordinate the government and military public information office activities and the need to improve military-media relationships. The "CNN Effect" (real-time unsubstantiated reporting from the field) continues to challenge the military and the chain of command reaction to such reports. Internet email and web sites and use of cellular and satellite phones in the crisis area provide other means for instantly communicating and informing, including disinformation and unsubstantiated reporting from the field.

Knowing and understanding the media consumption habits and social, religious, cultural, political and economic issues of the target audience are extremely important and continue to be a challenge for the information operations warriors and commanders conducting the operations. Target audiences can range from the unsophisticated to very sophisticated. Real world experience suggests that we have not done that well in understanding our target audience and winning the information war. For example, in Bosnia the PSYOP forces arrived with their traditional AM radios, print material, and loud speaker capabilities but soon discovered the target audience listened to FM radio and watched satellite broadcast TV. The IO techniques used need to take into consideration these differences in order to establish legitimacy for the operation, properly shape, influence and win the hearts and minds of the local population and leadership, to gain regional and world support, and influence the adversary's decisions. We need to be able to view things through the understanding and value system of those we are trying to influence, not through ours alone. Progress is being made but much remains to be done.

IO products and methods are maturing with experience derived from participation in real world operations. The traditional posters, handbills, leaflet drops, loudspeakers, and local and regional radio and TV broadcasts (including Commando Solo) still dominate the means of delivering the information campaign but the international media, cyberspace, and cellular and satellite phones are becoming important parts of the inventory of actions to take to manage perceptions and influence change. A more informed understanding of the cognitive aspects of operations and ability to influence the adversary and his supporters are also being pursued. As noted earlier, leaflet drops and Commando Solo radio and TV broadcasts were advertised as the dominate means for delivering IO messages in Afghanistan and Iraq and even in MC02 when the JTF commander asked for more IO, it was leaflet drops and Commando Solo that got tasked to do the job. Use of cyber network attacks, Internet emails and web sites, and Cellular capabilities have also been openly reported as new means used to help shape the information environment and influence key leaders and world opinion. Electronic Warfare techniques such as jamming and spoofing and military deception were also reportedly used extensively as well.

[15] Knightley, Phillip (2001), "The Disinformation Campaign," The Guardian, UK.

IO needs to be a proactive, continuous process that starts long before the military operation begins and troops actually are deployed and combat operations initiated and continues after the hostilities cease—it supports both winning the war and the peace. The principles of IO apply to all phases of the spectrum of operation—influence, deter, coerce, compel, defeat, transition and then influence. Work remains to be done to improve shaping the information landscape before and after a conflict. In practice, IO actions have tended to be more reactive and start later rather than in preparation for the operation. For Operation Iraq Freedom this reportedly was not the case, IO plans were more comprehensive and integrated than ever before.[16] The issue apparently was lack of leadership understanding and "will" to fully execute all elements of the plan and a lack of experienced IO warriors to execute day-to-day operations. IO actions today support the operation but need to be more effectively focused on continuing after the cessation of hostilities and beyond withdraw of military forces.[17]

Post-conflict military IO actions tend to focus mainly on support of the military security activities and to a lesser extent on establishing legitimacy for the civil-military operation to conduct humanitarian assistance and reconstruction actions. In regard to the latter, in Kosovo efforts were made to inform the local community of Civil Affairs humanitarian assistance and reconstruction activities and efforts to provide medical assistance through the Medical Community Assistance Program (MEDCAP). PSYOP-sponsored radio and TV programs provided live programs with Q&A that employed senior civil and military leaders discussing local and regional issues and activities related to reconstruction and return to normalcy. The use of Tactical PSYOP Teams to conduct face-to-face meetings with the local population and business, religious, and civil leadership were key in winning hearts and minds and helping establish legitimacy for the operation.

During the winning the peace phase, there are a number of players other than coalition military on the landscape, such as IOs and NGOs, that are also conducting their own version of IO and the challenge becomes one of collaboration, coordination and information sharing—much work remains to be done to improve Civil-Military IO planning and execution and collaboration and information sharing. The process of transitioning IO concepts into a war fighting and peace operations capability means that the related policy, doctrine, and tactical applications are being actively modified, developed and refined and therefore, until the change process is completed, IO will continue to have different meanings to different people and disconnects will exist in availability of trained and experienced personnel, capabilities, and tools and applications will differ as well.

There are a number of other factors influencing not only the ability to operationalize IO but also the introduction of war fighting concepts such as Effects Based Operations that employ IO as an enabling capability. Changing the warrior and attrition-based warfare culture to think effects and to use means other than lethal force has proven to be a challenge operationally—delivering bombs versus leaflets. It has been noted by some military officers that it would be hard to explain to a family the loss of their warfighter due to conducting leaflet drops during combat operations in spite of the fact that IO is now viewed as a warfighting capability. IO warriors have also found it difficult to convince the warfighting

[16] "Officials: Space, Info Targets Largely Cobbled On-the-Fly for Iraq," Elaine M. Grossman, Inside the Pentagon, 29 May 2003.

[17] See the DoD Command and Control Research Program web site www.dodccrp.org for examples from Bosnia and Kosovo.

commander's to reallocate (i.e., trade lethal means for non-lethal) the necessary resources and provide the needed authority for the IO warrior to effectively task and execute integrated IO operations.

It seems to be easier operationally to conduct IO as a series of separate traditional psychological operations actions such as leaflet drops, Commando Solo broadcasts, Radio/TV broadcasts, and PSYOP field teams rather than combining these actions with EW actions, deception, computer network operations, and military force to leverage the synergistic effects. Synchronization of IO actions is no different than synchronizing air-land operations and in fact military lethal force synchronized with non-lethal means may be needed to achieve the desired effect. There are also challenges using IO resources of a supporting command that are not in direct support of the operation but might be used to support crisis area operations in other ways. For example, attack out of area sources of supply, training, and economic support of an adversary. Collaboration, coordination, and synchronization of integrated operations that cross organizational and operational area of responsibility boundaries are a challenge but necessary to achieve the synergetic effect of attacking not only adversary forces within the crisis area but those outside of the crisis that provide support to them.

Although the availability of trained and experienced information warriors is improving, the pipeline of trained and experienced IO professionals is still lacking for meeting the global operational demands. Training and education also applies to the commander's and there understanding of IO and comfort level for using it operationally. IO cells supporting Joint Task Force headquarters operations still tend to be ad hoc creations and frequently are not composed of a team of professionals that have trained together in advance as a functioning IO cell before being deployed to support an operation, as would be the case for a maneuver unit. Elements such as the 1st IO Command (formerly the Land Information Warfare Activity (LIWA)) field support teams (FSTs) have been employed in the Balkans, Afghanistan and Iraq to help the JTF commander bridge the IO knowledge and planning and execution gaps.

IO tools are emerging but the vertical integration between echelons of command and horizontal integration between IO units still lack common tools to support integrated IO planning, execution, and assessment.[18] Collaboration and coordination among and between Combatant Commands, Services, and Agency activities remain problematic as well. New command arrangements such as STRATCOM's Space and IO Element (SIOE) have been created to facilitate the planning, coordination and execution of IO campaigns but the final arrangements for integrating IO into operations are yet to be fully understood, tested, and agreed.

If IO is to be viewed as a primary war fighting capability then organizationally it needs to be represented at the commander's table as other capabilities such as the maneuver forces commanders. Experience suggests that IO tends to be embedded within the Operations element or some other subordinate element of the JTF HQs command arrangements reducing its visibility to the JTF commander and its full integration into operational plans and use as a key war fighting capability. It is not an issue that IO is not being recognized by the commander and his staff because it is; the real issue is a matter of IO receiving the same recognition and use afforded other war fighting capabilities. The appropriate organization

[18] Air Force Information Warfare Center and Deputy Assistant Secretary of Defense Security and IO, "Phoenix Challenge 2003," 11-14 March 2003, Tysons Corner, VA

arrangements and location of IO functions within a Joint Task Force headquarters operation are still under consideration. MC02 tested some new concepts for integrating the activities of the SIOE, the JTF HQs IO Cell, and the Joint PSYOP Task Force (JPOTF) and as a result of this experience lot's has been learned but more work needs to be done to determine the appropriate operational command arrangement. The recent operations in Afghanistan and Iraq have used these elements as well and lessons will be derived from these experiences. The fact remains that for experiments, exercises and real world operations there continues to be overlaps in IO activities that need to be de-conflicted and better integrated. For example, in a USCENTCOM briefing on lessons from Afghanistan, it was noted that coordination between split headquarters staff, conducting Region wide IO operations and coordination with Interagency remained challenges for future operations.

Coordination challenges are particularly true for highly classified, so called "black IO," and sensitive IO related actions where many of the JTF HQs Operations and IO planning and execution staff are not likely to be cleared to know about them in advance of execution, and therefore, they cannot appropriately factor these actions into the overall JTF HQs planning, execution and assessment activities.[19] [20] [21] In these cases, ad hoc special JTF arrangements (the informal social networks that get created during operations to bridge gaps in the formal structure) are employed to facilitate coordination and de-conflicting overt and covert actions.

Visualization and assessment of the long-range impacts of IO actions are also somewhat problematic since shaping opinions and behavior are hard to visualize and the effects take time to happen. Experiments and exercises do not easily accommodate the uncertainty and long lead time of IO effects associated with the use of non-lethal means to achieve desired effects—diplomatic, social, information, and economic. Winning hearts and minds are achieved through trust relationships and trust is earned over time. Winning the peace is also a challenge for IO planning and execution. The ability to shape and influence changes in population perceptions and adversary behavior and the decision-making processes of an adversary can take long periods of time to become effective. Using modeling and simulation to predict effects can reduce the real time to fit an experiment or exercise but if it is not carefully incorporated, the results can also add artificiality.

Models and simulations that could accommodate and predict influences of non-lethal IO actions are lacking and this adds to the challenge of properly considering and assessing the impact of IO actions in the EBO planning process and real world operations. As noted earlier, elaborate PowerPoint briefings with creative icons, embedded pictures, streaming video, and images and detailed graphics tend to be the dominant mode for visualizing actions and effects. Some intellectual and creative thinking needs to be dedicated to developing techniques for IO effects visualization. The movie industry and commercial advertising and game developers may have some out of the box thinking that might serve to discover some new ways of presenting information.

Some tools are emerging and being used but this is largely work in progress. As noted earlier, assessment of effects are a particular problem for experiments and exercises where

[19] Air Force Information Warfare Center and Deputy Assistant Secretary of Defense Security and IO, "Phoenix Challenge 2003," 11-14 March 2003, Tysons Corner, VA

[20] Wentz, L. K. (1998), "Lessons from Bosnia: The IFOR Experience," CCRP/NDU publication, Washington, D.C.

[21] Wentz, L. K. (2002), "Lessons from Kosovo: The KFOR Experience," CCRP publication, Washington, D.C.

there is a limited time of play that introduces some artificiality into assessing the end impact of IO actions. Few tools and models and simulations exist to develop IO courses of action and to assess the effects of these actions for real world operations as well. As a result, IO Plans Cells use of tools to help examine and assess the PMESII effects and DIME actions over time are lacking. This is where the CAESAR II/EB tool could be of some assistance in developing and assessing IO-related courses of action. Additionally, it is difficult for IO Cells to effectively predict achievement of effects and in this regard, agreed measures of performance and effects (MOPs and MOEs) are lacking as well. The Intelligence, Surveillance and Reconnaissance capabilities tend not to be IO effects oriented and therefore, there is a need to adapt and shape these capabilities to facilitate IO targeting and collection of effects of IO actions.

There is also an artificiality introduced by war games, experiments, and exercise regarding the information campaign PSYOPS product development and testing (leaflets, scripts for Commando Solo broadcasts, and other material) and effects assessments since there generally is no "real world target audience" participants playing and many of the time lines for achieving effects exceeded the duration of the experiment and exercise. IO product testing and the equivalent of Battle Damage Assessment (BDA) for an information campaign are challenges yet to be adequately addressed and solutions provided. The product pre-testing and approval process needs to include those who will be message recipients or understand the likely reaction of those who will receive the message—view through the eyes of the target audience or surrogate SMEs not the friendly forces perception of how the target audience might react. Information campaign effectiveness assessments are difficult to conduct as well since TTPs and the MOEs and MOPs are still being developed and tools to recognize and assess IO effects are lacking. Linking effects to nodes to actions to resources is a challenge. First order effects such as physical destruction are easier to understand than the more intangible second and third order effects that reflect aggregation of actions and accumulated effects and subjective effects such as attitude and perception changes.

ISR systems and capabilities need to be tailored and tasked to collect IO effects—it's more than HUMINT which also has its own set of challenges related to availability of trained and experienced staff and de-confliction of competing activities on the operational landscape. Assessments need to be more than number of leaflets drop per unit area or radio/TV broadcast time and area coverage. For example, during the combat portion of operation Iraqi Freedom, it was reported that some 36 million leaflets were dropped and some 300 hours of Commando solo broadcasts were made and although these efforts had impacts on defections and surrenders of military forces, it did not produce the anticipated surrender of senior leadership. Assessments need to make sure that the messages are being received by the target audience and that the intent of the message developed in English was the message received in the target audience language and that they understood the intent of the message. This means that the translators that help develop the products need to be capable of reading, writing and comprehending and that the product developers need to understand the political, social, religious, symbolic, taboos, and cultural sensitivities of the target audience and of the messages and means by which they are delivered. For example, in Bosnia a poster had the picture of a young girl running through a field of high grass to denote freedom of movement. However, in Bosnia, a field of high grass implied there might be a minefield. Assessment also has a monitoring element to ensure the message is getting out and for quality control of the products and damage control in the event an unintended consequence needs to be rectified.

Computer Network Operations (Computer Network Attack, Defend, and Exploit) are difficult to incorporate in large, broad-based experiments and exercises. CNA/CNE staff can explore possible options and conduct planning but there are limited possibilities to actually follow through on proposed plans and actions. There are limited mechanisms to test the coordination and approval process for CNA/CNE activities and the ability to simulate effects of CNA actions is limited as well. Use of telecommunications and cell phones as an attack means have similar challenges in support of exercises and experiments as well. CND and Information Assurance also tend not to be adequately addressed in experiments and exercise in terms of intrusion detection, protection and recovery in response to simulated computer network attacks or virus introductions into the supporting information network. The argument normally used by the exercise and experiment directors is that the primary focus of the experiments and exercises are to evaluate concepts and C4ISR capabilities and the use of the collaborative and distributed planning environment and that the operational impact of losing the information systems during the experiment or exercise are not considered part of the objectives of the experiment. Operational impacts of network vulnerabilities certainly need to be examined in future experiments and exercises—operational network performance and recovery under stress such as high usage demands, computer network attacks, virus infections, and key node and link failures need to be better understood, especially if there is limited (or no) manual backup to support the operational command and control and information sharing capabilities.

In addition to protecting information systems, there is also protecting one's own information. In an operational environment, the IO Cell plays an important role in support of CND activities as well as OPSEC by monitoring the means for protecting and storing information and monitoring, reviewing and assessing JTF generated material that will be released by the command for public consumption and by the commander and staff activities related to interviews with the media and meetings with key military, political and religious leaders. Computer Emergency Response Teams monitor intrusion detection systems and reporting and take corrective actions when violations are identified. Red Teams are used to monitor and detect OPSEC violations and assess vulnerabilities of information and communications systems supporting operations. Open literature search of local and international (translated into English when necessary) media reports and web sites provide important insights into perceptions and misperceptions of the operation and whether the IO message intended was in fact the message received, reported and understood by the target audience.

Intended and unintended misuse of communications and information systems by military and civilian staff is a key element of not only Information Assurance but OPSEC as well. For example, in the information age, details on military and government web sites and military personnel homepages and discussed in emails to home can inadvertently inform others, including the adversary, of intentions, capabilities and vulnerabilities. In the Kosovo operation, aerial maps of the US Camp Bondsteel showed up in a Serb newspaper and photographs of sensitive facilities and military equipment showed up on soldier generated personal web sites. OPSEC plays an important role in the coordination of fires, maneuver and IO because it is import to deny the enemy critical information about friendly force capabilities and intentions. Likewise, OPSEC has a deception piece as well that allows certain information to be made available to the enemy in support of deception operations. Consideration of unintended consequences of OPSEC short falls has and continues to be a challenge to appropriately incorporate into the effects-based IO planning and assessment activities.

Information sharing is not a natural proclivity for many of the organizations and actors involved in coalition military war fighting and peace operations. Military and intelligence organizations are not accustomed to sharing data with international and NGO organizations, and vice versa. For operational security reasons, there is a continuing reluctance on the part of the military to share even a small and highly selective element of time-sensitive operational information with anyone other than military—especially with multinational political bodies and civil organizations. Even for military-to-military sharing, strict need-to-know rules are applied. Fears that data will be misused or that databases contain inaccuracies also work against open information sharing. Sharing of information[22] must become more than exchanges between platforms and services—it should extend to the interagency community, coalition partners, law enforcement, and IO and NGO communities.

Even in military-to-military sharing, not all nations in a military coalition are treated as equals. Many partners in today's operations are former enemies in the cold war, so there are different levels of need-to-know restrictions placed on sharing sensitive military-related information with them. On the other hand, there is a need for the Western nations to learn how to make better use of the military intelligence and political and cultural insights that these former enemies bring to the table in support of coalition peace operations, especially in areas where they may have more experience and understanding of the environment—the Balkans, Afghanistan and Iraq being prime examples.

NGOs and the media are concerned about maintaining the perception of their neutrality and are afraid of being perceived as pawns of military intelligence organizations. Therefore they are hesitant to work too closely with the military. In addition, they do not always share the same objectives, and are suspicious of national government intentions. NGOs need certain information or assistance from the military, such as weather, threats, military movements, and hostage rescue or evacuation parameters, if needed. They would like to know about the availability of military transportation and security services in order to help carry out their humanitarian assistance activities. On the other side, the NGOs in particular, have insights useful to the military. They generally have a greater knowledge of local conditions and they know how to accomplish things in the locale, broker cooperation from key locals, and can identify potential problems and humanitarian assistance needs.

There is a need in the peace support phase of operations to increase trust and improve the ability to share the information necessary to achieve both the civil and military goals. This must be done without undermining the International Organizations' and NGOs' neutrality and the military's sensitivities to exposing operational security information. This is a fine line to walk; but it can be done if everyone is sensitive to one another's concerns. In Kosovo, UNMIK, KFOR, and the NGOs seemed to have a reasonably good working relationship. They met frequently to coordinate and inform each other on activities of mutual interest. Information centers were established throughout Kosovo by the military and the UN. They were used by UNMIK, OSCE, KFOR and its MNBs to provide a means for improving collaboration, coordination, and information sharing among the various actors, including the international and local NGOs and all local ethnic groups. Civil Military Operations Centers were used throughout Afghanistan in order to enhance coordination with NGOs, IOs, and civilians. In Iraq, months of negotiation took place between military and civil organization elements to explore post-conflict arrangements for working together. In spite of these

[22] "Joint Forces Quarterly," Institute for National Strategic Studies, National Defense University, Summer 2002 issue.

negotiations, there remain issues of military control versus civilian control and the reluctance of the NGOs and others to be viewed as under control of the military—NGOs, in particular, view themselves as independent and impartial. The UNs Humanitarian Operation Center, patterned after the Humanitarian Community Information Center in Kosovo, is being used to share critical information among the civil-military participants in Iraq.[23]

SOME THOUGHTS FOR THE FUTURE

Both the R&D and the operational communities have been evolving and refining the concept of effects based operations and information operations. On the R&D side, some tools to support an effects based analysis of COAs have been developed. CAESAR II/EB, as one instantiation of this type of tool, has been used in operationally realistic war games and experiments in collaboration with the operational community. This experience has enable the researches to better understand the needs of the operator and to expand the researcher's repertoire of modeling types and techniques to provide support to different classes of problems. GMUs participation in the war games and experiments has been both challenging and rewarding, and the team members viewed the participation as a worthwhile exercise. There were positive learning experiences. It was felt that the GMU team was able to contribute in a modest way to each event. The team also gathered a great deal of insights about the integration of IO into EBO and the use of a CAESAR-like tool in the theater and tactical environment. The use of a collaborative information environment to support EBO and IO course of action planning and assessments was a useful and interesting experience. An interesting research effort would be to use the CAESAR II/EB-like tool on a collaborative information environment where the decision-maker, modeler, analysts and subject matter experts were geographically and organizationally separated.

Three variants of basic effects based models that were created with the CAESAR II/EB tool were presented. As in many cases, a good tool has multiple uses. GMU has discovered several through our war game inspired experimentation with the tool. The uses we have described in this paper span the spectrum from COA development and selection, to the inclusion of evidence from ISR to reduce uncertainty in the COA model, to overall assessment of multiple effects. We think that the tool or its successor can provide a unifying framework for effects based operations across echelons and across the process of COA selection, planning, execution and assessment. Perhaps the largest challenge ahead is to develop a cadre of analysts within the operational community who can quickly create these types of models—it's an art not a science. Members of that cadre should be made available at multiple echelons of the command and control structure. The cadre could continuously coordinate the development and maintenance of their models as they support the planning, execution and assessment process. As we continue to increase our understanding of the use of this basic model and the techniques and procedures that support those uses, we should begin to be able to better support the operators as they conduct effects-based operations and IO planning and assessments.

There is a need to develop a concept of operations for future experiment and exercise support arrangements that allow outside teams, such as the GMU team, to actively participation from the initial planning stages through AAR phases. Arrangements also need

[23] "Reconstructing Iraq: A Guide to the Issues," a joint publication of the Open Society Institute and the United Nations Foundation, May 2003.

to be made to accommodate the integration of the team into the appropriate element of the operational planning staff with pre-approved authority to access the required decision makers, SMEs, planners, analysts, tools and databases, and operational activities necessary to gain the insights and support required to construct appropriate COA models and conduct effects assessments to meet the needs of the experiment or exercise. In a CIE-like environment, team members should be given the equivalent of the Information Work Space (IWS) terminal used in MC02 to allow them to participate in all appropriate activities and access databases and web sites.

Operationalizing IO and integrating IO into EBO is work in progress and much remains to be done. Evolving a concept to an operational capability spans culture change, organization, training and education, doctrine, CONOPS, Tactics, Techniques, and Procedures (TTP), and M/S tools and C4ISR capabilities to facilitate the planning, execution, and assessment of IO and EBO courses of action. The following are some general observations:

- In addition to making IO a war fighting capability and military core competency, it also needs to support winning the peace. Attention therefore also needs to be focused on developing IO concepts, capabilities, training and tools for transitioning from warfighting to conducting post conflict support to "win the peace" phase of operations. This transition requires the introduction of more effective collaboration, coordination and information sharing capabilities to meet the needs and demands of a mixed civil-military environment. The rules of engagement and target audience for winning the peace also differ from the war fight environment. Public diplomacy plays an important role and not only contributes to establishing legitimacy but also to setting local, regional and global expectations as well.

- IO is more than leaflet drops and Commando Solo broadcasts, especially in the new world of global information and the 24x7 international media cycle. Cyber warfare has come of age as well. Information Operations, therefore, requires a comprehensive and integrated strategy from the inception of the operation through post-conflict and return to normalcy. In order to shape the landscape, IO needs to be employed before an operation begins and then continue throughout the conflict phase and then into the post conflict phases. The commander and staff need a clear understanding of the end state and it is essential that they know and understand the target audience and its sensitivities, habits and behavior.

- IO needs to use multiple means to convey information. One must also be careful not to raise unattainable expectations with an information campaign. Additionally, to be effective, actions need to support words. Knowing and tailoring your IO products to meet the needs of your target audience and behavior patterns remains key to success.

- IO requires the military commander's personal involvement and leadership and it must be a key element of his plans and operations staff—the IO leadership needs to sit at the table with the commander as other war fighting elements. The use of a Joint IO Task Force may be a way to elevate its status within the JTF organization.

- Better tools, including modeling and simulation capabilities, need to be provided to facilitate IO courses of action planning and assessments and to simulate effects of IO actions in support of experiments and exercises. Such tools need to be able to assess the success or failure and to help identify and clarify intended and unintended consequences of IO actions. In this regard, creative thinking needs to be focused on developing better means to visualize the effects of IO actions.

- It is important to not only understand the relative importance of IO in support of ongoing operations but to also understand the cumulative impact of past and present operations and the impacts of global and regional perceptions and expectations set by these operations that may establish unanticipated challenges that could influence and cause unintended impacts on future operations. Current operations and actions can and do have longer-term impacts that need to be understood as part of the planning and assessment process—2nd, 3rd and other order effects.

- Improved ISR tools and capabilities are needed to recognize the effects of IO actions and to facilitate tasking ISR collection of the effects of IO actions, including more effective use of HUMINT assets. Improved ISR systems tailored to targeting and collecting the effects of EBO and IO actions are needed as well.

- Measures of effectiveness and performance are needed to support IO planning and assessments and indicators need to be developed to guide ISR tasking activities and development of new collection capabilities.

- Joint and Service professional military education and training programs are needed to address EBO and IO thinking and course of action planning and assessment. There is a need to develop a training program to produce IO warriors, analysts, and decision-makers. In addition, the military system needs to treat IO as a military career field equivalent to other war fighting fields so that IO cells can be populated with experienced information operations warriors that have been trained in advance as an operationally ready, effective fighting element. Similar needs exist for the winning the peace aspects of operations.

ACKNOWLEDGEMENT

The contribution of the GMU System Architectures Laboratory staff: Dr. Insub Shin, Mr. Daesik Kim, and Mr. Sajjad Haider in the development of CAESAR II/EB is gratefully acknowledged.

The opinions, conclusions, and recommendations expressed or implied within are solely those of the authors. They do not necessarily represent the views of the Department of Defense, or any other U.S. Government Agency or George Mason University.
