

**2004 Command and Control Research and Technology Symposium
The Power of Information Age Concepts and Technologies**

**Predictive Battlespace Awareness: Linking Intelligence, Surveillance
and Reconnaissance Operations to Effects Based Operations**

By

Major Robert A. Piccerillo, USAF

And

David A. Brumbaugh

Major Robert A. Piccerillo, USAF
Headquarters, Air Force (AF/XOIR)
Intelligence, Surveillance, Reconnaissance Directorate
Air and Space Operations
Pentagon
Washington, DC 20050

Office (703) 697-4847
(703) 995-6855
Cell (571)-228-2726

robert.piccerillo@pentagon.af.mil

David A. Brumbaugh
Science Applications International Corporation (SAIC)
4501 Daly Drive, Suite 400
Chantilly VA 20151

Office (703) 814-7721
Fax (703) 817-9602
Pager (866) 693-0364

david.a.brumbaugh@saic.com

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE JUN 2004		2. REPORT TYPE		3. DATES COVERED 00-00-2004 to 00-00-2004	
4. TITLE AND SUBTITLE Predictive Battlespace Awareness: Linking Intelligence, Surveillance and Reconnaissance Operations to Effects Based Operations			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Headquarters, Air Force (AF/XOIR),Intelligence, Surveillance, Reconnaissance Directorate,Pentagon,Washington,DC,20050			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 19	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

2004 Command and Control Research and Technology Symposium The Power of Information Age Concepts and Technologies

Abstract

Today, both traditional and non-traditional Intelligence, surveillance and reconnaissance (ISR) assets are not postured to effectively support effects based operations (EBO). Specifically, ISR *should* be focused to perform confirmation rather than discovery missions. Although elements of this idea occur in doctrine it is only now after experience in Afghanistan and Iraq that the separate elements of ISR are moving toward a predictive environment. More significantly, the link between anticipatory ISR and EBO is starting to emerge.

The approach to this issue will be to describe and expand upon existing doctrine. The paper will identify such doctrinal sources as Joint, Multi-Service or Service doctrine for clarity. It will describe the elements of Predictive Battlespace Awareness (PBA) and how they are linked to EBO. It will show current shortfalls in the PBA process and describe possible means of improvement.

Introduction

The goal of an effects-based approach is tracing and understanding how physical actions influence an attacker or enemy commander's behavior. Operations in Afghanistan and Iraq have demonstrated the value of using discriminate force to achieve desired effects. This is made possible by improved ISR, shared situation understanding, access to human intelligence (HUMINT) reporting databases to derive possible intent, improved individual collaboration, greater agility, and other emerging technologies. Key enablers of this new style of war are persistent ISR, targeting, collaboration with other participants, preparations during peacetime, *predictive intelligence*, improved speed of command (the time it takes to recognize and understand a situation or a change in the situation), identify and assess options, select an appropriate course of action (COA), and translate it into actionable orders, and fast, accurate assessments.

This link is seen in the products of PBA. PBA is an evolving methodology briefly described in Air Force Pamphlet (AFPAM) 14-118 *Aerospace Intelligence Preparation of the Battlespace*.¹ PBA is intended to drive ISR toward a more proactive, anticipatory mode of operations rather than a reactive, discovery mode.

The adverse impact on command and control becomes especially evident with the employment of ISR assets such as Predator and Global Hawk. These assets can be employed in either a surveillance or reconnaissance role. However the adverse impact of switching back and forth between these roles abruptly causes loss of collection and inefficient use of ISR. On a larger scale, ISR operations are not synchronized with EBO. The key to focused, anticipatory ISR operations is the integration of military air, ground & space-based platforms, Special Operations, and commercial assets with the PBA/EBO construct. Horizontal and vertical integration of C4 and ISR assets combined with advanced anticipatory capabilities will provide commanders the means to focus ISR

¹ Air Force Pamphlet 14-118, *Aerospace Intelligence Preparation of the Battlespace*, 5 June 2001, pp. 6-7.

2004 Command and Control Research and Technology Symposium

The Power of Information Age Concepts and Technologies

operations and quickly re-task these assets to target anticipated adversary actions to achieve desired effects.

PBA begins with commander's guidance, intent, and IPB. More specifically, the first three steps of IPB i.e., define the battlespace; describe the battlespace's effects; evaluate the adversary. The fourth step, in which the adversary's potential COAs are developed and analyzed, is critical. This fourth step of IPB produces targets for attack and ISR collection. These products result from an analytical process that involves wargaming possible solutions based on the desired effect or outcome selected by the commander.

This paper describes an operational context within which a PBA environment, i.e., ISR support to EBO, integrates national, theater and tactical surveillance and reconnaissance assets to support ISR strategy and planning. The paper also discusses how the products and methodology of PBA provide a more efficient balance between surveillance and reconnaissance roles and better, more anticipatory support to EBO.

The result of this paper can have a significant impact on warfighting doctrine and training. It also shows a means in which the technical and procedural methodology of the PBA process can be synchronized with EBO. Most importantly this paper provides details upon which the Joint, Multi-Service, and Service doctrine can expand to include these transformational concept.

Linking EBO and PBA

Through a web based battlespace management environment operators and analysts can access the same dynamic common operating picture and be capable of selectively applying filters to provide users from across the room or around the world the ability to *visualize, collaborate, access and fuse data* for improved "shared awareness," promoting the commander's ability to anticipate and focus ISR assets to confirm activity and achieve effects. These principles provide the best opportunity to achieve the success envisioned by the Joint community and link EBO and PBA processes.

In addition to the above principles, the principles of targeting provide a natural link between EBO and PBA. There are four targeting principles and all apply to PBA:

- Focused—Focus on achieving the campaign's objectives.
- ***Effects-Based***—Target analysis examines all possible means of producing specific, desired effects based on all forces, weapons, and platforms available.
- Interdisciplinary—Targeteers reach beyond intelligence disciplines to many other areas of expertise outside intelligence.
- Systematic—Targeteers use a rigorous approach to achieve the campaign's objectives by creating effects in a systematic manner.

Targeting as a methodology is "a means to achieve the [Joint Force Commander's (JFC)] operational objectives."² By applying these four targeting principles within the PBA

² Jp 3-60

2004 Command and Control Research and Technology Symposium

The Power of Information Age Concepts and Technologies

process we can link EBO to the targets developed and analyzed in PBA. In short, “Effective targeting is distinguished by the ability to identify the targeting options, both lethal and nonlethal, to achieve the desired effects that will support the commander’s objectives.”³

To further this linking concept we must recognize that it is essential to link objectives with effects, weapons, delivery capabilities and ISR capabilities to assess signatures of the effects. As part of the assessment of operations targeteers can categorize the desired effects into direct or indirect effects. Usually direct effects are easier to discern and recognize.⁴

EBO Defined

EBO is defined as actions taken against enemy systems designed to achieve specific effects that contribute directly to desired military and political objectives. *It is important to remember that it is the effect that is achieved by destroying the target that matters, not the destruction of the target itself.* EBO requires military commanders and planners to comprehensively link to the greatest extent possible, strategic objectives to each tactical action. The underlying premise of EBO is that affecting a specific target set in a particular manner may have functional, systemic or psychological effects well beyond those created through simple destruction or degradation of the target set. The challenge is to shift from an approach that “services targets” toward a methodology of producing effects that accomplish specifics objectives in line with national policy goal;. Therefore, EBO is a way of thinking or a methodology for planning, executing and assessing operations designed to attain specific effects required to achieve desired national security outcomes. “Effects-based” connotes action to produce a distinctive and desired effect.⁵

PBA Defined

PBA is the state of awareness achieved and maintained by the commander allowing him to correctly anticipate future conditions, focus ISR assets, shape the battlespace, and drive an adversary to the COA the friendly commander prefers to achieve campaign objectives. PBA is a continuous process, providing visualization, intelligence analysis, exploitation, collaboration and operational wargaming activities to derive friendly and adversary COAs. When combined with dynamic command and control (C2) and operational expertise, PBA gives the commander the ability to deploy ISR assets on confirmation rather than discovery missions.

PBA and EBO are interdependent concepts. They are inextricably linked and mutually supportive. Both require a mature understating of the entire battlespace and multiple options (branches) and follow-on operations (sequels). Moreover, both disciples are ultimately concerned with shaping the battlespace and decisively affecting the

³ Joint Publication 3-60, *Joint Doctrine for Targeting*, 17 January 2002, p. I-5.

⁴ Ibid. pp. I-6 – I-7.

⁵ Air Combat Command (ACC/XP), *Effects-Based Operations*, ACC White Paper, May 2002, pp. 3-4.

2004 Command and Control Research and Technology Symposium

The Power of Information Age Concepts and Technologies

behavior of the adversary. The marriage of PBA with EBO must be seamless, i.e., anticipating the adversary's actions then driving the adversary toward a specific COA to achieve desired objectives based on an effects based plan.

The commander's level of awareness is achieved through the full integration of four key elements continuously refined in parallel to provide a seamless understanding of the battlespace:

- Intelligence Preparation of the Battlespace (IPB),
- ISR Strategy and Planning,
- ISR Execution, and
- Assessment.

IPB: Identifying and Selecting the Adversary's COA

IPB is a systematic, rigorous process of analyzing the threat and the effects of the environment involving four steps:

- (1) Define the Battlespace,
- (2) Describe the Battlespace's Effects,
- (3) Evaluate the Adversary, and
- (4) Determine the Adversary's COAs.

Intelligence and operations planners proceed through the process of evaluating potential target systems and individual targets for their significance, vulnerabilities, and exploitable characteristics (both kinetic and non-kinetic) to achieve desired battlespace effects. Analysts dissect the target system identifying its elements and determining in detail how it functions. Within that framework the target analyst then describe those critical vulnerabilities that will neutralize components or the whole of the target system, again, depending on the desired effect. While EBO depends on this approach, decision makers and planners must have a clear idea of what they are trying to accomplish, actions that might be taken to that end, and how proposed actions contribute to the desired end-state. IPB and EBO connect clearly stated objectives to proposed actions through process of logic, historical analysis and wargaming, and refine them to operational plans through the strategy-to-task methodology. EBO require military commanders and planners to comprehensively link to the greatest extent possible, strategic objectives to each tactical action.

The strategy that emerges from this collaborative effort is an effects-based plan designed to drive the adversary to the COA selected by the commander. This allows a commander to "play out" COA options to find critical information requirements (CIR) and provides the basis for intelligence collection and synchronization in support of COA development and analysis.

At this point, named areas of interest (NAI) are also developed highlighting key decision points or areas where key adversary activity is likely to occur and indicate the adversary's desired COA. Furthermore, target areas of interest (TAI) are also defined for ISR assets to collect against. TAIs are points or areas where the adversary's key assets

2004 Command and Control Research and Technology Symposium

The Power of Information Age Concepts and Technologies

for the success of each COA will be used. Ideally, these are places where the adversary will be vulnerable and as such these are high value targets (HVT). Logically, the elimination of HVTs reduces the chance of success of a given adversary COA and forces the adversary to ultimately choose the COA preferred by the JFC. This is supported by the concept of deploying ISR assets on confirmation rather than discovery missions, effectively shrinking the operational size of the battlespace and achieving ISR persistence.

ISR Strategy and Planning

Analysis derived from IPB and effects-based planning is used to focus ISR assets for employment and sequencing to confirm selected COAs. Generally, however, ISR assets are among the scarcest in a theater. Hence, ISR strategists and planners must seek to optimize disparate requirements with scarce resources in a timely and efficient manner. Critical to this is the addition of improved HUMINT data and reporting to provide added context for what is remotely observed through imagery, signals and measurement and signatures intelligence disciplines. Furthermore, like EBO planning this must be as continuous and dynamic as the operational cycle. This is why ISR planning must be fully integrated within the IPB process. A key factor impacting ISR strategy development are access to available sensor mix, cueing, and the ability to visualize, integrate and layer the entire common operating pictures.

ISR Execution

ISR Execution requires the seamless integration and synchronization of ISR operations with the overall effects-based campaign plan and focused by PBA. However, rapid response to changing battlespace events necessitates ISR visualization capabilities and a process that is responsive to the commander. During the execution phase of PBA, a fused picture of friendly, neutral and adversary forces, capabilities and locations are required. By fused we mean, "ISR-derived information from many sources is combined, evaluated, and analyzed to produce accurate intelligence."⁶ One particular challenge is battlespace visualization of attained and emerging effects, both intended and unintended, that result from friendly and adversary actions. ISR Execution monitors and analyzes adversary activity and supports all aspects of the targeting process to include assessment. This is a dynamic process and requires agile and layered visualization, collaboration and dynamic C2.

To detect dynamic targets, operations and intelligence staffs must work closely with operators and targeteers to determine accurate, identifiable and especially, timely requirements for collection systems that are fed to the ISR visualization toolset. Theater sensors and their platforms may be cross-cued or re-tasked to rapidly detect, identify and continuously track TSTs, thereby providing situational awareness necessary for flexible and timely support to decision makers. The goal is a seamless transition between collection and targeting.

⁶ Air Force Doctrine Document 2-5.2, *Intelligence, Surveillance, and Reconnaissance Operations*, 21 April 1999, p. 11.

2004 Command and Control Research and Technology Symposium

The Power of Information Age Concepts and Technologies

The execution phase of the ATO cycle represents a dynamic process to command and control air and space operations. ISR operations monitor and analyze adversary activity as well as support lethal and non-lethal targeting. They must also be postured to anticipate events that drive changes to the ATO and adapt quickly to dynamic battlespace conditions. ISR employment, based on continuous assessment and reassessment, enables the seamless transition from pre-planned missions to dynamic tasking and cross-cueing of ISR assets.

Assessment

The iterative process of evaluating how each PBA component is contributing to the commander's overall understanding of and ability to shape the battlespace. Without a plan that synchronizes intelligence collection operations with combat operations, success or failure of the EBO plan cannot be adequately determined. The operational requirement is to generate actionable assessments for the commander. This cannot be achieved without inculcating effects-based approaches throughout the operational cycle of planning, executing and assessing force employment.

Not only are analysts attempting to determine if the desired effects are being achieved, but also assessing the effectiveness of the ISR plan. This requires not only a real-time fused ISR picture and access to BDA products, but also an agile C2 architecture to focus and re-focus ISR assets quickly. Assessment must be accomplished in timeframes dictated by the operation and not by the timelines traditionally observed in the Intelligence Community. Surveillance may begin to predominate over more traditional reconnaissance, i.e., increasingly viewing and measuring the effects of combat operations in real-time.

ISR Visualization

Critical to the PBA concept is the commander's ability to visualize the ISR common operational picture (COP). ISR visualization will significantly enhance the commander's ability to prosecute operations and focus assets where they are needed most. By providing the capability to maximize the use of limited ISR low density/high demand assets, the commander's battlespace awareness is magnified and his ability to command and control forces vastly improves. The ISR battlespace management environment allows for a scalable, layered view of the battlespace. Being able to display the ISR COP over red and blue force dispositions, terrain effects, weather, electronic order of battle, HVTs and NAIs, a vast amount of situational awareness is provided for improved decision making accuracy and speed of command.

The intent of an ISR battlespace management environment is to make national, theater and organic surveillance and reconnaissance more interactive or complimentary, not to duplicate or compete with national or theater level collection management functions and systems. It depicts for the all-source analyst the information content available and permits the analyst to determine relative confidence in the analytical

2004 Command and Control Research and Technology Symposium

The Power of Information Age Concepts and Technologies

products that result. The integration of national and theater information begins with the visualization of all sensors' field of view or regard.

The PBA Cycle

PBA is a continuous process, and relies on thorough assessments to assist the commander in determining future information requirements, linked to objectives and desired effects. Using PBA-derived understanding as a baseline, intelligence personnel provide objective assessments to operational planners to wargame and gauge the overall impact of military operations against adversary forces, evaluate the command's collection strategy to include current priority intelligence requirements, and provide an assessment of likely adversary COAs. Once the commander selects the preferred adversary COA, operations, intelligence and IO planners will wargame the COA in order to form and publish focused effects-based operations plans.

At the beginning of the cycle, the challenge is determining where and when to focus attention in order to influence events early, and begin setting conditions for future operations. Therefore, IPB is essential to supporting the visualization process, and anticipating critical decision points during operations. Using pre-conflict analysis, operations, intelligence and IO planners may anticipate when and where action will occur and then focus on broad friendly, adversary and neutral force interactions (action, reaction, counter-action dynamics) in the area of operations to determine the most effective way to achieve the commander's desired effects.

As events and threats evolve during combat operations, events escalate and efforts focus on specific area of operations, analysts can provide input through command collection managers to posture theater national, and other non-traditional ISR assets in anticipation of significant events to help maintain situational awareness and confirm targets. Collectively, analysts will create an in depth understanding of the battlespace to provide the combatant commander with an understanding of the adversary as a complex—though exploitable—system of interrelated systems (human and machine as well as fixed and mobile). The IPB process creates a broad and in-depth understanding of the adversary and the battlespace environment and help identify, assess, and estimate the adversary's centers of gravity, NAIs, high value and high payoff targets, critical vulnerabilities, capabilities, limitations, intentions and potential COAs. The goal is to derive an effects-based plan that forces the adversary to the COA selected by the JFC!

Based upon comprehensive analysis derived from IPB and the EBO plan, ISR planners can focus and properly sequence ISR operations on critical "decision points" to confirm anticipated activity and satisfy joint force intelligence and effects-based requirements.

Maintaining PBA throughout a crisis requires an operational architecture capable of monitoring, evaluating, updating, tasking, controlling, and managing forces in real-time over large and dispersed operational areas. Integrating aircraft, unmanned vehicles, space-based platforms, HUMINT and commercial assets will deliver focused ISR,

2004 Command and Control Research and Technology Symposium

The Power of Information Age Concepts and Technologies

unmatched perspective of the battlespace, and access to areas normally denied to conventional airborne collection assets,. Integration of C2 and ISR assets will provide commanders the means to rapidly assess the full spectrum of military operations.

Analysts operating within the battlespace management collaborative environment will disseminate information at the appropriate level in time spans that permit informed decisions. This will be accomplished via chat and by publishing finished intelligence products to a URL. Once published, an automated e-mail message will be generated and disseminated to pre-identified customers, notifying them of newly published products.

Once operations have begun to secure strategic objectives, commanders prepare their forces for future operations. This is particular vulnerable time as joint warfighting command structures are changed for occupation or reconstitution and joint and inter-agency C2 forces shift emphasis from declining crisis to emerging warning problems in other operations areas. Although force protection operations become increasingly important, post-conflict operations also consist of activities that have political, economic, and diplomatic impact. Therefore, the commander must maintain a degree of PBA that ensures flexibility for future operations ranging from the resumption of hostilities, force protection, to redeployment.

Conclusion

PBA is an important, near-term enhancement integral to the current EBO. While promising, fully implementing the PBA/EBO methodology will not be easy. No concept can ever completely remove the “fog and friction” of political action and warfare. There are too many variables and such activities always involve numbers of thinking, adaptive human organizations. Most often the problem would seem to be out-thinking an adversary. Properly applied, the PBA/EBO methodology offers tremendous promise for helping to solve this problem, allowing us to move into the future and transform the nature of warfare from solely force application to embracing all elements of national power in an integrated and focused methodology. This paper is the foundation for the evolution of PBA/EBO concept and for developing a PBA/EBO TTP document that will enable combatant commanders to create preemptive, decisive, full-dimensional effects throughout the battlespace—anywhere, anytime.

Predictive Battlespace Awareness

**Linking Intelligence, Surveillance and Reconnaissance
Operations with Effects-Based Operations**

David A. Brumbaugh

Science Applications International Corporation (SAIC)

Intelligence & Information Solutions Division

4501 Daly Drive, Suite 400

Chantilly VA 20151

28 May 2004

Introduction

- Intelligence, surveillance and reconnaissance (ISR) operations are not postured to support effects-based operations (EBO)
 - ISR should **anticipate the adversary**
 - ISR should be focused on **tracking**, not discovery
- Efforts to produce a more anticipatory ISR environment may become the basis for ISR linkages to EBO
- Predictive Battlespace Awareness (PBA) is a methodology briefly defined in Air Force Pamphlet (AFPAM) 14-118 *Aerospace Intelligence Preparation of the Battlespace* that focuses ISR on anticipatory operations

Definition of Effects-Based Operations

- ...[A]ctions taken against enemy systems designed to achieve specific effects that contribute directly to desired military and political objectives.
— *Effects-Based Operations*, Air Combat Command White Paper, May 2002
- In achieving the [Joint Force Commander's] objectives, targeting is concerned with producing specific effects...The art of targeting seeks to achieve desired effects with the least risk, time, and expenditure.

— *Joint Publication 3-60, Joint Doctrine for Targeting*, 17 January 2002

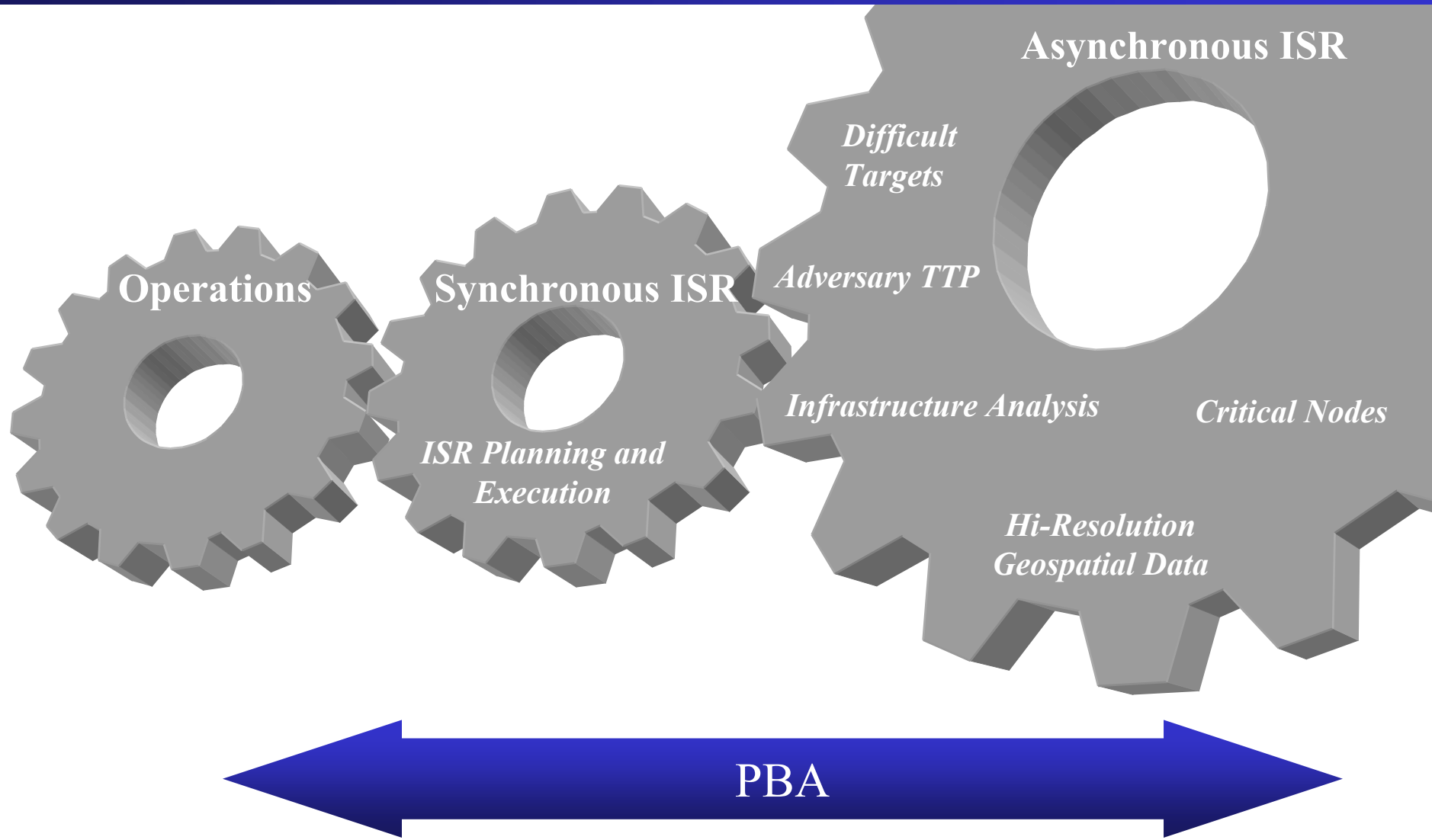
Definition of PBA

- PBA is the state of awareness achieved and maintained by the commander allowing him to correctly anticipate future conditions, focus ISR assets, and shape the battlespace
 - A coherent framework that maximizes the capabilities of ISR assets across the spectrum of operations
 - Drive the adversary to the course of action preferred by the friendly commander
- A continuous process providing visualization, exploitation, collaboration, re-tasking, processing and dissemination of information to the appropriate level in an intensely dynamic environment

Elements of PBA

- 4 Steps
 - Intelligence Preparation of the Battlespace
 - ISR Strategy and Planning
 - ISR Execution
 - Assessment
- PBA recognizes that some aspects of ISR can be synchronized to the tempo of operations *and some cannot*

Synchronous vice Asynchronous ISR



How PBA Works

Intelligence Preparation of the Battlespace (IPB)

Define the Battlespace

Describe Battlespace Effects

Evaluate Adversary

Determine Adversary's COAs

Doctrine
(behavior)
and OB

Products of IPB
are *Decision Aids*

Decision Aids

Geospatial
Weather
Targets
COA, NAI, TAI*

*COA – Course of Action
NAI – Named Area of Interest
TAI – Targeted Area of Interest

4 Elements of PBA

- (1) IPB
- (2) ISR Strategy & Planning
- (3) ISR Execution
- (4) Assessment

Time Sensitive
Targets (TST)

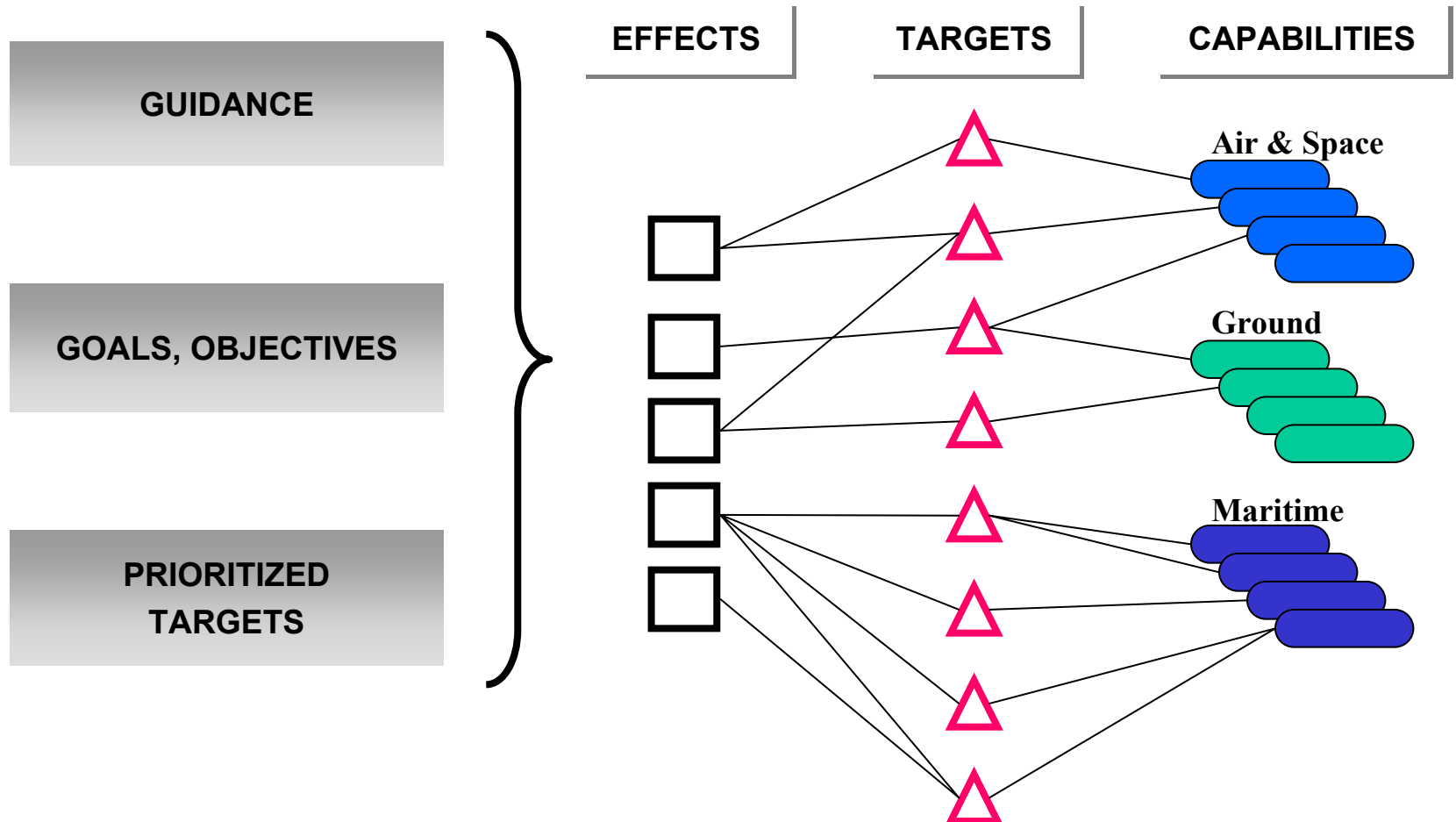
Joint Integrated
Prioritized Target
List (JIPTL)

ISR Collection Plan

Problems Remedied:

- ISR becomes postured to support EBO
- ISR anticipatory, not reactive
- ISR remains synchronous and asynchronous with operations

Effects Linked to Targets & Capabilities



Conclusions

- Battlespace visualization requires synchronous and asynchronous analytical support
 - At all operational levels
 - Analytical efforts must run in advance of operations and decision making to be predictive
- Automated war gaming for objective COA analysis
 - Multiple COAs for analysis means insufficient time for traditional “paper” exercises
 - To anticipate the adversary the capability to rapidly analyze changing adversary options is a must
 - Focuses ISR for tracking, **NOT** discovery
- Doctrine & Training
 - We have carefully defined doctrine and implemented training based on how to fight DESERT SHIELD / STORM more effectively
 - We have to implement what we’ve learned about fighting asymmetrically

How to Reach Us

David A. Brumbaugh
Intelligence & Information Solutions Division
Science Applications International Corporation (SAIC)
4501 Daly Drive, Suite 400
Chantilly VA 20151

david.a.brumbaugh@SAIC.com
(703) 814-7721