

TNO Physics and Electronics Laboratory

ONGERUBRICEERD

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Literature survey on Effects-Based Operations.

A Ph. D. study on measuring military effects and effectiveness

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Context and Problem definition

In this Ph. D study research is being done to develop and test a methodology for measuring operational readiness, operational effectiveness and operational/political outcome of (the deployment of) military units. Planning methodologies, systems and processes, as well as performance measurement management methods and systems are of interest for the study.

Roadmap

This literature survey on Effect-Based Operations (EBO) is a first result of this study. Abstracts are made of most of the relevant literature on EBO. During the study reports on other parts of the subject of the study will be published.

Results and conclusions

Although EBO originates from strategic airforce thinkers it looks like it is applicable for joint use too. The current EBO practice is rather a methodology to physically limit the enemy's ability to organise own activities to respond properly. It can be seen as a large-scale chess game in which the moves of the enemy are limited systematically. The level of EBO in which the enemy even does not decide to start to play because he is convinced that he loses is not yet achieved. The real challenge is to find measures and metrics for the non-material, cognitive domain.

Applicability

The study should result in a methodology to support military planners at the strategic and operational level in assessing the best fit of military capabilities to operational challenges.

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Abbreviations

ABM	Airborne Battle Management
AEF	Aerospace Expeditionary Force
AETF	Aerospace Expeditionary Task Force
AF	Air Force
AI	Aerial Interdiction
AMSTE	Affordable Moving Surface Target Engagement
AOC	Air Operations Centre
AOR	Area of Responsibility
APC	Armoured Personnel Carrier
AS	Air Staff
ATACMS	Army Tactical Missile System
ATO	Air Tasking Order
BDA	Battle Damage Assessment
C ²	Command and Control
C ³ I	Command, Control, Communications and Intelligence
C ⁴ I	Command, Control, Communications, Computing and Intelligence
C ⁴ ISR	Command, Control, Communications, Computing, Intelligence, Surveillance and Reconnaissance
CAS	Complex Adaptive System Close Air Support
CCA	Confrontation and Collaboration Analysis
CEP	Circular Error Probable
CINC	Commander in Chief
COA	Course of Action
COG	Centre of Gravity
COK	Centre of Knowledge
COMINT	Communications Intelligence
CONOPS	Concept of Operations
CR	Contextual Research Crisis Response
CRO	Crisis Response Operations
D ¹¹	Deter, Destroy, Disrupt, Degrade, Decapitate, Divert, Dislocate, Delay, Deny, Deceive and Defend
DAEO	Dynamic Air/Space Execution Order
DAL	Developing Aerospace Leaders
DBA	Dominant Battlespace Awareness
DBN	Dynamic Bayesian Networks
DCF	Discounted Cash Flow
DE	Dominant Effects
DMPI	Desired Mean Point of Impact
DOD	Department of Defence
DP	Dimensional Parameter

DPD	Defence Policy Development
DSM	Digital System Model
DSP	Decisive Strategic Point
DT	Dynamic Tasking
EA	Exploratory Analysis
EAC	Equivalent Annual Cost
EAF	Expeditionary Aerospace Force
EAP	Effects Assessment Process
EB	Effects-Based
EBF	Effects-Based Force
EBJO	Effects-Based Joint Operations
EBO	Effects-Based Operations
EBP	Effects-Based Planning
EBP&A	Effects-Based Planning and Assessment
EBT	Effects-Based Targeting
EI	Empirical Information
ELINT	Electric Intelligence
ENP	Elements of National Power
ES	End State
ETO	Effects Tasking Order
F ² T ² EA	Find, Fix, Track, Target, Engage and Assess
FSCL	Fire Support Co-ordination Line
GMTI/SAR	Ground Moving Target Indicator/Synthetic Aperture Radar
GPS	Global Positioning System
GRS	Global Reconnaissance Strike
GSTF	Global Strike Task Force
HUMINT	Human Source Intelligence
IN	Influence Net
ISR	Intelligence, Surveillance and Reconnaissance
IT	Information Technology
JBI	Joint Battlespace Infosphere
JCP	Joint Campaign Plan
JDAM	Joint Direct Attack Munition
JEBO	Joint Effects-Based Operations
JFACC	Joint Force Air Component Commander
JFC	Joint Force Commander
JSF	Joint Strike Fighter
JTF	Joint Task Force
JV 2020	Joint Vision 2020
JWAC	Joint Warfare Analysis Center
LOAC	Laws of Armed Conflict
LOC	Line of Communication
LTDP	Long Term Defence Planning
LTDP	Long Term Defence Planning Process
LTP	Long Term Planning

MA	Mission Analysis
MAAP	Master Air Attack Plan
MAP	Master Attack Plan
MBT	Main Battle Tank
NCA	National Command Authorities
MFC	Multinational Forces Compatibility
MFC	Multinational Forces Compatibility
MLRS	Multiple Launch Rocket System
MOE	Measure of Effectiveness
MOFE	Measure of Force Effectiveness
MOM	Measures of Merit
MOOTW	Military Operations Other Than War
MOP	Measure of Performance
MOPE	Measure of Policy Effectiveness
MSA	Mission System Analysis
MTW	Major Theatre War
NCA	National Command Authorities
NCP	National Campaign Plan
NEV	National Element of Value
NGO	Non-Governmental Organisations
NTM	Notice to Move
OBO	Objective-Based Operations
OBP	Objectives-Based Planning
OE	Operational Effects
OMM	Objective to Metrics Methodology
ONA	Operational Net Assessment
OODA	Observe-Orient-Decide-Act
OOTW	Operations Other Than War
OPSEC	Operations Security
OR	Operations Research
PA	Parallel Attacks
PGM	Precision Guided Munition
PI	Photo Interpreters
POL	Petroleum, Oil and Lubricants
PVO	Private Voluntary Organisation
PW	Parallel Warfare
QM	Qualitative Modelling
ROE	Rules of Engagements
SACEUR	Supreme Allied Commander Europe
SAM	Surface to Air Missile
SBP	Scenario-Based Planning
SCF	Specific Capability Forces
SCP	Stealthy Combat Platform
SD	System Dynamics
SDP	Structure Development Plan

SE	Strategic Effects
SER	Strategic Environment Research
SFP	Standard Force Package
SIAF	Small Independent Action Force
SIGINT	Signals Intelligence
SOF	Special Operations Forces
SOSA	System of Systems Analysis
SP	Strategic Paralysis
SSCO	Small Scale Contingency Operations
STT	Strategy To Task
SW	Strategic Warfare
TAV	Total Asset Visibility
TBO	Target-Based Operations
TBP	Threat-Based Planning
TCO	Transnational Criminal Organisation
TCT	Time Critical Target
TE	Tactical Effects
TEWG	Terrorism Early Warning Group
TMD	Theatre Missile Defence
TNO	Netherlands Organisation for Applied Scientific Research
TNO-FEL	TNO Physics and Electronics Laboratory
TSA	Target System Analysis
TST	Time Sensitive Target
USAAC	United States Army Air Corps
USAF	United States Air Force
USEUCOM	United States European Command
USJFCOM	United States Joint Forces Command
USMC	United States Marine Corp
VBSEM	Value-Based Strategic Effect Model
WMD	Weapons of Mass Destruction
WME	Weapons of Mass Effect

1. Introduction

1.1 General introduction

Effect Based Operations or shortly EBO are a rather new military force application concept in military operations. As a prime supplier for the Netherlands Ministry of Defence, TNO-FEL assists in Research and Development for Policy and Decision Support. Within this framework a Ph.D. study on measuring military effects and effectiveness started in 2003. TNO-FEL hopes that the research can result in a methodology, which can be used in Long Term Military Planning, Operational Planning and Operational Evaluation.

Effect Based Operations could be one of the possible gateways to tackle this PhD study objective. In this report you will find abstracts of literature on EBO and related areas.

1.2 Backbone of the study

The research is centred on a very common problem known in most military organisations. Based on the rapidly changing and fluid security environment, there is a disharmony between national security policy concerns and existing force structures. Military organisations have no well-defined and logical methods for force planning activities to identify the quality and quantity of forces required. An additional pressure is the decreasing or at best constant level of military budgets in many countries, which represents limitations of current and foreseeable military capabilities. Unfortunately, also the force planning activities are based in many countries on legacy systems. The result is a clear divergence in criteria and measures in Long Term Military Planning, Operational Planning and Operational Evaluation, which put a huge pressure on achieving a coherent military force.

To solve the difficulty to link the three perspectives together, we need to identify and define a methodology, which enables permanent organisational learning and better fits military capabilities to operational challenges. For this a concordance of criteria and measures must be found to put Long Term Military Planning, Operational Planning and Operational Evaluation into a common framework. This consistency may result in coherent military organisations with a strong operational focus.

From the research we expect that it is possible to identify a methodology on measuring soft factors relevant to political-military decision-making. With this methodology we hope to extend a force application concept in a way that it becomes the foundation for long term military planning purposes. The expected methodology will enable military planners to measure the effects deployed military forces are likely tasked to achieve in missions. Hopefully the methodology will contribute to more flexible and responsive military organisations facing current and emerging challenges.

The following working hypotheses form the basis for the research:

- Effects are measurable and can serve as a basis for concordance of criteria and measures.
- Scenarios based on effects have the potential to better link Long Term Military Planning with Operational Planning and Operational Evaluation.

The following general research questions serve as a guide through the research:

- How can we measure effects?
- How can effects become the integral linchpins between Long Term Military Planning, Operational Planning and Operational Evaluation?
- How can we transform effects into military capabilities?

1.3 What is EBO?

The concept Effects-Based Operations or short EBO is a new form of force application concept, which appeared in the beginning of the 1990s. Before and during the 20th century most clashes of military forces were fought by adversaries, who tried to destroy each other on the battlefield. This intention, based on the twin predominant strategies of the time, annihilation and attrition, resulted in both bloody and protracted battles. This destruction-based thinking changed slowly with the increasing brutality of the wars during the 20th century.

The fall of the Soviet Union together with the disintegration of the Warsaw Pact ended nearly fifty years of Cold War. This significant transformation also brought about sweeping changes in the way of fighting wars. New ways of thinking and new ways of fighting have emerged in the US to counter a wide range of unpredictable adversaries that confront the existing world order. To meet the challenges of the future, all instruments of national power must be used to reduce or contain potential sources of threat through persistent and effective coercion. The traditional US strategic approach to crisis prevention and response is a strategy of coercive diplomacy to confront an adversary. This approach requires that policy-makers have a broad range of options to dissuade, deter or compel potential adversaries from taking action. In this effort all elements of national power must be applied effectively to change an adversary's thinking.

An approach is needed, which seeks to forecast how an adversary would respond to a range of coercive actions both in military and non-military terms. EBO introduces new thoughts to achieve rapid victory by attacking the coherence of the enemy's ability and will to fight. With EBO the military can exploit the asymmetric advantages in knowledge, precision and mobility. This approach helps envision the enemy as a system, which has the characteristics of being complex and adaptive. By picking up the idea of integrating effects into planning considerations we favour specific effects rather than the simple destruction of targets.

Since the successful 1991 Gulf War the US Air Force in every military operation has been applied under an effects-based operating concept that emphasises the accomplishment of strategic goals. Warfare in the context of EBO allows us to think about ways other than just simple destroy the enemy's forces. EBO is about accomplishing the objective via effects we want to achieve. This difference in mind-set frees up resources and minimises damage and loss of life. EBO is the definite springboard to accomplish security goals and objectives in an integrated, unified fashion by better linking all security pillars together.

The newly established United States Joint Forces Command is the leading body in this transition toward a new approach of warfare. USJFCOM defines EBO as a process for obtaining a defined strategic outcome (effect) on the enemy through the synergistic, multiplicative and cumulative application of the full range of military and non-military capabilities at the tactical, operational and strategic level. Since the desire for a more rapid resolution of future conflicts has not diminished, EBO can be the approach to understand and reduce the adversary's critical capabilities and coherence allowing for decisions in intensely dynamic and complex situation. In this context an effect is the physical, functional or psychological outcome, event or consequence that results from specific military or non-military action.

1.4 Readers guideline

This TNO Report contains abstracts of 70 articles, theses, interviews and books dealing with Effects-Based Operations and related topics. The report introduces the reader into the world of Effects-Based Operations.

The second chapter gives a general overview on how EBO is perceived in the news. The third chapter puts EBO into the context of the real world with the problems militaries face in different coalition operations short of war. Also ideas like 4th Generation Warfare will be introduced, together with the problem of defining the Centre of Gravity in the planning and preparation phase of any military operations. The fourth chapter displays the basic ideas behind EBO, which together form the theoretical background of this very concept to warfare.

These ideas represent the strategic focus, the ability to carry out attacks in a parallel way and to think in complexity. The fifth chapter is a representation of articles and theses dealing with an air force centric EBO approach. The combination of stealth technology and precision weapons puts the quality of air forces into a new dimension. In chapter six we find abstracts of papers trying to extend this originally air force centric force application concept to a joint force employment philosophy. Joint EBO or Dominant Effects are attempts to achieve an asymmetry in the full spectrum of conflicts. Chapter seven deals with methodology and modelling approaches to make EBO accessible for a better planning and analysis process, which can eventually lead to the ability of modelling EBO in computer-based war games.

2. Short articles dealing with Effects-Based Operations in general

2.1 Introduction

The concept of Effects-Based Operations is seen by many as a new mindset for warfare, a common thread for various competing futuristic concepts. With the technological advances of the last decades and new doctrinal thinking, militaries can achieve some sort of policy objectives in a more efficient and effective way. The key in EBO is attacking certain target sets to work towards a systemic collapse of the enemy. This new way of war with achieving mass of effects without mass of forces can result in a victory at lower cost of lives and resources on both sides. With these attractive characteristics an effects-based approach has the potential to transcend service boundaries. One author finds an analogue to EBO in the Blitzkrieg strategy of the Germans in WWII. EBO works also in a broader context, because the application of advanced information technologies together with small, covert teams using sensors like in Afghanistan, herald the possible future of military operations. Militaries in the 21st century will probably be used to achieve psychological impact instead of physical destruction.

2.2 Arkin, William M.

Arkin, William M., *A New Mindset for Warfare*, Washingtonpost, 22 September 2001, www.washingtonpost.com/ac2/wp-dyn/A8672-201Sep22

In June 2000 the US military completed a series of futuristic experiments, called Rapid Decisive Operations (RDO). It is a concept to achieve rapid victory by attacking the coherence of the enemy's ability to fight. RDO exploits asymmetric advantages in knowledge, precision and mobility to create maximum shock on the enemy's ability and will to fight. It was an attempt to break out of a stove-piped design for current warfare, whereby military and other efforts are essentially separated by bureaucratic interest. Instead a new approach with a single, integrated, co-ordinated and synchronised National Campaign Plan (NCP) is recommended.

Competing futuristic concepts reflect a new paradigm about warfare with the loosely defined concept of Effects-Based Operations (EBO) being the common thread. Effects-Based Targeting (EBT) brings the concept of EBO to the battlefield.

In EBT the selection of targets and the means to engage them are based on their contribution to the desired effect, while minimising any undesirable or negative effects with the will and perception of the decision maker being the ultimate target.

RDO and EBO help us envision the enemy, not as a traditional nation state but as a Complex Adaptive System (CAS). Much of the enthusiasm for EBO in the US military is based upon technological advances in communications distribution, data-mining tools, graphical display and social/demographic modelling tools similar to those used in advertising, marketing and political campaigns.

The central requirement of EBO is better intelligence than the US currently possesses. While the US has made enormous advances in precision, accuracy and explosive power, the Americans have lagged behind in intelligence, knowledge and understanding required to exploiting these new weapons and platforms truly. EBO thinkers do not particularly think that the doctrinaire and dominant current language of fire and manoeuvre will not at some point come into play.

2.3 Cook, Nick

Cook, Nick, *Shock and Awe?*, Jane's Defence Weekly, Vol. 39, 2 April 2003, pages 19-21.

The shock and awe against Iraq was a far more limited attack on a target of opportunity that marked the opening salvoes of the air assault in the early hours of 20 March 2003. It is a subtly different air campaign, underpinned by a decade's worth of technological advances and some new doctrinal thinking. The war in Iraq is seen by some observers as a critical test of a US military strategy known as Effects-Based Operations (EBO). The USAF is the leading exponent of this war-form, which instead of listing a bunch of targets to bomb them or finding the enemy to be killed, emphasises achieving some sort of policy objective in a more efficient and effective manner. Effects-based planning places particular emphasis on the need to limit collateral damage to minimise civilian casualties and damage to civilian infrastructure.

EBO is designed to regard the enemy as a system of systems in which the elimination of key component parts can bring victory without the need to inflict widespread damage on a country's infrastructure or casualties among its civilian population. Within the framework of an enemy's overall capabilities, EBO can target individual systems, which can be further broken down into subsystems. By attacking target sets in this way, it is possible to work towards achieving systemic collapse.

But an effects-based strategic air campaign that aims to minimise Iraqi civilian casualties is also viewed as a weakness. Precision weapons are one of the key underpinnings of effects-based planning.

The advent of satellite guided munitions like the Joint Direct Attack Munition (JDAM) with a Circular Error Probable (CEP) less than 3 metres precipitated much of this new thinking. In the first 24 hours of the war every weapon was precision guided. The low cost nature of the JDAM enabled this revolution.

A challenging area is the air-to-ground interface because new tactics, techniques and procedures need to be developed in order to synchronise actions with forces on the ground, like the exchange of real-time data with friendly forces at squad level.

2.4 Correll, John T.

Correll, John T., *The Purpose of War, The objective is not to destroy the enemy but to gain strategic result*, Air Force Magazine, Editorial, August 2001, Vol. 84, No. 8, www.afa.org/magazine/editorial/08edit01_print.html

In days gone the way to fight a war was to destroy the enemy's army and occupy his capital. The centrepiece of the strategy was the clash of one massed force with another.

Around ten years ago a new way of war emerged in which it was possible to achieve the effects of mass without the actual massing of forces. The exploitations of new technologies such as stealth, information dominance and long-range precision strikes enables us to defeat an enemy at lower cost of lives and resources on both sides. Some land power advocates sees in the concept of EBO the favouring of air power and the diminishing of the primacy of land battle and believe however that the classic model of war is still in effect with the fundamental nature and objectives of warfare having not changed.

The idea of EBO is that success in armed conflict should be measured by results and not by destruction. But in reality destruction of the enemy was never more than the means to a strategic end, not an end itself.

EBT leads to economy of force and it is sufficient to inhibit or intimidate the enemy with deterrence, the highest form of intimidation.

EBP applies across the spectrum of the conflict, from smaller-scale operations to major theatre war. Until now the concept has been identified chiefly with air power, but the US Joint Forces Command believes that its value should transcend service boundaries.

There is no need or desire anymore to capture or occupy another nation's territory, its resources or rule its people. It is nonsense to argue that warfare is unchanged. The question is whether we will have the wisdom to exploit the change.

2.5 Dunnigan, James

Dunnigan, James, *Effects Based Repackaging*, StrategyPage, 5 December 2002, www.strategypage.com/dls/articles/20021215.asp

The Pentagon has reinvented the wheel again and given it a new name. They now call Blitzkrieg (lightning war) just Effects-Based Warfare. Realising that the attrition warfare with more stuff just like dumping bombs is not sufficient anymore, Pentagon officers went on to study how the Germans did it in WWII. The recipe is simple you just:

- Carefully analyse who has what,
- What can each side do with what it has,
- Formulation of a plan that capitalise on our strengths and enemy weaknesses,
- The execution of the plan is as rapid as possible, not giving the enemy sufficient time to respond and cope.

For the past quarter century the American armed forces have been reforming themselves into a faster moving, more flexible organisation. The mentality has changed. Moving fast and quickly sorting out military situations became second in nature. The result was the rapid victories in 1991 and 2001.

2.6 Rosen, Stephen P.

Rosen, Stephen P., *The Future of War and the American Military, Demography, Technology, and the politics of modern empire*, Forum, www.harvardmagazine.com/on-line/050218.html

Before 09/11 much of the thinking in the Pentagon about the future anticipated relays of the 1991 war against Iraq, along with limited peacekeeping operations. After 09/11 thinkers act as if the future of war will be dominated by the fight against terrorism. This goes together with the US military focus shifting from Europe to Asia. Revolution in Military Affairs (RMA) as phenomenon was detected earlier and now advocates of it argued that rapid improvements in information technologies – sensors, communications, data processing – would make possible to find most large military systems, such as air bases, aircraft carriers, and tanks, and to destroy whatever one can find.

The use in Afghanistan of small, covert teams of soldiers, supported by high-tech sensors and long range, high accurate missiles, was very much like what RMA advocates within the US Marine Corps (USMC) had proposed in 1994 in a concept called “Sea Dragon”. The fact that the US has such impressive military technology will lead adversaries who cannot match its technology to find an equaliser. Terrorism may be one and nuclear weapons another.

If we regard the US as an indirect empire than its interest is not combating a rival but maintaining the imperial position and order. With this in mind the maximum amount of force can and should be used as quickly as possible for psychological impact – to demonstrate that the empire cannot be challenged with impunity. Imperial wars end, but imperial garrisons must be left for decades to ensure order and stability. In addition to advanced-technology weaponry, an imperial position requires large, but lightly armoured ground forces for garrison purposes and as reassurance for allies who want American forces on their soil as symbolic of US commitment to their defence.

Imperial strategy focuses on preventing the emergence of powerful, hostile challengers to the empire: by war if necessary, but by imperial assimilation if possible. There is an alternative to an empire: instead of guaranteeing order around the world, the U. S. could help other countries to defend themselves.

2.7 Wolfe, Frank

Wolfe, Frank, *Air Force Officials To Emphasize Effects-Based Operations in QDR*, Defense Daily, 18 January 2001, www.dean.usma.edu/socs/ECON/ens/articles/QDR_USAF_18Jan01.htm

The Air Force Staff is to stress the importance of effects-based operations (EBO) in the Quadrennial Defense Review process – a mode of operations first shown in the 1991 Persian Gulf War. Rather than the cost per weapon or platform, Air Force officials try to get the Pentagon to consider the cost per target engaged. Gen. Deptula noted the efficiency during the war's first hours of the F-117 stealth aircraft in striking key targets with significantly fewer support aircraft than non-stealth platforms.

Views on the F-22 are that one of the reasons we need to get people to recognise and consider an EBO to making resource allocation decisions, because too often people focus on individual platform costs. What needs to be considered in defence allocation decisions is what the cost per target engaged or what is the cost of desired effect achieved. F-22 advocates view the future fighter as an aircraft that will allow the US to fight from long range by protecting bombers and support assets and destroying advanced enemy double digit SAMs. The proliferation of these advanced Surface to Air Missiles (SAM) has led some military officers to conclude that that non-stealth aircraft will not feature in future engagements.

Evaluation of systems in the future will be in terms of functionality and effect they bring to accomplishing the national security needs.

2.8 Conclusions

The articles represent a random selection of what is available on the Internet and what can be found in magazines within one's reach. Reading through the articles helps become familiar with the phenomenon of Effects-Based Operations. They are

good for a first familiarisation with the topic, but do not go deep into the idea of EBO. The articles just introduce but do not analyse EBO and the other related concepts. They give a rough information and put the phenomenon roughly into a broad context. The sources are sufficient for a first impression and give a general overview on the topic by displaying the most typical features and characteristics.

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3. Coalition Operations, COG Analysis, 4th Generation Warfare, Army XXI Design and Dominant Manoeuvre

3.1 Introduction

Effects-Based Operations is just part of a much bigger picture dealing with the changing nature of warfare. Since the collapse of the Soviet Union and the world communism, new threats and challenges have emerged. Modern information management techniques enable a significant change in military affairs with a much more dynamic sensor-to-shooter cycle. Superior information exploitation is essential, as the interconnection of all force elements into an integrated whole. The mass-on-mass strategy of the industrial era is not affordable anymore. Militaries rather take part in missions, which are significantly different from just fighting wars. This kind of coalition-based military operations have increasingly become the norm, but the ad hoc nature of most coalitions introduces issues that do not exist in homogeneous single-nation force structures. Military deployments in the upcoming decade will also be conducted alongside allies or coalition partners. Many fear that military operations short of war can limit the number of units available for a major conflict and deplete existing capabilities and readiness. This is but one threat many militaries face. Due to pressures on the military budgets in Europe, a capability gap is emerging between the US and the NATO Europeans in this decade. This limits the chance of European nations to make the transition to a military, which is able to mass effects without the massing of forces that requires a move from a platform-centric to a rather network-centric warfare to shatter the will and cohesion of the enemy quickly. The biggest emerging asymmetries will likely be in deep-fires capability, in the ability to synchronise manoeuvre and in force protection. This emerging gap needs to be closed, because only fully balanced capabilities cause synergism and provide a wide array of choices to decision-makers. A combination of precision engagement and manoeuvre results in forces with a balanced full spectrum dominance. This equilibrium is needed to achieve strategic objectives quickly and at a minimum cost by leveraging decisive effects. This is more important because the future warfare is characterised by rather psychological goals, mission-type orders, decreased dependency on logistic support and emphasis on manoeuvre.

The enemy in future conflicts will probably be compartmentalised, cellular and predatory, operating in networks outside the bounds of the nation state. War and crime will increasingly be interrelated and the distinction between civilian and military continues to erode or may disappear.

Much of the battle space will be urban with an unprecedented complexity and brutality. To meet these challenges, intelligence must focus more on cultural and social paradigms to contribute to superior situation awareness.

To define appropriate Courses of Action to achieve the desired effects many militaries use the concept of Centre of Gravity. The employment of this concept requires thinking in systems, in which the enemy is not a static entity but an organism, which reacts continuously to the environment what is exactly the basic premise of Effects-Based Operations.

In this chapter you will find abstracts that address issues like Coalition Operations, COG Analysis, 4th Generation Warfare, Army XXI and Dominant Maneuvre.

3.2 Cheek, Gary H. (Col.)

Cheek, Gary H. (Col.), *Effects-Based Operations: The End of Dominant Maneuver?*, U. S. Army War College, Carlisle Barracks, 09 April 2002, www.stinet.dtic.mil/cgi-bin/fulcrum_main.pl

The origins of effects based operations

Warden laid the foundation of Effects-Based Operations (EBO) with depicting the enemy as a system and future war as a parallel warfare. He believes that technology would allow the US to attack multiple, vital targets simultaneously at the strategic level thus collapsing and adversary's system with no means to respond. Deptula took parallel warfare further by stating that projection of force is rather better than the presence of force to achieve effects. He thinks that technology has decreased the relevance and necessity for ground forces.

Effects-Based Operations

In the first quarter of the 20th century Douhet and Mitchell strongly held beliefs in an independent air force under the command of an airman and their emphasis on strategic attacks that break the enemy's will to fight. From this point of view EBO is not just an idea that emerged from precision weapons and stealth.

Information, leadership and decision-making

Information is key to successful execution of EBO – “know your enemy”. But errors and incorrect information in recent operation in Afghanistan clearly showed that no military will ever achieve perfection in their knowledge on the enemy. Human dimension will introduce risk and error and limit advances in technology. The enemy reacts, deceives and disperses.

Massive application of Information Technology (IT) can increase dependency on information with massively overload commanders and planners, which eventually results in an over-centralisation of command. EBO depends on human intelligence assets to determine the real effects on the enemy's system and will, which effects the enemy can circumvent. Accurate intelligence is the weak point of EBO.

Protection and firepower

Stealth technology is an asymmetric advantage the US enjoys. EBO using stealth and precision munitions means an increase in efficiency but there is a fundamental difference between efficiency and effectiveness.

To compel: Effects-Based Operations or Close Combat?

As Clausewitz states war is “an act of force to compel our enemy to do our will”. Compel means that the final decision is not with the enemy whereas EBO suggests that with controlling the situation the enemy still have space for decision. EBO alone is not sufficient, close combat the final arbiter of war is needed. EBO is impersonal, fleeting in-nature, persuasive and in-discriminative from the enemy’s point of view. Compelling force ensures decision in conflict.

Precision fires and their impact on dominant manoeuvre

EBO will have problems in conflicts like guerrilla wars with few targets suitable for precision weapons.

Adapting from Faith-Based Operations

EBO can filter the vast amount of information and provide a theoretical foundation to maximise new and future IT to produce decision superiority in order to achieve decisive effects. EBO is an analytical form of warfare and sees into the future, anticipating the enemy and setting conditions for friendly forces.

Conclusion

EBO have little basis in experience and represent a risky proposition upon which to base national defence. EBT as part of strategic attack and operational fires in conjunction with ground manoeuvre shows more promise.

3.3 Hosmer, Stephen T. et. al.

Hosmer, Stephen T. et. al., *Bettering the Balance: Large Wars and Small Scale Contingencies*, Issue Paper, RAND Arroyo Center, www.rand.org/publications/IP/IP167/

The Army has been participating in Small Scale Contingency Operations (SSCO) like disaster relief, peace operations or Operations Other Than War (OOTW) for decades. New is the rate at which they have been occurring and the Army now has to do it with a much smaller force structure. In general participating in SSCO, particularly in humanitarian and peace operations does erode the capability to fight a major theatre war. To avoid a scenario like this, the army has a number of options:

- Use contractors,
- Rely on the reserves to restore war fighting capability,
- Redesign existing organisations to give them a wider range of capabilities,
- Improve routine training and provide additional focused training prior to deploying to an SSCO,
- Reduce equipment problems by altering logistics processes and priorities and
- Improve its effectiveness at information related operations with an eye to shortening SSCO.

Capabilities

SSCO effect the Army's war fighting capabilities primarily in two ways: first they limit the availability of units for major conflict, second they erode the capabilities and readiness of both deployed units and those that remain behind. (Doesn't need to be explained more detailed).

Force Structure Approaches to Offset Effects

For most types of units the Army has sufficient force structure to deal with a limited number of smaller scale contingencies and still respond to a theatre conflict. Important is that a force structure option, that should not be pursued is to create a unit specifically for peace operations. Better options are to use contractors, although this can be quite expensive. Another way is using the reserves or redesigning current organisations by adding flexibility with a greater modularity – reorganising functional capabilities within a unit – and expanded functionality.

Training Approaches to Readiness Trade-offs

Great many of the skills required by major conflicts overlap those needed in smaller scale contingencies but regardless of the training benefits of some smaller scale contingencies, such participation inevitably interrupts normal unit training for wartime operations.

Equipment Approaches to Readiness Trade-offs

SSCO can devastate equipment. Units tend to operate equipment more frequently than they do during normal peacetime training, sometimes with reduced maintenance support. Distance and tailoring units can exacerbate the effects on equipment, deploying units have been directed to leave equipment for follow-on forces, contractors or UN forces.

Improving Readiness for Information-Related Operations

Information-related operations refer collectively to:

- Intelligence Operations must support the particular tasks being performed during the different phases of an intervention (entry, consolidation, reconstitution and transition). To improve intelligence support for entry forces should order a surge on intelligence collection at the first signs U. S. military intervention might be required. Since most of the information needed to support the tasks will come from local sources acquired, a sufficient number of trained intelligence personnel needed to be deployed at the very outset of the intervention to gather information.
- Operations Security (OPSEC) has typically been stringent during intervention planning and preparations. Because of the crisis atmosphere and media attention that invariably surround future entry operations, commanders need to be ready to suppress alerted defences during entry phase, regardless of the degree of OPSEC employed.
- Deception, C² neutralisation and Psychological Operations (PSYOPS) have proved a valuable force multiplier because psychological effects of military actions can prove decisive in SSCO the advice of area experts and PSYOPS specialists about the potential psychological effects should be consulted.
- Public Affairs Operations are important for any military involvement but particularly for SSCO.

3.4 Lee, Seow Hiang

Lee, Seow Hiang (Maj.), *Center of Gravity or Center of Confusion, Understanding the Mistique*, Air Command and Staff College, Air University, Maxwell AFB, Wright Flyer Paper No. 10, December 1999, www.maxwell.af.mil/au/aul/aupress/Wright_Flyers/Text/wf.pdf

Introduction

The COG concept is according to joint doctrine the basis for devising both national military and theatre strategies.

In the Beginning – Clausewitz’s Centre of Gravity (COG)

Clausewitz’s ideas on COG have two potential pitfalls, (1) because his work is unfinished his concept of COG can be misunderstood in a one sided and biased way, (2) one must take care not to overemphasise the literal meaning of Schwerpunkt.

Although the concept is briefly mentioned in book 4, his ideas are found primarily in books 6 and 8. In book 4 he writes that a COG is always found where the mass is concentrated most densely and presents the most effective target for a blow, although he also lurches into discussion that the elements of the COG are unity and cohesion. In book 6 he writes about more COG, which will be found wherever the forces are most concentrated. In book 8 he describes the COG concept by alluding to the sources of strength that emerge from the nature of conflict and the unique characteristics and aim of the belligerents. He argues that under specific circumstances the enemy COG could be a city, a community of interest among allies, the personality of leader or even public opinion. Unravelling his conception of the COG is difficult, due to the methodology of his work and the fact that it was unfinished. Nevertheless we can identify two distinct approaches:

- A book 6 version highlights the emphasis on the opposing army, a terrain centric perspective with an ultimate aim to destroy the enemy armed forces, and
- A book 8 version, which takes a broader and perhaps more amorphous view of the concept in which the COG is derived as a function of our understanding of the paradoxical trinities of the belligerents.

The Definition and Nature of COG: Revealing Additional Sources of Confusion

Much confusion and disagreement can be traced back to four key reasons, which are neither mutually exclusive, nor do they always operate separately:

- *Caused by a lack of consensus* – (1) Class A definitions emphasise the importance of focusing on vulnerabilities, which originates from the desire to avoid strength-on-strength clash during a conflict and distinguish between manoeuvre and attrition warfare. Unfortunately these definitions are grossly incomplete as they do not help planners appreciate what “critical” means and hence fails to provide a useful focus for the campaign planning efforts. Class B definitions emphasise the enemy’s strength and COG is therefore synonymous with the centre of mass, which has changed so radically over the centuries that a validity can be justifiably questioned and a narrow focus on mass can lock into an attrition warfare approach.

Class C definitions emphasise the sources of strength and the effect it renders on the enemy. These definitions do not make a priori assumptions as to whether the focus for the main effort is inherently strong or weak. SEE table on page 7!

- *Caused by a lack of consensus over its nature* – questions are like is there one or many, what is the relationship between objectives and COGs. There is direct relationship between friendly objectives and the COG because our main effort should cause the enemy system to change in a way that it functions according to our will, and if it is congruent at each level of war this leads us eventually to victory,
- *Caused by differences in service perspectives and CONOP art* – the differences in services' perceptions, which can be equally legitimate and yet significantly divergent lead to different theories of war, contributing to disparate conceptions of COGs,
- *Caused by the unpredictability inherent in war* – which can be caused either by lack of perfect intelligence or various non-linearities like chance, uncertainty, indirect effects, unintended consequences, human errors and frailties.

Differing Perceptions of the COG in the Gulf War

General Schwarzkopf identified the COG as that thing that you destroy it, you destroy the ability to wage war. The COGs were Saddam Hussein himself, the Republican Guard and the chemical, biological and nuclear capability. For the USAF perceptions differed substantially SEE table on page 18! Altogether one can say that in reality, fog and friction will always characterise real war. This poses an important challenge for operational planners living in the real world and having to make real decisions in finite time.

Implications of Enduring Inconsistencies: The Employment of the Concept

A full understanding of the COG concept requires wrestling with the implications of enduring inconsistencies. Employing the COG concept:

- *Requires systems thinking* – enemy is not a static entity, it is an organism that continuously acts and reacts internally and with the environment. It embodies the interactions of living and non-living sub-entities out of which multiple COGs arise. Systems thinking views things as a whole and it refers to the attempt to view the world in terms of irreducibly integrated (and self-organising) systems by focusing attention on the whole as well as on the complex (and often dynamic) interrelationships among its constituent parts. Effects on social institutions, political states and economic systems depend not only on what the case is but also on belief that it is. We must recognise that thinking in systems is not natural to military practitioners who favour quick and decisive actions. Although thinking in terms of one-way linear processes can often be misleading it is important not to exaggerate systems effects. System effects need not cripple human actions like either constraining (where systems are rendered less systems-like in their responsiveness, hence foreclosing options and facilitating action) or parallelism.
- *Is an act of leadership* – the ideas of leadership can be pertinent when one interchanges the phrase main effort with the COG. According to Clausewitz a good leader is to some extent a military genius with the following cornerstones, which empower the person to act.

These are the strength of character, the ability to keep one's head at times of exceptional stress and violent emotion with the willingness to stand as a rock and good instinct.

- *Is an evolving process* – begins with decisive action and sustained with continuous feedback. There is often a mistaken belief that one needs to know the true COGs with complete certainty before acting. Even though we may be able to discern the COGs with complete certainty initially, action and feedback from enemy's responses can lead us closer to the true COGs. There is a dynamic relationship between our actions and the enemy's that favours the side seizes the initiative. When commanders act, they multiply all the conditions of uncertainty for their adversaries and indirectly compensate for their own imperfect situational awareness. Often the ability and willingness to create and exploit opportunities faster than the opponent generate decisive results.

Conclusions and Lessons

The truth of social sciences is that we will never have complete answers to complex phenomena. Thinking about the COG concept requires a combination of two approaches:

- We must recognise the sources of confusion and take active steps to explicate the contentious issues where possible and
- Students and operational planners must learn to combine the art and science of employing the concept in an uncertain world where the desire for complete consensus will always be frustrated.

3.5 Nichiporuk, Brian

Nichiporuk, Brian, *Forecasting the Effects of Army XXI Design Upon Multinational Force Compatibility*, Documented Briefing, RAND Arroyo Center, www.rand.org/publications/DB/DB279/DB279.pdf

The fact is that most of the US Army's deployments in upcoming decades are likely to be conducted alongside our allies and coalition partners, which can be alliance operations (operations conducted within the bounds of NATO) and coalition operations (operations outside of the bounds of an established alliance). Multinational Forces Compatibility (MFC) is very important in these missions, because:

- Many analysts suggest that future adversaries of the US will give little or no warning of an attack against critical US ally or friend,
- Incompatibilities during Small Scale Contingency Operations (SSCO) can quickly cause misunderstandings about the means to be used to acquire the ends sought by multinational force, which can lead to gradual political and military disintegration of operations,
- The knowledge that one member of an alliance has advanced capabilities that are not compatible with those of the other members can cause strains in the alliance that will hinder its ability to act decisively,
- There is the likelihood that poor MFC could undermine the credibility of US commitments and deterrence postures around the world.

The background of concern is that the capabilities gap or the asymmetry in capabilities between the US and the NATO-West Europeans will likely emerge in the 2005-10 time frame. A variety of pressures and competing priorities will not permit West European governments to substantially increase their defence investment levels in the years to come. Therefore creative, procedural and not costly workarounds can help ameliorate the emerging capability gap.

Force XXI aims at achieving objectives by better integrating and using existing platforms. It will enable *better and faster force tailoring* of deployed task-forces, so that these combined arms task forces can deploy direct to combat without spending much time in intermediate staging and assembly areas. These units will be able to *mass effects* of their combat power without massing forces. As *lethality of future weapon systems* increases, the battlefield of the future will demand smaller force densities and non-linear force alignments. *Deep precision fires* will come from systems like MLRS (Multiple Launch Rocket System), Crusader (155 mm SP Howitzer) and the ATACMS (Army Tactical Missile System). A *superior situational awareness* with digitised units will be so well interconnected that every node in the unit will have complete situational awareness of friendly force positions. The use of the *highly accurate timekeeping function* in Global Positioning Systems (GPS) will enable more precisely synchronised operations. A *better force protection* will enable more rapid and aggressive manoeuvring against opponents, with defensive electronic warfare systems, active protection for armoured vehicles, better obscurants and Theatre Missile Defences (TMD). In *logistics* the Total Asset Visibility (TAV) as system will allow leaner logistics networks to be put in place in the theatre of operations. Split based operations use *advanced telecommunications technology* to keep many support functions physically located in CONUS, while still having the output in near real time. Force XXI represents a move from platform-centric to network-centric warfare by using high-speed, simultaneous operations on air, land and sea and in space to shatter the enemy's cohesion quickly. Neither attrition nor manoeuvre will be the standard by which we judge effectiveness by joint US military operations. The ability to perform missions will be grounded in a highly capable backbone information grid with smaller sensors and engagements grids. Although the NATO-West European allies are less sophisticated than the US, workarounds can ameliorate compatibility problems. The US would be able to infuse large amounts of tactical communications equipment to provide an underlying information backbone for allied operations. NATO could activate numerous liaison teams to prevent that communications and planning mix-ups do not occur. Another measure would be phased deployments and careful intelligence preparations. Extensive pre-deployment training and planning, careful force separation measures and deployment of existing, integrated command staffs are also measures to prevent compatibility problems.

The real danger lies in short-warning, out-of-theatre Major Theatre Wars (MTW) in terms of force compatibility with four areas of concern, (1) deployment, (2) employment, (3) logistics and (4) C⁴I. The weaknesses in these areas derive from the investment gap and the speed of transition from territorial defence structure to a power-projection with lean and light force structure model. In enhancing *force deployment* of out-of-area contingencies steps can be seen, but they alone will not solve the deficiencies in this area.

Regarding *employment* some European nations are undertaking selective ground force modernisation programs but there will be asymmetries in:

- Deep fires capability (long-range sensors, real-time targeting adjustment capabilities, battle damage assessment tools),
- Synchronisation of manoeuvre (digitisation and horizontal integration of individual unit nodes) and
- Force protection capability (against weapons of mass destruction, good theatre missile defence and personnel protection of soldiers on the battlefield).

This lack in employment of forces harms the ability to shape the battle-space and will force West Europeans to fight more close battle engagements. The lack of fully digitised units would cause timing and organisation problems in the implementation of operational plans, as the inability to apply artificial intelligence to decision making and planning. With *logistics* the concern is based on the varying levels of national munitions sustainment stocks, especially in precision-guided munitions and the stockpile of reserve munitions, which could compel West European units to operate at a lower tempo. Another problem is the relative shortage of expeditionary logistics units and networks in West European armies, with many closely tied to homeland depots. With C⁴I the biggest problems are misaligned operational architectures, and poor tactical standardisation protocols. There is not only a difference in the threat perception of key-out-of-area regions between the US and the West Europeans, but poor compatibility will do more than just limit the efficiency of combined expeditionary forces. Capability gaps could create a division of labour on the battlefield with US divisions fighting the enemy's armoured units in open terrain, while less capable West Europeans fighting engagements in complex terrain, like urban areas. This asymmetry could force rouge states to use nuclear, biological and chemical weapons. Capability gaps could also lead to divergence in opinion as to what are the true Centres of Gravity (COG) in a given campaign. The advanced US military would see the COGs in cohesion and will, while West Europeans in more traditional variables like territory and attrition rates.

Poor compatibility would force US troops to act as fire brigades to backstop weaknesses in allied or partner units that could threaten the integrity of the entire allied or coalition military position in theatre. The speed of operations may also outstrip the ability of alliance or coalition political leaders to keep up.

Perhaps the most doable work-around is a matching of command structured with different kind of contingencies allowing smoother transition from peace to war. To handle the problem, RAND proposes six types of different multinational command structures:

- Integrated command structure with separated forces,
- Integrated command structure with integrated forces,
- Parallel command structure with separated forces,
- Parallel command structure with integrated forces,
- Lead nation command structure with separated forces,
- Lead nation command structure with integrated forces.

Major Theatre War

To apply the possibilities above for MTWs, five variables were chosen for an MTW:

- In-area versus out-of-area contingencies,
- Short versus long warning time,
- Short versus long duration of combat,
- Attrition versus manoeuvre war and
- Separation of national forces versus no separation.

It turned out that lead nation command structures seemed to be the most flexible of the three. They would prove useful in almost all out-of-area operations save those without force separation. Parallel command structures are more limited but better suited to short-warning rather than long warning MTWs. Integrated command structures are simply not portable out of area, they are useful only in theatres proximate to NATO territory.

Small Scale Contingency Operations

To apply the possibilities above for MTWs, six variables were chosen for an MTW:

- In-area versus out-of-area contingencies,
- Short versus long warning time,
- Hostile versus anarchic environment,
- Stabilisation mission versus support operations,
- Separation of national forces versus no separation and
- Short versus long duration of the operation.

It turned out that lead nation command structures seemed to be the most flexible of the three. They would prove useful in almost all out-of-area operations save those without force separation. Parallel command structures are more limited but better suited to short-warning rather than long warning MTWs. Integrated command structures are simply not portable out of area, they are useful only in theatres proximate to NATO territory. It turned out that the lead nations structures are the most flexible of the three types in SSCs. To make sure that command structures are matched with contingency types, compatibility can also be improved by undertaking a variety of policy initiatives in the area of force co-ordination. This could be a *division of labour* among the US and West Europeans in terms of military expeditionary capability with each West European military adopting a speciality area (a denationalisation of defence) for its participation in multinational expeditionary operations to simplify many Trans-Atlantic interoperability issues. It would be also beneficial for the US to make some facets of the development of Force XXI operational architectures more transparent to NATO-West Europeans, which could eliminate some compatibility problems at an early phase. The Army could also set up a database of C⁴I compatibility maps that would include profiles of the C⁴I capability of every major US ally and potential coalition partner.

Compatibility Maps

The following five levels of interoperability have been identified by the LISI model, (1) isolated or manual, (2) connected or peer to peer, (3) functional or distributed, (4) domain or integrated, (5) enterprise or universal.

The compatibility maps could show technical shortcomings in interoperability, and could also be used to develop modest bilateral investment strategies. Also political-military engagement strategies offer a way to dealing with compatibility problems. The US Army forward presence in critical regions outside Europe would serve a springboard to begin coalition operations with stockpiles of ammunition, spare parts and forward liaison teams. The US could also identify anchor coalition partners in each region outside Europe and build up bilateral planning staffs to establish common protocols and standards that would form the basis of future operation in the region. Intelligence should also make a concerted effort to track non-standard indicators of military capability in regions where there are no formal alliances.

3.6 Pearce, LeRoy J. Dr.

Pearce, LeRoy J. Dr., *Coalition Operations in the Global Village*, AFCEA Canadian, Spring 1998

The Globalisation of Society

The tools of knowledge management technology can be expected to have a profound but also rapidly evolving effect on human affairs. A globalisation of economies occurred in the nineteenth century and is still occurring today. Today's globalisation is the result of plunging communication and computing costs. This situation has the potential to make a much deeper national economic penetration or international integration possible. Technology is enabling a new globalisation of commerce. What technology has given us is a communications infrastructure that simplified greatly our ability to talk over great distances and to learn in essentially real time what is happening on the other side of the world. Some forecast the demise of the nation state while others predict radical changes in our personal lives. The Centre of Gravity (COG) of business has shifted to information and the associated networks.

The Revolution in Military Affairs

Information technology and the modern information management techniques have enabled and continue to enable a very significant change in military affairs. What is happening is the realisation of a much more dynamic sensor to warrior cycle and the creation of a web type of structures amongst the deployed force elements. The time required to cycle through observe, orient, decide and action loops has reduced while the amount of data available and the options that can be considered has increased dramatically. Superior information exploitation is essential to achieve goals in the new military affairs era. What occurred else is the webbed interconnection of all of the force elements into an integrated whole, with the work of an integrated whole exceeding the sum of the individual parts. The web-like infrastructure is enabling superior performance through the synergy that can occur from the integration of individual force elements into a fighting whole – see Network Centric Warfare. An also important factor is the increased potential of the use of information weapons, crisis management techniques and strategy of containment or dismantling of the opponents campaign on a bit by bit basis.

The mass on mass strategy of the industrial era is no longer affordable nor is now socially acceptable to an informed public more focused on the new world of the information era.

Coalition Network Centric Warfare

Coalition military operations will increasingly be the norm as nations come to appreciate the political and military advantages of such arrangements. Each nation will bring national assets to a mission. The technical capability to use the same national equipment to connect with other nations in a federation of networks or more likely, to a mission network is paramount. A more accurate model for a coalition or multinational C³I operations is one of either the formation of a special mission net or the partitioned, federated connection of segments of national domains as is appropriate to the scale of the mission. Most coalition are ad hoc in nature but nations tend to develop their infrastructures in isolation from the ad hoc coalitions they will likely be used in.

The Way Ahead

Multinational missions introduce issues and opportunities that tend not to exist in homogenous, single nation force structures. Military commanders are still in the process of understanding the full impact of the information era on military affairs. With training and doctrine rooted in the industrial era, commanders and planners for military affairs are attempting to adjust and map the way ahead into the 21st century while at the same time sorting through the implications of multinational operations.

3.7 Reimer, Dennis J.

Reimer, Dennis J., *Dominant Maneuver and Precision Engagement*, Joint Forces Quarterly, Winter 1996-97, pages 13-16,
www.dtic.mil/doctrine/jel/jfq_pubs/domin.pdf

A trend is emerging that takes the form of a search for technological silver bullets being pursued at the expense of proven and balanced battlefield capabilities. Many believe that precision strike weapons can win all future wars, although human dimensions of warfare cannot be countered by technology alone. The cost of such wishful thinking has too often been paid by ill-prepared, untrained forces fighting desperately with their valour and blood to compensate for the lack of strategic forethought. Historically the advantage of fully balanced capabilities has been overwhelming and with this in mind we must strike the right balance between precision engagement and dominant manoeuvre.

Strategic Balance

Balanced capabilities provide a wide array of choices to decision-makers, allowing them to use friendly strength against enemy weaknesses. The combination of precision engagement and dominant manoeuvre destroys the enemy force. The years 1994-95 with conflicts in Haiti and Bosnia showed that forces on the ground, with balanced full spectrum dominance secured US interests. Technological advances bring radically increased lethality and mobility.

Our goal must be to field a capabilities-based force proficient in operating in all dimensions of conflict.

Operational Concepts

Manoeuvres and fires have always been primary elements of combat power. They allow forces to move into positional advantages to deliver direct or indirect fires to control or destroy an enemy's will to fight. We need the synergism of simultaneous dominant manoeuvre and precision engagement. This kind of holistic approach creates the conditions for decisive outcome. Full spectrum dominance depends upon a balance of dominant manoeuvre and precision engagement, supported by focused logistics and full-dimensional protection. Joint Vision 2010 provides a coherent picture of the future to develop unique capabilities with four emerging operational concepts like (1) full dimensional protection, (2) focused logistics, (3) dominant manoeuvre (4) and precision engagement. Although technology is advancing at an increasing pace, we must not make the mistake of relying on that alone. As noted, it is the adoption and application of appropriate strategy, doctrine and balance of operational concepts that ensure the outcome of a conflict. Looking to the future we must maintain the equilibrium between dominant manoeuvre and precision engagement in order to:

- Meet our national security needs,
- Prevent a short sighted, technology-based solution to operational requirements,
- Resolve many issues without using lethal means by employing ground forces in a show of force way,
- Leveraging decisive effects of positional advantage and psychological impact to achieve strategic objectives quickly and at a minimum cost.

We cannot eliminate the irrational aspects of war through a purely technical solution since the objective of war is to achieve the strategic aims set by political leaders.

3.8 Walker, E. C. T. Dr.

Walker, E. C. T. Dr., *Panel Report: Coalition Planning for Operations Other Than War*, www.aiai.ac.uk/project/coalition/ksco/ksco-1999/PROCEEDINGS

The difficulty of obtaining and the willingness to share basic data for the planning process from political, military and civil participants, rather than the planning process itself, emerged quickly as a differentiating issue for Operations Other Than War (OOTW). In addition the distinct goal of long-term settlement or continuing war avoidance, rather than the goal of finite resolution of a military conflict distinguishes OOTW, as well.

Operational discussions

The operational characteristics of a variety of war avoidance operations like peacekeeping, peace-enforcement, non-combatant evaluation and disaster relief are roughly the following:

- OOTW often involve chronic problems and on-going activities by potential participants,

- Co-operation and co-ordination among military, civil, non-government and other organisations is required,
- Participants have often not only conflicting public and private agendas and objectives, but they have also distinct cultures of organisation, operation and accountability,
- OOTW are essentially open, participation is quasi voluntary,
- Co-ordination of disparate organisations and large, unorganised groups of civilians is required,
- Locus of control, roles of participants and organisations are multi-faceted, fluid and ill-defined,
- Ad-hoc information infrastructure must be assembled and maintained,
- Training or preparation for most participants is not possible,
- Intent and consequences of actions are misunderstood or lost in translation across cultural interfaces,
- Specificity of objectives, culture of engagement and accountability differs widely among military, governmental and private organisations,
- It is extremely difficult to negotiate a mutually agreed set of objectives among OOTW participants in a fluid, uncertain situation,
- It is also a difficult problem to share detailed information about the resources and capabilities which the participants intend to make available to OOTW.

It is also difficult to develop objectives and doctrine for military organisations that are engaged in settlement and war avoidance operations. It is important to understand how military C² systems and procedures can be integrated with sophisticated and perhaps pre-eminent non-military, or even non-government information infrastructure and decision making procedures.

Some Non Governmental Organisations (NGO) will have made intelligence and operational contacts and may have considerable number of operatives. Some private participants may have unique or uniquely sophisticated capabilities and resources.

From this point of view most OOTW are collaborative, with much decision making remaining decentralised, local and unaccountable. The will to plan, the information for planning, the plan itself initially are unknown and must evolve together, while the objectives, resources and intent of some participants will be concealed.

Technical discussion

The basic data required for planning for OOTW are characterised by:

- Multiple perspectives and metrics for plan evaluation,
- Large number of goals and complex dependencies with goals being different, conflicting and sometimes unclear across and within the organisations,
- Incomplete information about available resources,
- The presence of multiple agents and means for accomplishing objectives,
- Graduated response changes in objectives over time,
- Flexible, scalable, affordable and robust implementation.

The challenge of a coalition for OOTW is to take such characteristics as given, rather than as barriers that somehow should be circumvented or removed.

3.9 Wilcox, Greg/Wilson, Gary I.

Wilcox, Greg/Wilson, Gary I., *Military Response to Fourth Generation Warfare in Afghanistan*, www.emergency.com/2002/4gw5may02.htm

Just what is Fourth Generation Warfare?

1GW: reflective in terms of tactics and technology (line, column, mass armies – straight lines and mass charges into the mouths of cannons),

2GW: attritive in terms of fire and movement (technological improvements in and heavy application of firepower and communications, extensive use of railroad),

3GW: manoeuvre based and non-linear (response to the increased firepower of the enemy, it is more based on ideas than technology in order to defeat more heavily armed industrialised armies),

4GW: the future of war (very Small Independent Action Forces (SIAF) or cells acting on mission-type orders, decreased dependency on logistic support, more emphasis on manoeuvre, psychological goals rather than physical ones)

characterised by:

- three basic constructs
 - the loss of the nation state's monopoly on war,
 - return to a world of cultures and states in conflict,
 - internal segmentation along ethnic, religious and other interests lines within the own society,
- and four predictions
 - shift in focus from the enemy's front to his rear,
 - practitioners of 4GW will probably seek to use the enemy's strength against him,
 - practitioners of 4GW will probably use freedom's openness against itself,
 - the 4GW force will not need a lot of money to wage 4GW.

The case of Afghanistan

- Any response to 4GW will probably be not just a simple military response but a global war,
- Even powerful states with strong militaries are very vulnerable to unconventional attacks,
- Prior to plan any operation, a different set of information gathering (intelligence) is needed, human intelligence and cultural intelligence is probably as important as technical intelligence,
- To avoid an escalation of the conflict the enemy has to be isolated carefully,
- The enemy to fight is not only militant but also entrepreneurial with own banking system, cut outs and blind alleys,
- Military response is probably just one part of a much larger strategic response,
- To cope with the conflict and to achieve a victory at the end and immense amount of cash is needed to cover all expenses (liberal use of cash did not hurt either).

Operations

- The enemy is elusive and doesn't fight in a fair way, he is experienced and hardened with sometimes operating in the underground,
- The enemy can find sanctuary in adjacent countries,

- The identification between friend and foe is difficult,
- The terrain is difficult and the allies are uncertain,
- Delivery platforms are given: fixed-wing bombers and helicopters,
- Application of Special Operations Forces (SOF) to advise allies and conduct operations (they pulled the rest of the force in the direction of least resistance to achieve considerable victory through manoeuvre),
- Use of conventional forces to secure bases and to conduct operations,
- To avoid own troops being lucrative targets, the numbers of ground forces to fight is kept low,
- Various generations of warfare are present at the same operational area.

Offering Up Some Fodder for Thought

Essence of Moral Conflict by Boyd, SEE page 11-12!

3.10 Wilson, G. I./Sullivan, John P./Kempfer, Hal

Wilson, G. I. (Col.)/Sullivan, John P (Sgt.)/Kempfer, Hal (Lt. Col.): *Fourth Generation Warfare, It's Here, And We Need New Intelligence-Gathering Techniques For Dealing With It*, Armed Forces Journal, International, October 2002.

Our world and the nature of conflict are changing. The ways we wage war and protect the public is also rapidly changing. The now-and-future conflict is transnational and global. This “fourth-generation warfare” is manifesting itself in highly compartmentalised, cellular, predatory adversaries operating in networks outside the framework of traditional nation states. 4GW moves beyond terrorism and has the following characteristics:

- The loss of the nation-state’s monopoly on war,
- A return to a world of cultures and nation-states in conflict and
- Internal segmentation of division along ethnic, religious and special interest lines within our own society.

Continuous Conflict

War and crime are increasingly intertwined, yielding ethnic enmity, refugees, displaced persons and opportunities for criminal exploitation. These recurring bad actors operate largely at the low end of the technological spectrum, but they are beginning to operate to exploit technology. Transnational Criminal Organisations (TCO) are networked more than ever and control large sums of money. The world is dominated by conflict and random violence between the “haves” and “have-nots”. In this post-modern conflict the distinction between civilian and military continues to erode and may disappear.

Multiple Operating Environment

4GW will be found in a variety of settings. This so-called “Three-Block War” demands a high degree of situational recognition and knowledge to understand which response is required and when it is required. Adequate intelligence, surveillance and reconnaissance must be available.

Intelligence needs

Intelligence needs to provide indications and warning and Human Source Intelligence (HUMINT). Lack of situational awareness has long been the impediment to executing appropriate Courses of Actions (COA). We need to anticipate and understand the dynamics of these issues, having not only knowledge dominance but also, more importantly, dominance in understanding the context of the action, event or engagement.

Urban Operations

Much of the potential battle-space of the future will be urban. Conducting complex and brutal urban expeditionary operations will be the case. Besides that, they are extremely demanding and taxing and complexity is a feature of all urban operations:

- Compressed decision times,
- Increased operational tempo,
- Crowded theatre for operations (thousands of inhabitants/m³),
- Degraded command and control,
- Complicated decision-making.

Intelligence for 4GW: “Everyone’s Business”

A new intelligence paradigm needs to be crafted that acknowledges realistic expectations for intelligence-related activities and specifies that intelligence is in fact everyone’s business. New tools and approaches are needed to sort pertinent information from noise. Combining traditional and new tools can assist in identifying the indicators of violence that may trigger a military or combined military-civil response.

Civil protection

Meeting 4GW threats to stability and security requires a direct and enduring commitment to forward-thinking military and civil readiness. Terrorism Early Warning Groups (TEWG) can involve collaboration among local, state and federal level law-enforcement and response agencies. To meet the now and future warfare, our intelligence must focus more on cultural and social paradigms, not just military orders of battle.

3.11 Conclusions

This chapter places Effects-Based Operations into a broad context and reveals the complexity and the interwoven nature of many different ideas and approaches to decode and deal with the challenges of the current security environment. EBO offer a framework to see and understand these current and future challenges in a unified way.

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4. Strategic Warfare, Parallel Warfare, Strategic Paralysis, Complexity Theories

4.1 Introduction

The ideas behind Effects-Based Operations are not novel to many theorists. Since the first airplane entered military service, many thinkers have sought for a better application of the aerial component to avoid the butchery of the surface battle as seen in the trench-warfare of WWI. Starting with Douhet many air protagonists believed that a proper application of this weapon offers a better way to fighting and achieving victory. Apart from the developments resulted in the current military technology, also a new way of strategic thinking has emerged. This includes ideas like strategic warfare, strategic paralysis and parallel warfare in connection with complexity theories. This approach recognises war as a non-linear interaction packed with uncertainty, ambiguity and risk.

This thinking focuses on the totality of the enemy who is regarded as a system composed of numerous subsystems. This systemic approach opens possibilities, because if any part of the system becomes incapable of functioning, the rest of the entity is also affected. Within this construct the ultimate effect is just forcing the enemy to comply our will. This approach regards the whole of the enemy as target and not just the military force. Within this construct fighting is not the essence of war anymore. The real essence is forcing the enemy to accept our objectives as his own.

Western societies expect that armed conflicts will be short, decisive and accomplished with a minimum of casualties. This requires the capability to achieve specific effects and not the absolute destruction based on target lists. The central question is how time and space can be exploited in terms of what effects are desired. It aims at compelling a positive political outcome with the use of force to control rather than to destroy. This can be seen as an alternative to annihilation and attrition, because rendering the enemy forces useless is just as effective as eliminating it. Controlling can be accomplished quicker and with far fewer resources. In this construct the ideal application of force involves actions against all targets in each target system at one time. This output orientation redefines the concept of mass and the physical presence of forces. To achieve a change in the enemy's behaviour we need to attack or threaten those targets selectively, which most directly support the enemy's ability or will to continue with his current behaviour. If the right combination of these elements can be neutralised, a paralysis on strategic scale may occur.

Only this concept of expending minimum effort to produce maximum effect promises that fighting wars will be quick, inexpensive and with as little bloodshed as possible.

This new way of thinking about conducting war stands for complexity, parallel thinking and planning in cycles. Planning and analysis is a delicate balancing act involving multiple dimensions and interactions. Complexity can be defined as the state region between equilibrium, order and stability on the one pole and chaos, turbulence on the other. If we regard the enemy as a complex system, we regard him basically as interactions of numerous simple interacting sub-systems or entities. Adaptation is important in complex systems. Understanding it is crucial in determining the desired effects. The field of Complex Adaptive Systems offers hereby some principles.

4.2 Barlow, Jason B.

Barlow, Jason B. (Maj.), *Strategic Paralysis, An Airpower Theory for the Present*, School of Advanced Airpower Studies, Air University, Maxwell AFB, May 1992, www.maxwell.af.mil/au/aul/aupress/SAAS_Theses/Barlow/barlow.pdf

Chapter 1 – Introduction

Since the first air plane took to the skies, military men everywhere have sought a better understanding of air power and how best to use this unique weapon to defeat an enemy. The final objective sought in any military conflict is a change in the enemy government's behaviour. What is not so clear is how this change is achieved and more specifically, the role air power plays in it. The goal of Strategic Paralysis (SP) is to selectively attack or threaten those targets that most directly support the enemy's ability or will to continue with his current behaviour. For this SP requires four key ingredients, (1) the right targets, (2) high technology, (3) an enemy dependent upon a well developed, modern and vulnerable infrastructure and (4) aerospace control. SP warfare should result in a change in the enemy's behaviour at a lesser cost to both sides, because of the weapons used and the targets selected.

Overview

Right targets – not all targets are of equal value and since air power is usually limited and precious, it only makes good sense to concentrate it on those targets that will result in the largest enemy effect. Key targets or National Elements of Value (NEV) represent a cross-section of the enemy's sources of strengths. If the right combination of these elements can be neutralised, paralysis on a strategic scale will occur. NEVs are located in leadership, communication, industry, population, military, alliances and transportation systems.

For NEVs, four key assumptions are made:

- NEVs vary in importance from country to country,
- Interactions between NEVs are self compensating, a change in the strength of one element will likely be offset by other elements,
- The enemy government and leaders are rational and not willing to sacrifice everything,
- A necessary intelligence is available to carry out the campaign, because the purpose is to paralyse and not to obliterate – an excessive destruction comes back as a burden on the very societies that caused it.

Technology – stealth, Precision Guided Munitions (PGM), cruise missiles, deep penetrating bombs and GPS enable us to accomplish things never before attainable. Minimising damage and civilian losses are key tenets. Enticement to behavioural change rests in the weight of this accumulated damage and in the threat of future destruction.

Vulnerable infrastructure – means a well-developed, modern and vulnerable infrastructure. Air power cannot attack what is not there, and it cannot attack what it cannot find. SP assumes that attacks on these highly prized elements will not only shock and stun the enemy but inflict great pain, acting as a powerful incentive for behavioural change.

Aerospace control – is the control of the skies over the enemy to enable the freedom to strike at will over his territory. But this is not exactly air superiority in the traditional sense, because as long as the necessary targets can be attacked while holding the rest at risk, the enemy could still control portions of the sky above his country.

Chapter 2 – The Theory of Strategic Paralysis

Though not suited for all types of conflicts and beholden to four distinct prerequisites, SP is a complementary strategy of great potential. The idea of paralysing an enemy is not new (see Liddell Hart's theory). SP promises a solution to the conflict at some level of destruction short of complete annihilation. With SP fewer people and supplies are at risk, timing and tempo of attacks are controlled. The very nature of the targets ensures a quicker, less costly victory. The concept of SP is quite old but as an actual strategy it is quite new. SEE figure on page 15! SP is a uniquely different strategy being neither solely annihilative, nor attritive and it is enabled by a change in force or capability with a difference in quality and not quantity.

Traditional strategies of war – there are two fundamental strategies of warfare, annihilation and attrition. Attrition warfare seeks an eventual victory by exhausting the enemy in time, space, energy and supplies. Attrition strategy generally occurs between forces of roughly equal capability. It is usually a strategy of greater duration and cost, both in lives and treasure.

Annihilation implies superiority over one's adversary and seeks the complete and utter destruction of the enemy. It is a strategy of overwhelming force. Both annihilation and attrition have one thing in common, the initial battles of force on force. In contrast SP aims at an earlier and less costly solution by paralysing the enemy's key sources of strength.

Strategies of war in an air power framework – the airplane added a new dimension to warfare and promised to take the fight to the enemy despite the situation on the ground. This access to enemy territory hinged upon the ability to gain and maintain control of the sky. Air superiority enabled countries to move from an attritive strategy to one of annihilation, whereby air superiority is seen by the branches as a prerequisite to success on land or sea. Also technology plays a similar role for a move to SP, like precision guided munitions, cruise missiles, global positioning satellites and stealth.

These technology developments have endowed air power with the penetrative capability and delivery accuracy necessary to paralyse an enemy's strategic centres. SP represents an important shift toward drastically limiting damage in warfare.

Strategic paralysis concept – in SP air power is employed to accurately strike at an enemy's NEVs to paralyse his ability to continue the conflict and perhaps even break the will to do so. The desired result is the change in the enemy's behaviour. This strategy is naturally attractive because it holds victory from the air at a far less cost and shorter time span. It also conforms the way Western democracies like to fight wars, quickly, inexpensively and with as little bloodshed as possible.

- *Vulnerable infrastructure* – SP requires important and vulnerable targets if it is to succeed like bridges, communication centres, power production stations and water plants. If there is no vulnerable infrastructure, the strategy can go over to annihilation or even attrition, which might occur where an enemy's leap in technology of force becomes great enough to deny aerospace control. A drop from SP can also be self-inflicted with mismanagement of precision weapons, the failure to materially maintain air superiority or no exploitation advantages because of political considerations.
- *Strategy selection* – while attrition is an unpopular strategy forced upon or inherited by its user, SP is different in its very intent. It is to strike in a surgical fashion with smart weapons in contrast to an annihilative warfare fought with dumb and more expansive weapons. There is a difference both in scale and price with the potential of SP to resolve conflict at a lower cost because of its unique methodology and target selection.
- *Strategic paralysis and territorial acquisition* – SP is probably not well suited for territorial acquisition, but it should work well in convincing an enemy to cease with territorial aggression. It helps persuade an opponent to give up his position before a costlier form of warfare is necessary.
- *Strategic paralysis for offence and defence* – SP is a strategy that is clearly more relevant to offensive engagements, because it is a strategy of action and initiative.

War is a contest of wills with a desired ultimate end state of the enemy's submission to our will. With an eye on the state of affairs, an enemy completely devastated after the end of the battle might make the end not worth the means. With commerce and prosperity of nations closely interwoven and interdependent, the destruction of the enemy's economic wealth recoils on the head of the victor. Warring nations should endeavour to gain their end while inflicting a minimum level of permanent injury to both life and industry. But can a force from the air alone coerce an enemy to change his behaviour? Of interest is the mechanism for inducing or coercing a change in the government's position, which can occur at least generally in three ways:

- Key governmental leaders can be killed or replaced by a more sympathetic group,
- The government can be overthrown either by popular revolt or from a faction within,
- The leaders in charge can change their minds and stop what it is they are doing.
SEE figure on page 31!

Chapter 3 – Choosing the Right Targets

Military leaders have always sought for targets that promise a quick decisive victory. The search for the enemy's Centre of Gravity (COG) means to find a single target or set of targets that once destroyed yields victory. Target selection lies at the heart of military doctrine and theory.

Section 1 – The theories of Clausewitz and Jomini. Both recognised that the destruction of the enemy's armed forces was not the real objective of war. The idea of the COG concept was based on the fact that all wars are costly in time, lives and treasures. *Clausewitz* coined the term COG in the early 1800s and saw it in the enemy's armed forces, particularly the land forces, which if defeated the surrender would follow. Many modern day military leaders still understand the COG largely as *Clausewitz* – the idea of identifying an enemy's COG to get the most impact with least effort. But if an enemy's COG in general sense is the strongest point, it is also likely to be the most heavily defended and least vulnerable to attack. A fact that seems to be in opposition to traditional military theory that emphasises surprise, mass and economy of force. *Clausewitz* also conceived COGs in the community of interest in allies, the public opinion, but he still contended that the central feature of the enemy's power might be the defeat and destruction of his fighting forces.

To defeat an enemy he considered (1) the destruction of the enemy army, (2) seizure of his capital and (3) an effective blow against the principal ally. The entire notion of a COG is singular in concept, but what if you have discovered two? *Clausewitz* dealt with the issue of multiple COGs most prominently when dealing with alliances. He also thought war as a linked engagement and not as a collection of separate campaigns. He seemed to imply individual engagements to gain importance only as they contributed toward the final objective. Therefore, if these engagements are viewed as steps in defeating an enemy's COG, then this statement is consistent with his earlier thoughts. *Clausewitz* argued strongly for the importance of identifying and attacking the single centre of source of an enemy's strength. *Jomini* believed that the key to victory was manoeuvring to attack the enemy at the decisive time and place with the greatest possible force. He used the term Decisive Strategic Point (DSP) because he discovered that not all points or targets in the theatre of war were of the same strategic value. He suggested that the capture or destruction of a key point could be decisive by itself in determining the outcome of the battle with a marked influence on the campaign.

Section 2 – The air power theories of Douhet, Mitchell, Liddell Hart and Warden. *Douhet* saw the destruction of the enemy air force as the key to success and number one priority, because everything of the enemy's then became vulnerable. He believed that the command of the air would have a decisive influence on the outcome of the war. After command of the air was achieved, he advocated attacking both the morale and material means of the enemy, but leaned strongly toward enemy morale as being pre-eminently. According to him command of the air was subjecting the enemy's territory to the own offensives. From this point of view winning command of the air was paramount because with it came the ultimate victory. He envisioned societal chaos and collapse under the strain of heavy aerial bombardment with people driven by the instinct of self-preservation would rise up and demanding to the end of war. He called the enemy's key elements the vital centres with recognising that not all targets were equally important.

Attacking these vital centres would crush the material and morale of the enemy. According to him vital centres were concentrated industries, large population centres, communication lines, hydraulic resources, railroad junctions, depots and military storage areas. He stated that enemy target selection was the most delicate operation with no hard and fast rules or general standards due to the various circumstances. Two key ideas are important in a summary of Douhet's theory, (1) the destruction of the enemy's air forces (COG?) to achieve command of the air and (2) attacking the enemy's vital centres, especially his population. *Mitchell's* ideas dealt more with tactics than strategy but were no less significant given his place in history. Curiously he had little to say about the selection of vital targets, preferring instead to stress the importance of air power.

He proposed the destruction of the enemy's war making capability and influencing the people's desire to renew the combat by using explosive bombs and gas. As early as 1926 he questioned the need to defeat an enemy's army in the field and instead advocated the use of airplanes as a method to go directly to his heart. A desired method of prosecuting war previously was to neutralise the vital centres of an enemy country in order to paralyse his resistance. Air power could have a decisive impact upon the enemy's capability and will to continue the fight. *Liddell Hart* used the term Achilles heel, with aiming the effort at the enemy's vulnerable position as a means to achieve victory at the lowest possible cost. He wanted to find the one target that would give the most impact for the least effort. He recognised that to strike capitals and other vital centres previously, first the enemy's main forces had to be disposed. This led to the delusion that the enemy armed forces themselves were the real objective. He identified the key targets in any country as the government, industry and the people, based on the belief that nations collapse from within when combined with exhaustion from war. But he also saw that the enemy air forces would first have to be defeated face-to-face before any such benefits could be realised. *Warden* believes that air superiority must come first. By this he means eliminating enemy forces that could interfere with air operations, because so much else is heavily dependent on it. Also for him is gaining air superiority a prerequisite to victory rather than an end itself. Air superiority opens the door for everything else air power can bring to the conflict. According to him, COG can exist at every level of warfare, tactical, operational and strategic. A COG is the point where the enemy is most vulnerable and where an attack will have the best chance to being decisive. He considers an enemy's command element always as a COG. He is convinced that certain key centres in any country warrant targeting for the impact they could have on the outcome of the battle.

Chapter 4 – More Targeting Theories

The notion of identifying, attacking and destroying or paralysing an enemy's critical and lucrative point(s) is the bedrock of most military theory. It has the foundation for a quick, decisive victory in war. The identification of the enemy's key weaknesses is critical in his defeat and therefore quite important for the effective application of air power (it must be used where it will have the most impact).

The authors of the *Inter-parliamentary Union* report of 1931 said that there were only two types of warfare left, (1) those against the enemy's fighting forces and (2) those against his vital centres with a decisive battle between aerial forces determining the outcome of the war. The loser would be forced to realise the threat of bombing his vital centres. The study concluded that only four industries were the foundation of national independence, (1) iron and steel industry, (2) chemical industry, (3) electrical industry and (4) oil refineries.

Warden's strategic rings model is a recent, though not original attempt to categorise a nation's key components of targets and their interactions, but unfortunately it allows for only a static view of the situation. He maintains that the command element is the most critical of the targets, which if destroyed causes the country to collapse. SEE figure on page 66! *British notions* with Air Commodore *Charlton* identified the destruction of storage areas for oil and fuel as the most critical target for air power, because their destruction limited the air force's ability to fly. He also saw the sources of electrical power as targets of strategic value. Air Marshall Lord *Tedder* described target systems for air attacks as largely fitting into classes of point targets and common denominators. Key points or panaceas were railways, canals, power plants, iron and steel plants and of course, oil. Even the *Luftwaffe* had also its own lists of important targets, a fairly comprehensive list that included nearly all industry, the people's morale, the enemy forces, the communication and leadership. The *Air Corps Tactical School (ACTS)* claimed that air power could break down the enemy's will to resist and his capability to fight by:

- Destroying organic industrial systems in the enemy interior that provided for the enemy's armed forces in the field,
- Paralyzing the organic industrial, economic and civic systems that maintained the life of the enemy nations itself and
- Attacking the people themselves, especially those concentrated in the cities.

ACTS advocated direct attacks on the enemy's national economic structure for the purpose of reducing the capacity for war of the hostile nation and applying pressure to the population at the same time with equal efficiency and effectiveness. Given this, it should be possible to determine the vital links in the chain, which if attacked would cause the breakdown or collapse of that economic system, which later became the industrial web theory. *Curtis LeMay* defined strategic air warfare as air combat and supporting operations designed to effect the systematic application of force to a selective series of vital targets. He sought the aggressive destruction and disintegration of the enemy's war-making capacity to a point where he no longer retained the ability or will to wage war. Vital targets were manufacturing systems, sources of raw material, critical material, stockpile, power systems, transportation system, communication facilities, elements of the enemy armed forces and agricultural areas. As we can see there were a number of attempts at defining what constitutes a nation's vital centres to determine the most critical targets whose destruction would ensure the enemy's downfall. Every country consists of many separate but interrelated components and a nation is just as strong as the sum of these components. The enemy's strength is spread out among several interrelated key elements.

Chapter 5 – The National Element of Value Model

The NEV model describes seven strategic target categories or elements which mirror the country's own status in industrial, social, cultural and political development. To apply the model the following four assertions are important:

- NEVs are interdependent and self-compensating, with a dynamic relationship. Though a single element might be important, at a given moment it is still affected by the others. In fact it reacts to its environment. The magnitude of an effect depends on the size of each piece and the speed of removal. If one NEV is crippled, it might be possible for another to take its place. NEVs can substitute each other – an evidence for the adaptability of modern economies.
- NEVs vary in importance from country to country with no two countries having the same strategic target set. Elements within a nation can change in their importance, compensating for the weakness of others. Therefore a continual evaluation will be needed during the conflict to ascertain which elements are the most critical. Not every source or element carries the same weight or is equally vulnerable in all countries.
- NEVs regard the enemy leadership as rational heads of state that can be influenced, because he values life, limb or property. The enemy leadership should understand phenomenon like cost or unacceptable levels. This model fails if imposed on an irrational leader or against a value system that is not understood.
- Proper identification of an enemy's NEVs requires a significant increase in the intelligence base, because it provides the foundation upon which the determination of the enemy's most vital targets rests. Without it, efforts are just wasted with the conflict extended and costs increased.

Every country enjoys at least four instruments of national power, the so-called DIME (diplomatic, informational, military and economic) construct. From a military viewpoint, it is important to identify the targets within a country's instrument of national power. It determines where the enemy nation draws its strength to continue the fight. A breakdown reveals the following seven broad categories, which delineate the country's sources of strengths and identify the targets necessary for victory:

- *Leadership* – is defined as both the political and military decision-makers within the government. Whoever is in control of the people, the government and the military are of interest. Leadership is a key feature in every nation.
- *Industry* – since most wars require a bounty of equipment, it includes all of a country's manufacturing, agriculture and technically productive enterprises, as well as those parts necessary to support them, such as power production, water supply and raw materials. Attacks on industry must be aligned with strategic aims of the conflict with the precision of modern air power allowing for selectivity and to minimise long-term damage.
- *Armed forces* – are rarely the true or final objective in war with the enemy's will occupying that position. In any conflict the usually preferred option is to convince the enemy to comply or change his will short of resorting to military force. The military is just another means of national power and may not be the principal NEV.

- *Population* – may be the most important source of strength and the hardest to impact. It embraces all features of a country like nationalism, morale, will, religion, beliefs etc. It is the population that does the fighting, suffering and dying in any conflict, so in theory at least the ultimate power to start and stop a conflict lies within the population. Yet attacking the will of the people is risky and difficult.
- *Transportation* – includes ground, air and sea transportation nodes to put forces in contact with the enemy and to sustain them. Some components may be highly vulnerable like bridges, rail yards, airports, docks and depots or sub pens. Transportation is also related to all of the other NEVs, as well.
- *Communications* – means not so much the message but rather the means by which the message is communicated. Elements are radio stations, telephone wires, microwave antennas and satellites with associated stations together with fibre optic cables. A complete destruction is counterproductive because it prohibits the ability to communicate with the enemy.
- *Alliances* – comprises the friends, allies, trading partners and neighbours with which a country receives support for continuing the conflict. They are those strategic relationships with other countries, from which the enemy receives equipment, personnel, war-making supplies or moral support. No modern country is self-sufficient.

Chapter 6 – Conclusions

The strategy of SP offers important benefits over attrition and annihilation. It is less costly and shorter. SEE text!

4.3 Bence, Christopher

Bence, Christopher (Maj.), *Warden vs. Pape*, Preface, Air & Space Power Chronicles, document created on 28 February 2002, www.airpower.maxwell.af.mil/airchronicles/cc/bence.html

Since the Wright brothers' historic flight in 1903 air power theorists have embraced the airplane as a formidable weapon capable of performing a wide variety of missions. It is the inherent flexibility that has caused a great controversy as to the proper application of air power. Moreover as technology changes the dynamics of air power, so does the theory surrounding its proper application. Currently two prominent theorists, John A. Warden III and Robert A. Pape are in the forefront of the air power debate.

Warden's theory is based on the premise that the only way to influence an adversary is to affect the leadership or decision-making entity. Pape argues that air power's primary focus should be to coerce an adversary by denying the ability to oppose one's military by targeting the enemy forces. In his book *Warden* established the aim of translating strategic military objectives into theatre air campaigns. He notes that strategic thinking must start at the top by understanding the strategic objectives and the nature of the enemy in order to analyse the situation deductively. Deductive thinking is according to him the essence of strategic planning. Warden regards the enemy as a system comprised of numerous sub-systems.

Within this construct he relates the end-state (objectives) to the means (action). This requires a good understanding of the enemy's structure, culture, geography etc. With his systemic approach we are able to perform a critical analysis of the enemy, searching where air power should be focused in order to force him to comply with our desired end state. Warden's model is described with five concentric circles with leadership as the inner circle and expanding to organic essentials, infrastructure, population and fielded forces. The most critical ring in this model is leadership, but he argues that each ring consists of one or more Centres of Gravity (COG) which may be directly tied to the innermost ring. Planners must consider the enemy as a whole system, searching for where strategic air power can be decisively applied to force an adversary to accept our will. This system-of-system approach is designed so that if one ring is affected, it will negatively affect the rest of the system. Warden's concept of viewing the enemy is applicable to any group like non-industrialised nations, terrorist organisations or drug cartels. His approach gives the ability to identify and target critical components to affect the decision-making entity. The first problem with Warden's approach is that it does not deal with the unpredictability of the moral factor, a phenomenon based on the differences in the human nature. If one is truly going to analyse the adversary, this factor cannot be ignored. Another problem is, that Warden posits leadership as the most critical and important ring. In reality not all systems have leadership as the most critical COG. Nevertheless his theory provides an excellent starting point in evaluating an adversary.

Pape focuses air power on the enemy's military forces. He also sees that forcing the enemy to comply with our will is the ultimate objective of any military actions and that air power's flexibility makes it an excellent tool for achieving that objective. He argues that the only way to achieve victory and compel an adversary is by military coercion through theatre attacks focused on the operational level of war. His coercion theory seeks to change an adversary's actions by manipulating costs and benefits.

Pape defines the following three types of coercive air strategies:

- *Punishment* with targeting industry and infrastructure in order to inflict pain and suffering on civilians so as to spur revolt,
- *Decapitation* with targeting leadership and communication facilities in order to paralyse the adversary and
- *Denial* with targeting the military forces.

Pape argues that air power should be focused at destroying fielded forces, thereby denying an adversary the capability to achieve military or political objectives. This denial weakens an adversary to the point where friendly ground forces can seize disputed territories (the ultimate goal in a conflict) without suffering unacceptable losses. Air power flexibility and lethality must be used to do most of the work, leaving friendly ground forces to mop up the enemy. Pape strives to minimise casualties, therefore his denial theory's focus is to exploit the vulnerabilities of the adversary's fielded forces. Military coercion is a legitimate issue facing the military in today's unpredictable world. Focusing air power against fielded forces yields quantifiable results that can be easily measured, especially when compared with trying to measure strategic effectiveness.

Although Pape states that the denial theory applies to irregular forces as well, he assumes a conventional force-on-force conflict. Pape also argues that denial is the more effective form of coercion than punishment or decapitation, but with three limitations:

- Concessions can only be obtained over specific territory denied to the opponent,
- Military pressure must be continually applied until a settlement has been reached,
- Denial is expensive because it requires occupation of the disputed territory by ground forces.

Having analysed the two theories, we can conclude that a combination of both represents an air power theory focused to achieve decisive results. By focusing air power simultaneously on leadership and the fielded forces of an adversary, strategists influence both the decision-making entity and their basis of power, thereby forcing the adversary to comply with our will. The events in 1990 presented Warden an excellent opportunity. Operating from Bush's four national strategic objectives he developed five theatre strategic objectives for the air campaign with four phases and using his five-ring model:

- Phase I – the strategic air campaign was designed to seize air supremacy and strike a wide range of strategic COGs in Iraq,
- Phase II – started the transition to the operational level by striking Iraq's air defence network in Kuwait,
- Phase III – shifted the primary focus to the Iraqi forces in Kuwait and
- Phase IV – was the air support of the ground campaign.

General Schwarzkopf executed the phases I-III simultaneously with emphasis on strategic targets gradually shifting to operational targets as the air campaign evolved. An evidence that both Warden's and Pape's theories were executed simultaneously. On the other hand Bosnia presented several challenges for air power's application in a Military Operation Other Than War (MOOTW):

- *Operation Provide Promise* demonstrated air power's flexibility with humanitarian aid and supplies,
- *Operation Deny Flight* sought (1) to protect UN forces delivering aid and (2) to stop Serbian atrocities by banning all unauthorised flights over Bosnia and Herzegovina,
- *Operation Deliberate Force* was designed to capitalise upon air power's speed, flexibility and precision forcing the Serbian leadership to lift the siege of Sarajevo and negotiate for peace.

Deliberate Force demonstrated air power's effectiveness in operations that are limited by political, domestic or military constraints. Air power cannot unilaterally win, but it can be a decisive element if properly applied. Thus, by focusing air power simultaneously on fielded forces and leadership, one is best able to compel an adversary in order to achieve the desired end-state. Warden's five-ring model provides air power strategists the foundation, to analyse an adversary and determine where air power should be focused. In order to achieve the political and military end states, air power must be simultaneously focused on the leadership and the fielded forces of an adversary.

4.4 Bird, Richard F.

Bird, Richard F., *Crisis Response, Complexity and Analysis*,
www.mors.org/meetings/ebo/ebo-reads/Bird_Response.pdf,

While applying Effects-Based Operations (EBO) it is important to think in complexity, parallel thinking and planning cycles. This article focuses on the planning process in chaotic situations because an organisation's security establishment might face complex challenges in any future crisis. The world environment is complexly fluid, decision opportunity abound. Therefore planning and analysis for maintaining internal and external equilibrium is a delicate balancing act that requires continuous observation, awareness, learning, adaptation and action. It involves multiple dimensions and interactions, thousands of actors and interests. Unfortunately there is little information or data with which to work and history, experience may hold no relevant lessons for us. With this in background planning and analysis describes a process not a product. Crisis by its nature is sudden, unexpected and traumatic and produces chaotic responses in social systems.

A central aspect of crisis action is the complexity of response required from multiple players, which may become involved at some stage of the crisis evolution.

Complexity

There are many definitions for the phenomenon. It is the state-region between equilibrium, order, linearity and stability on the one pole and chaos, turbulence on the other. A system is complex when it is easier to build, than to describe mathematically. Complexity has many recognisable attributes:

- *Dynamic processes* – exhibit inexorable change over time, what one player does effects how others react.
- *Non-linearity* – generates instability, discontinuity, synergism and unpredictability by placing a premium on flexibility, adaptability, innovation and responsiveness.
- *Recursion* – occurs when determination of a further succession of results uses operations on preceding results. It is built upon preceding processes, which means that the past influences our future by our lessons learned.
- *Hierarchical processes* – are evident when elements at different hierarchy levels interact to produce surprising results based on decisions made in a knowledge vacuum. What happens at one certain echelon effects others in ways they do not anticipate, appreciate or comprehend.
- *Sensitivity to initial conditions* – means that small changes in initial conditions can produce drastically different consequences. Crisis may appear to originate under similar circumstances, yet their outcomes may defy generalisation due to small differences in their initial conditions.
- *Emergence* – is a manifestation of a unique self-organising ability of complex systems, which cuts both ways because crisis and response can both emerge, but emergence happens most freely when there is little or no control applied.
- *Complex Adaptive Systems (CAS)* – evolve into self-organised forms in the absence of external constraints. CAS exhibit coherence under change without central direction.

Based on above Crisis Response (CR) requires conceptually grasping the big picture at once. The rest of the article (two pages) is about decision making in the face of the uncertainty with:

- feedback loops or thinking in cycles,
- using metaphors,
- using probabilistic methods, and
- using models and simulations.

4.5 Deptula, David A.

Deptula, David A. (Brig. Gen.), *Effects-Based Operations: Change in the Nature of Warfare*, Aerospace Education Foundation, Defense and Airpower Series, www.aef.org/pub/psbook.pdf

The Gulf War air campaign introduced profound changes in the planning and conduct of warfare. Today and in the future armed conflicts are expected to be short, decisive and accomplished with a minimum of casualties. The critical element of this process is called the effects-based approach. With this approach we can define the nature and type of forces that we must field to deal with emerging and future threats. It also has very significant implications for the mix of aerospace, land and sea forces for the future.

Introduction

During the Gulf War by the end of the first 24 hours more than 1300 air sorties were flown. The first night demonstrated that the conduct of war had changed, 150 discrete targets made up the Master Attack Plan (MAP) for the opening 24-hour period of the air war. This meant more separate air attacks in 24 hours than ever before in the history of warfare.

Defining Rapid Decisive Operations (RDO): Parallel Warfare

Understanding the changes that occurred during the Gulf War should facilitate the exploitation of technology and development of war fighting concepts to better meet the defence challenges of the future. The campaign plan was designed to (1) paralyse Saddam's control of forces, (2) neutralise the enemy's capacity to fight, (3) undermine his will to fight, (4) reduce his military production base, and (5) control his capacity to build Weapons of Mass Destruction (WMD). The construct of warfare employed has become known as parallel warfare and was based upon achieving specific effects, not absolute destruction of target lists revealing the difference between serial (sequential) and parallel (simultaneous) approach. Earlier air campaigns applied force sequentially to roll back defences before attacking targets of the highest value. Each target clears the way for the next one until finally the target of value can be hit. The capacity of simultaneous attack enables surprise at the tactical level, a larger span of influence, fewer casualties, paralysing effects and shorter time to impose effective control over the enemy. The greater high value target coverage in a short time is not the only benefit of parallel attack. Parallel war exploits three dimensions to achieve rapid dominance, time, space and levels of war.

The crucial principles defining parallel warfare are how time and space are exploited in terms of what effects are desired at each level of war – the essence of Effects-Based Operations (EBO). The term Rapid Decisive Operations (RDO) seeks to achieve a similar result with greater rapidity and less mass.

Well beyond the activity of destroying opposing forces lies the ultimate purpose of war, to compel a positive political outcome, with the use of force to control rather than destroy. Any political entity can be thought as a system, consisting of a number of subsystems, or as a system-of-systems. The effective control of a system may lead us to the same strategically relevant results, with significantly less force though. Effective control of the enemy's operational level systems will paralyse his ability to function at the strategic level. The object of parallel war is to achieve effective control over an adversary for power and influence with parallel attacks carried out at rates high enough the enemy cannot repair, adapt to or find alternatives to keep critical systems functioning.

Seeking Rapid Dominance: Concept of Origins

There are three primary reasons simultaneous air attack never evolved to the degree of parallel war demonstrated in the Gulf War:

- Lack of precise weapons delivery to compensate mass,
- The high number of resources required to suppress enemy air defences and
- The absence of an operational level concept focusing on effects.

The first two required technological solutions, which enabled the third, a concept of operations aiming to achieve control over an enemy's core systems. EBO aim at the very ability of the enemy to control his vital functions. SEE figures on pages 8-10! Precision Guided Munitions (PGM) overcame the necessity to mass aircraft for successful attacks. The combination of stealth and precision radically reduces the number of aircraft, supporting personnel and infrastructure required striking a large number of air-targets effectively, which demonstrate the enormous leverage of the stealth/precision combination. Former approaches focusing on destruction result from two traditional concepts of war, *annihilation* (destruction) and *attrition* (exhaustion). An alternative concept is *control*. Rendering the enemy forces useless is just as effective as eliminating that enemy force. Controlling can be accomplished quicker, and with far fewer casualties. The rarity of bloodless victories enhances rather than detracts their value. Destruction should be viewed as one means to achieve control over an enemy. It is used to achieve effects on the enemy – not to destroy his systems, but to prevent them from being used, as the adversary desires. The process of planning effects is complex. In conjunction with intelligence, planners must determine which effects on each enemy system can best contribute to the fulfilment of military and political objectives of the theatre campaign. Strategy is the orchestration of means to accomplish ends. The design of the air campaign grew out of a mindset questioning how to impose force against enemy systems to achieve specific effects that would contribute directly to the military and political objectives.

Planning was based on a COG approach, beginning with an examination of potential strategic COG, their operational systems down to the sets of individual targets, which became important only if the system was still operating. The ideal application of force in a parallel attack strategy involves the application of force against all targets in each target system at one time.

Unfortunately no intelligence system will ever fully comprehend adversary strategic COG, constituent operational systems and the set of individual targets making up each system. Moreover an enemy will attempt to negate the effects of actions taken against him while trying to respond effectively. As a consequence parallel war conducted to achieve RDO may involve more than one set of force application. An attractive element of parallel war is its potential to reduce the duration of conflicts relative to wars fought previously, although to achieve war winning effects will take a finite but indeterminate time.

Effects-Based Operations: Why is it important?

Parallel warfare is the manifestation of the Revolution in Military Affairs (RMA) and EBO is a critical enabler, which calls for a basic realignment in war planning. Implications of EBO include that (1) it offers a viable alternative for attrition and annihilation to compel an adversary's behaviour, (2) it exploits current weapons systems while transitioning to emerging technology and (3) to best exploit the potential of EBO, the military must institute organisational changes. The strategies of annihilation and attrition rely on sequential, individual target destruction, generally measured in terms of forces applied, or input. Using EBO the determinant of success is effective control of systems, that the enemy relies upon to exert influence or output. The combination of stealth and precision redefines the concept of mass. Massing surface forces to overwhelm an enemy is no longer an absolute prerequisite to impose control over the enemy. Since the ability to impose effects is independent of the massing of forces, the projection of force may become more important than the deployment of force. If the same effect can be imposed without the physical presence of large scale massing of forces, then in some circumstances the deployment of forces can be replaced by the projection of forces to achieve the same effects. The evolving security environment requires greater responsiveness, long range, effective punch and high leverage. Focusing on influence rather than solely on presence enables us to consider different and perhaps more effective ways to accomplish the same goal with fewer resources. Redefining the concept of mass, increasing reliance on force projection rather than solely on force deployment and aiming to control adversary systems instead of destroying them, requires changes in the current force management. The changes needed may include more reliance upon extra-theatre C⁴I organisations, distributive intelligence architecture and off-board systems that can provide information directly to the user.

Effects-based Operations Has Increasing Relevance

We are in a transition phase of the ongoing RMA. Parallel war achieved through EBO departs from traditional strategies. EBO provide a useful construct on how to conduct war that can bridge the gap between the weapons of today and the weapons of the future. The air campaign in the Gulf and over Serbia gave us a view of the leverage that stealth, precision, rapid and secure information transfer, ready access to accurate positional information and other cutting edge technological systems can provide.

The Military Must Embrace Organisational Change To Exploit EBO

We may no longer have the option of overwhelming force or an abundance of weapon systems to conduct war in the future. In the future the luxury of each service component doing its own thing may not be an option.

New organisations and doctrine aiming to exploit EBO can fulfil the full potential of the concept. What is needed is a new joint military doctrine with a focus on weapons system capabilities and EB planning, rather than on employment environment or presumptions of attrition and annihilation. Jointness is the use of the most effective force for a given situation. Jointness means an integrated or unified application of service components.

Conclusion

In the Gulf war aerospace power proved its potential as a definitive military instrument. It was also the first war in history in which air power, not ground forces played the dominant role. While the tenets of EBO can be applied in every medium of warfare, the relative advantages of air power fit seamlessly in this strategic construct. EBO has the potential to reduce the force requirements, casualties, duration of conflict, forward basing and deployment of forces previously required to prevail in war. In short, the parallel approach as an antithesis of attrition and annihilation warfare changes the basic character of war. It is the philosophy of control an enemy, but also a springboard for better linking military, economic and political elements to conduct national security strategy in depth. Focusing on effects enables us to consider different and perhaps more effective ways to accomplish the same goal with fewer resources.

4.6 Deptula, David A.

Deptula, David A. (Brig. Gen.), *Firing For Effects, The important measure is not the targets destroyed but rather the effect on the enemy's capabilities and actions,* Air Force Magazine, April 2001 Vol. 84, No. 4, www.afa.org/magazine/April2001/0401effects_print.htm

Coalition air forces had in a single 24-hour period flown some 1300 offensive sorties against 152 target sets – indeed the Gulf War began with strikes against more targets than were hit by the Eighth Air Force in 1942-43. It just was not the sheer number of sorties that made Day 1 so unusual. The specific effects produced by this bombing activity were just as important. The war's first night demonstrated that the conduct of war had changed. It marked the birth of Effects-Based Operations (EBO) as a principal means of conducting warfare. The air campaign was built around a highly adaptive attack plans to:

- Paralyse Saddam's ability to control his forces,
- Neutralise the ability of those forces to fight,
- Undermine their will to fight,
- Reduce the size of Iraq's military production base,
- Create conditions needed to control Iraq's capacity to build Weapons of Mass Destruction (WMD).

It is a concept that has come to be known as Parallel Warfare, based upon the coalition's ability to achieve specific effects and not just the simple destruction of targets. The concept in war describes an operation in which forces attack all major targets at more or less the same time to attain cascading effects.

The object of parallel war is to achieve effective control over the set of systems of power relied on by an adversary and influence his leadership, population, essential industries, transportation and forces.

In a *sequential attack* each target clears the way for the next one, until finally the target of value can be hit. The effort and time required suppressing the enemy defence limit the number of targets that can be attacked at one time. In a *simultaneous attack* all pieces of a defence system are hit at once but its nature leads to somewhat sequential application of force. Simultaneous attack on all objectives opens a door to major changes in warfare. It permits surprise at the tactical level, a larger span of influence, fewer casualties, paralysing effects and reduction in time required to gain control over the enemy.

Parallel war entails more than compressing sequential attacks into a single multifaceted attack. Parallel war exploits time, space and levels of war vigorously to achieve rapid dominance, which is just the essence of EBO. War's ultimate purpose is to compel a positive political outcome. Use of force to control rather than to destroy an opponent's ability to act, opens new possibilities. Control – the ability to eradicate the strategic freedom of the adversary – does not necessarily mean eliminating all of that enemy's tactical actions. Critical to the concept of control is the ability to affect essential systems on which an enemy relies. Pursuit of effective control conserves military forces otherwise needed for destruction. This in turn expands the number of systems subject to control through force application.

Effective control of enough of the adversary's enabling operational-level systems will paralyse his ability to function at the strategic level. The enemy will be compelled to acquiesce to the will of the controlling force (Iraq was attacked in parallel at rates that high, that it had essentially no chance to repair lost assets or find alternatives).

Military planners have always seen the desirability and value of simultaneous attacks, but due to three factors they had never been able to produce them:

- Effective air defences, which forced the attacker to divert aircraft away from the main attack,
- Inaccurate weapons, which produced a need for mass aircraft and bombs,
- Lack of an operational level concept focusing on the use of effects rather than destruction.

If having an effects-based targeting approach, not all nodes have to be destroyed. Attacks are needed only to make them ineffective and unable to conduct operations during specific periods. Planning for effects raises complex issues. Planners working with intelligence officers must determine which effects on each enemy system will contribute most to the attainment of military and political objectives of the theatre campaign. This depends upon the specific political and military objectives, enemy vulnerabilities, individual target systems and weapon systems capabilities. Assigning certain air assets (means) to certain target systems to achieve specific effects (ends) is the basis of the new-style air campaign. But it is important not to confuse the *efficiency* of hitting individual targets with the *effectiveness* of achieving campaign objectives.

The design of the air campaign grew out of thinking about how to hit an enemy's systems to achieve specific effects contributing to the military and political objectives of the coalition. Planning was based on a Centre of Gravity (COG) approach. It began with a critical examination of potential COGs, their constituent operational systems and led to identifying the set of individual targets making up each system. Decisions about whether to stop or continue an attack depended on whether the coalition had achieved a specific effect.

Unfortunately intelligence about the enemy will never be total. Moreover, an enemy will attempt to negate the effects of attacks. As a consequence parallel war may involve more than one case of force application, even if there are sufficient resources to attack all known elements. The advent of EBO calls for a basic realignment in war planning. The combination of stealth and precision redefines the concept of mass – the agglomeration of forces. Classical mass is no longer required. Surface forces will always be useful, but massing surface forces to overwhelm an enemy is not required to gain control of an enemy. Massed forces present a lucrative target to an enemy.

Potential adversaries may capitalise on the massing of forces and associated build-up time to deny US access to a war theatre. Since the ability to impose effects is independent of the massing of forces, the projection of force becomes more important than the development of force. If the same effect can be imposed without physical presence or mass, then in some circumstances deployed forces can be replaced by power projection.

System-based intelligence analysis is critical to the application of EBO. Redefining the concept of mass, relying to a greater degree on force projection rather than force deployment and aiming to control adversary systems rather than to destroy them require changes in the current approach to force management. EBO provides a useful construct on how to conduct war that can bridge the gap between the weapons of today and the weapons of the future. It allows useful application of current weapon systems, as we require a new generation of tools needed to fully exploit the concept. As technological innovation accelerates, non-lethal weapons and cyber-war enabled by information operations will become operative means in parallel war. Non-lethal weapons, information warfare, miniaturised highly accurate munitions and space-based systems might make such concepts reality.

Parallel war through EBO does not exclude any force component in time, space or level of war at the outset of any political-military challenge. Optimum parallel war is dependent upon a functional organisation encompassing not just the air component but the entire theatre campaign with a true joint force commander orchestrating the synergies of the entire force. EBO can be applied in every medium of warfare.

4.7 **Fadok, David S.**

Fadok, David S. (Maj.), *John Boyd an John Warden, Air Power's Quest for Strategic Paralysis*, School of Advanced Airpower Studies, Maxwell AFB, February 1995,

www.maxwell.af.mil/au/aul/aupress/SAAS_Theses/Fadok/fadok.pdf

Air power theorists have posited numerous schemes to best exploit air power's inherent flexibility and ubiquity. One of them is Strategic Paralysis (SP) characterised by its non-lethal intent and promise of force economisation. SP differs markedly from the more traditional strategies of annihilation and attrition. Boyd's thoughts on SP are process oriented and aim at psychological incapacitation. His theory of conflict is philosophical, emphasises the mental and moral spheres of the conflict, the area of how to think. Warden's theory of SP is form oriented and aims at physical paralysis. His theory is practical, emphasises the physical sphere of a conflict, the area of how to act. Early air power theorists argued that paralysing the enemy is best done by economic warfare based upon industrial targeting, while Boyd and Warden argue that paralysing the enemy is better done by targeting his C2 facilities by a control warfare. Air power's brief history has witnessed a steady transformation in strategic paralysis theory from an early emphasis on war-supporting industry to a current emphasis on war-supporting command to a possible future emphasis on war-supporting information.

Chapter 1 – Introduction

Since the advent of the air plane in 1903, theorists have posited numerous schemes to best exploit the inherent ability of aircraft to rise above the battlefield and go straight to the heart of the enemy nation. From this standpoint the author contends, that:

- Boyd's theory of conflict and Warden's theory of strategic attack share a theme common to most, the SP,
- Their divergent thoughts on SP represent two distinct traditions regarding the nature and purpose of theory and
- The paralysis theories of Boyd and Warden represent a fundamental shift in the evolution of strategic air power thought from economic warfare to control warfare.

Chapter 2 – The Notion of Strategic Paralysis

The roots of SP theory reach deep into history. In 1827 *Clausewitz* recognised that there were at least two distinct forms of warfare. Absolute war focused on total annihilation of the enemy. In contrast, in real wars annihilation was not a strategic option due to restrictions imposed by political ends/or military means. As a result of this dual nature, destruction is according to him a condition imposed on the enemy that he can no longer carry on the fight.

J. F. C. Fuller recommended a brain warfare stating that the physical strength of an army lies in its organisation, controlled by its brain. A shot through the head was the most efficient and effective way to destroy the enemy's military organisation and military strength. He set out to examine the nature of war as a science by introducing the concept of the threefold order. As the framework for his military study Fuller posited three spheres of war – physical, mental and moral, which dealt with the destruction of the enemy's physical strength (fighting power), disorganisation of his mental processes (thinking power) and disintegration of his moral will (staying power). Forces within these spheres operate in a synergistic and not isolated way. Paralysis of an adversary consists of physical, mental and moral dimensions. As a strategy it entails the non-lethal intent to physically disable and mentally disorient an enemy to introduce his moral collapse.

SP aims at the enemy's physical and mental capabilities to indirectly engage and defeat his moral will.

The overriding principle or law, which governs the conduct of war, is that of economy of force, a concept of expending minimum effort to produce maximum effect.

Liddell Hart insisted that the more potent and economical form of warfare was disarmament through paralysis rather than destruction through annihilation. Early enthusiasts extolled the third dimension that the aerial weapon added to the battlefield. They speculated that air power could defeat an enemy nation and its armed forces by incapacitating or paralysing the war-making potential in the rear, which promised decisive victory at significantly lower cost in terms of lives and treasury. According to them the airplane possessed the unique ability to avoid the bloody stalemate on the ground below and to combine shock and firepower into a single weapon able to strike deep into the enemy heartland against his most vital centres.

Hans Delbruck argued that there were two traditional strategies of combat, annihilation and attrition. Annihilation aims to destroy the enemy armed forces, whereas attrition seeks to exhaust them. Thus while strategies of annihilation produced rapid decisions through overwhelming defeat of enemy armed force capability, attrition produced more drawn out affairs capped by the slow but steady softening of the enemy's will. SP seeks rapid decision via enemy incapacitation by fusing battle and manoeuvre. SP bypasses battle in favour of attack upon sustainment and control of armed forces. SP is a military option with physical, mental and moral dimensions, with the intention to disable rather than destroy the enemy. It seeks maximum possible political effect or benefit with minimum necessary military effort or cost. It aims at rapid decisions through a manoeuvre battle directed against an adversary's physical and mental capability to sustain and control his war effort to diminish his moral will to resist.

Chapter 3 – Boyd's Theory of Strategic Paralysis

According to him, one cannot determine the nature and character of a system within itself and any attempts to do so will lead to greater disorder and confusion. His comprehensive theory of conflict links victory to successfully forcing an inward-orientation upon the adversary by folding him back inside himself. The aim of his manoeuvre warfare is to render the enemy powerless by denying him the time to mentally cope with the rapidly unfolding and uncertain circumstances. A military operation aims to (1) create and perpetuate a highly fluid and menacing state of affairs for the enemy and (2) disrupt or incapacitate his ability to adapt to such an environment. The qualities for successful military operations are initiative, harmony, variety and rapidity – qualities, which allow to adapt to uncertainty and frictions. In this sense, adaptability means reduction of own frictions. At the *operational level* this means a severe disruption the adversary's combat operation process used to develop and execute his initial and subsequent campaigns plans. At the strategic level it is the penetration of an adversary's moral-mental-physical being to dissolve his moral fibre, disorient his mental images and disrupt his operations and overload his system. Paralyzing means creation of non co-operative COG by attacking the moral-mental-physical linkages which bound the hubs together.

At the operational level the end result is the destruction of the enemy's internal harmony and external connection to the real world. The key in his OODA loop is efficient and effective orientation, a process of analysis and synthesis by developing mental images shaped by our personal experience, genetic heritage and cultural traditions. SEE figures on page 16-17!

Chapter 4 – Warden's Theory of Strategic Paralysis

Warden has emerged as a leading advocate of force application in the third dimension. He contends that the most effective and efficient application of air power is in the strategic realm, with strategic air warfare being more political than economic in nature. Targeting enemy leadership to produce desired policy changes should guide the employment of own air forces. He emphasises air strikes against enemy COGs because air power possesses the unique capacity with its inherent speed, range and flexibility to achieve the strategic ends of war with a maximum effectiveness and minimum cost by striking the full spectrum of enemy capabilities in a swift and decisive manner. Analysing the enemy as a system, Warden contends that all strategic entities can be broken down into five component parts, leadership, organic essentials, infrastructure, population and fielded forces. He proposed a further breakdown of any given ring into five sub-rings and so forth until the COG surfaces. If the COG is hit, it can impose some level of physical paralysis of the enemy. If one of the rings is destroyed or neutralised, the effective functioning ceases, impacting the entire system in a more or less significant way. Based on this, with the lessons drawn from the Gulf War, one can realise:

- The importance of strategic attack and the fragility of states at the strategic level,
- The fatal consequences of losing strategic and operational air superiority,
- The overwhelming effects of parallel warfare,
- The value of stealth and precision weaponry in redefining the principles of mass and surprise, and
- The dominance of air power as the key force in most operational and strategic level conflicts.

Based on his work, the air strategist must appreciate the political objectives being sought by military actions (end). Then he must determine the best military strategy to induce the enemy to comply with his will (ways) and finally, he must use the five-ring model to identify COGs subject to parallel attacks (means).

For this he proposes strategies of imposed cost (coercion) by making resistance too costly, or paralysis (incapacitation) by making continued resistance impossible for the enemy command, or destruction (annihilation) by annihilating the entire system making policy changes of the enemy leadership irrelevant. SEE picture on page 27! But in real world, also the comprehensive study of socio-cultural factors, are important since these factors determine both the form and the structure of an enemy and the process or dynamics by which it operates. For more critics SEE pages 28-29!

Chapter 5 – Clausewitz and Jomini Revisited

These two authors represent two distinct approaches to the study of war, one practical and focused on the physical realm, the other philosophical and focused on the moral and mental realms.

The *Jominian tradition* believes that the practice of war can be reduced to a set of general principles or rules, which can be scientifically derived and universally applied. It acknowledges that the nature of war is complex and dramatic, its complete mastery is truly an art of form. However the strategy of war is scientific, knowable, constant and governed by principles of eternal validity, a predominantly linear approach based on the how-to-act instead on the how-to-think. The *Clausewitzian tradition* is non-linear in perspective and rather provides the intellectual methods by which to unveil the answers to war's perplexing questions rather than provide the answers themselves. It seeks to develop a mind-set or way of thinking, rather than to describe rules of war.

Chapter 6 – Boyd, Warden and the Evolution of Air Power Theory

As the 20th century passed its midpoint the modern world began a slow metamorphosis from and industrial society to an informal society:

- *The Past* – Paralysis by Economic Warfare and Industrial Targeting means the direct striking of the enemy's economic war making potential with the purpose of disintegrating and collapsing the enemy's war economy. *Sir Trenchard* regarded the enemy's vital centres were his production, transportation and communication from which his war effort was sustained. Also the moral effects of such attacks were highlighted Destroying the enemy's capability and will to resist, SP were sought by psychological dislocation and terror ensued from economic disruption and collapse. The *ACTS* saw the object of strategic bombing in dropping aerial bombs upon the commercial centres and lines of communications to cut off necessary supplies of the armies. They proposed industrial targeting to achieve physical paralysis by destroying the enemy's industrial web.
- *The Present* – Paralysis by Control warfare and Command Targeting means that the notion of SP through economic warfare was not completely dismissed, but control warfare shifted the focus to the enemy's systems of governance and information processing.

John Boyd concentrates on disorienting the mind of the enemy command by disrupting the process of command and control. The one who has better control of the information flow can operate within the enemy's OODA loop. *John Warden* advocates paralysis through control warfare based on command targeting. He focuses in the form, by which command and control are exercised. He also recognises the importance of information management to the effective operation of the enemy as a system. The information linkages between rings may present the key to taking down the entire enemy system. Both authors have shifted the focus from war-supporting industry to war-supporting command, from economic warfare to control warfare.

- *The Future* – Paralysis by Control Warfare and Informational Targeting means that information dominance or information efficacy may have been more as decisive as the more traditional control of the air. The increasing dependence upon efficient information processing systems will continue to create opportunities to deny, disrupt and manipulate the collection, analysis and dissemination of battlefield information. Future advances in C⁴I technologies with their integration into weapons delivery platforms promise a radical increase in the tempo of the next century's warfare. As a result, controlling the data-sphere will be top-priority in most future conflicts.

There are both technological and organisational dimensions to this new revolution. Centralisation would give way to decentralisation and with networks replacing hierarchies with a vertical to horizontal power shift. Later co-operation between semi-autonomous agents and agencies becomes more vital than top-down command.

Chapter 7 – Conclusion

For the conclusion see introduction.

4.8 McCrabb, Maris Dr.

McCrabb, Maris Dr., *Uncertainty, Expeditionary Air Force and Effects-Based Operations*, www.eps.gov/EPSSdata/USAF/Synopses/1142/Reference-Number-PRDA-00-06-IKFPA/uncertaintyandoperationalart.doc

I. Introduction

The USAF has come to two complementary paths how aerospace can be employed: Aerospace Expeditionary Task Force (AETF) as a framework for organising, preparing and deploying decisive aerospace power to anywhere within a short period of time,

Effects-based Operations (EBO) offer a framework for employing and exploiting that power in the quickest and most effective manner while keeping the risk of friendly losses and collateral damage to a minimum.

Commanders plan, conduct and assess operations using scarce resources to achieve results – they must see in order to know, they must know in order to decide and they decide on actions they believe will work effectively. War is a conflict with a clash of wills against an intelligent adversary that reacts.

Thesis – Linear models like Observe-Orient-Decide-Act (OODA) or Strategy-To-Task (STT) treat the enemy almost as an impenetrable entity. Understanding adaptation is crucial in determining not only second, third and higher order effects, but also predicting how an agent (target, adversary) might adapt before we take our actions. The field of Complex Adaptive Systems (CAS) offers some principles to help us do three things:

- To deal with uncertainty we have to concern ourselves, the adversary and the environment,
- To predict in some useful manner how our assumed intelligent adversary should, can or could react to our actions,
- To plan, execute and assess actions in terms of the effects we desire.

Relevancy –The reason for the subject derives from the nature of air power, the nature of conflict and the constraints on the use of force with restrictive Rules of Engagements (ROE). From the earliest days the psychological impact of an air power was seen as significant as its physical impact. The mystique comes from qualities like speed, range, lethality and increasing invincibility, which are crucial elements in determining the effects the air force can achieve. The desired end state of war is not the military operation, but a certain political aim.

Important is that military actions must hark back in a fairly clear manner to the political aim sought and must be aimed in some manner at the political military leadership of the adversary. The use of force underwent significant change over the 20th century. The fear of friendly casualties and the desire to limit collateral damage is known. Their impact on air power is that the planning of any operation requires a great care and the operations must be carried out to achieve discriminate effects through discriminate application of discriminate power.

Application to Force Provision – While this paper concentrates only on force employment issues, the author believes that the techniques offered here also apply to problems of force provision, which has a long-term horizon and the need to deal with uncertainty.

II. Uncertainty, Ambiguity and Risk

Uncertainty is defined as unknown but potentially knowable information.

Ambiguity is unknown and unknowable information. The key difference between uncertainty and ambiguity is time. *Risk* is the difference between what is known or wished to be known and what is unknown or unknowable. Uncertainty equals risk to the commander who must decide upon what is an acceptable level of risk. AETF and EBO increase uncertainty and ambiguity over what already exists in military operations.

III. AETF, EBO and Uncertainty

EATF has the major goal to tailor the right forces to assigned or anticipated missions. It can rapidly deploy over great distances on short notice to inflict potent damage on the enemy without risking the life of own soldiers. EATF is light (fewer, but more capable assets and short Notice to Move (NTM)) and lean. Short NTM place a premium on information gathering, fusion and correlation. An executable Course of Action (COA) must be developed within a few hours to detail the implementation. The stark reality is that no one has ever been able to accomplish this process that quickly (locations are not precisely known, no accurate maps available, goals and objectives tend to be less precise than would like, etc.) and necessary tools are not available:

- Current technical systems are built on very structured process models that explicitly eschew any lack of information,
- The separation from classified to unclassified information and sources is another deficiency,
- The expectations derived from past successes, the increased media attention, the lack of overwhelming popular support,
- Increased reliance on ad-hoc coalitions including NGOs and PVOs with the fact that most coalition members simply lack the capacities and mindset of the Americans

Effects-Based Operations – Joint Vision 2010 states that instead of relying on massed forces we will achieve massed effects. Information superiority and advances in technology will enable us to achieve the desired effects through tailored application of joint combat power. This means that the purpose of military forces is no longer the destruction of the enemy forces or capabilities – forces just achieve effects. An effect is an outcome that results from some action taken. A direct effect results immediately from the action taken.

Several concepts implied here are very important for EBO:

- All direct effects have indirect effects,
- There is an implied time lag between when the action taken causes the direct effect and when the indirect effect is felt,
- What constitutes a direct or indirect effect depends upon point of view – from the point of view of the object it does not generally matter whether the cause is a direct or indirect effect,
- Direct and indirect effects interact and these interactions are more important in any attempt to impact a complex system than are actions.

If we examine the connection between direct and indirect effects the following observations are important:

- Direct effects are the same as first order effects and all subsequent numerical effects are indirect effects,
- Direct effects are those resulting from direct actions.

Totality of effects on an entity (target) consists of direct/first order and indirect/nth order effects. This totality is an aggregation of effects over time which can lead to a vicious cycle – this is that when something bad happens, it effects other parts of the system that cause something bad to happen there which in turn causes something bad to happen somewhere else. Regarding EBO it is also important to know that as one moves from direct/first order effects towards indirect/nth order effects one moves from physically oriented effects to behaviourally oriented effects which are much harder to model, predict or find indicators for. Furthermore effects have variable degrees of persistence and accumulation, which means that any usable model must include at a minimum temporal and capacity aspects.

EBO and Target-based or Objective-based Approaches – The difference between EBO and the TB approach is that TB at best looks at first or second order effects and therefore an explicit modelling of interdependencies between objects (target) is not possible. But goals at strategic or operational levels are almost phrased in terms of fourth order or above effects. If we focus on the difference between EB and the OB approach we see that it lies in the higher order effects and interdependencies. OB approaches do not identify the sources of effects. Missing is the meshing of direct/first order effects and indirect/higher order effects that produce the totality of effects (cumulative effect). Nor does OB approaches deal with interdependencies within the adversary regarding targets or its objectives. With EBO the basic problem is establishing casualty, agency, identity and indicators (to assess mechanism and manage scarce ISR assets). The main task of the planning process is to establishing the linkage between objectives sought down to actions to take. Attempting strategic paralysis via parallel attack requires an EB-approach, centred at a minimum on second or presumptively third-order effects. SEE definition of parallel attack on page 23! There are two critical parts of strategic paralysis for EBO:

- Through COG (NEV) analysis one can find the vital centre or “Achilles heel” of the adversary,
- The focus on coping strategy of the adversary – it is insufficient to simply look at the vital centres without determining how an enemy might react.

IV. OODA and STT

OODA loop – see John Boyd’s theory in other papers. STT should really be called OBP consisting of two major ideas:

- Higher level objectives found on theatre level can be decomposed down to specific tasks and activities that the lowest level performs,
- Objectives, tasks and activities can all be linked from top to bottom and across the complete width and depth of operations, strategies at higher level become tasks at the next lower level.

Objectives (ends) are achieved in some way (strategy, cause) using some means (resources). The great strength of OBP is that it provides a means of linking all activities together around a common element (objective). Furthermore OBP links major activities like intelligence, sustainment and operations together enabling everyone to see the “big picture” and how their individual activity fits in and support the overall theatre campaign plan. Clear strengths of this approach is:

- The economy of force mechanism,
- The support to trade-off analysis (substitution sense and scarcity sense),
- Important tool for force structure analysis and requirements definitions (!),
- This model is amenable to machine language coding due to its highly linear structures.

The biggest limitation of linear systems is that they cannot deal with the non-linear world. It does very well with non-reacting physical systems, but performs poorly when used to understand reacting (coping) systems typical for human affairs with interactions and interdependencies. With an increased number of agents (targets) a system is much unpredictable. Since agents adapt (cope) they have an adaptation space around them.

V. Warden-Barlow

Humanity largely exists in a linear world and some models explaining the enemy are also linear ones. The assumptions of a linear world (“if you know a little about a linear system, you know a lot”) are:

- There is only one valid answer,
- The whole is equal to the sum of its parts,
- The same action, under all the same conditions, produce the same effect,
- Cause and effect are demonstrable.

In contrast CAS exhibit coherence under change, via conditional action and anticipation and they do so without central direction.

Warden – parallel attacks. The power of Warden’s model is its heritable nature and its interdependencies with decomposing functions (assigned activities or roles that are closely related to others such as they depend upon them). The strengths of interdependencies in Warden’s model lies in its vertical, horizontal and across character – the rings and sub-rings are a decomposition of target systems to target sets than to targets and individual aim points. Nevertheless this model is linear with a bias towards an adversary as a rational actor and requires an enormous amount of information and does not deal with the adaptation of the enemy.

Barlow – strategic paralysis. Parallel attacks selectively attack or threaten targets that most directly support the enemy's ability or will to continue with its current behaviour, because not all targets are of equal value in terms of the effect on the enemy. The problem with this model is that it is also linear in nature, it requires also massive amounts of information and regards the enemy as a rational actor (decision-maker). It gives no guidance how to turn data into information and information into knowledge needed. According to Steven Rinaldi four points are crucial to further discovery:

- Dynamic systems must be analysed from a holistic rather than a reductionist point of view,
- Agent (player) interactions create global properties that cannot be predicted from prior knowledge of the agents,
- Economies can survive small losses of any industry or almost the complete loss of any small industry but almost the complete loss of any large industry makes it very difficult to adapt,
- Competition and disturbances force systems to discover adaptations that enable them to survive environmental changes that they are partly responsible for causing.

VI. Agent Adaptation Space

An agent is a generic term for an entity that can react to changes in its environment. It acts for something or someone else called the principal. Agents are also characterised by tags, which allow them to select among agents or objects that would otherwise be indistinguishable and provide a basis for filtering, specialisation and co-operation. SEE the last ten pages!

4.9 Senglaub, Michael

Senglaub, Michael, Ph. D., *The Analytic & Philosophical Imperatives of Effects-Based Operations (EBO)*, www.mors.org/meetings/ebo/ebo_reads/Senglab.pdf

Introduction

Effects-Based Operations (EBO) is one of three operational process concepts. Military actions in this context include economic, psychological, informational, diplomatic and combat activities. The other operational concepts include Objective-Based Operations (OBO) and Target-Based Operations (TBO). What is not discussed in the literature is the application of EBO at the strategic and tactical levels or its employment in land and sea operations.

Operational Concept Descriptions

TBO involve the identification and selection of adversarial assets and applying sufficient force to destroy that. OBO are conceptualisation of mission intent from which Courses of Action (COA) can be defined and from which Measures of Effectiveness (MOE) may be derived. EBO on the other hand appear to fit the operational and tactical regimes and provide a natural foundation for establishing and defining combat measures of effectiveness. EB-approach naturally focus on the transitions between states rather than the static states of the system supporting the conflict. EBO equally supports land and sea operations in a broad spectrum of conflict.

Trends impacting EBO

The future probably replaces massed force with massed effects. Also rapid response and increased tempo are required to achieve the force multiplication ratio needed to compensate for smaller force sizes. This direction is also pursued by a greater reliance on sensors and the data they generate. The capability to forward deploy forces will diminish and the chance to deploy own forces from bases within the own borders to area of conflict will increase. Tendency is the fielding of new systems with lighter armour and new weapons with smaller rounds. These factors reduce the logistics load but add significantly to the information gathering and processing requirements. Precision can compensate for the size and volumes of the rounds fired, but it makes Battle Damage Assessment (BDA) more difficult. The types of conflicts are also changing. We will likely face more humanitarian aid situations and policing operations. Based on population trends we will face combat in urban terrain. In these environments there will be a mix of combatants and non-combatants and the concern for minimising collateral damage requires precision weapons, as well as non-lethal and low collateral damage weapons.

Analytic Environment for EBO

SEE figure on page 4 and the text on pages 3-10!

Complex Adaptive Systems (CAS)

If we regard the adversary as a complex system, we regard it basically as interactions of numerous simple interacting sub-systems or entities. Considering EBO we need to extend the phenomenon of an adversary as a complex system to a complex adaptive system in which the entities comprising that system can adjust their behaviour as a result of externalities acting on the system. Combat is such a system and a reduction to gaining an understanding of it is inadequate. Hereby eight characteristics of a CAS:

- Their behaviour stems from a large collection of interacting components,
- Complex systems are typically organised in a hierarchical way,
- Macro behaviour is self organised with decentralised control,
- The macro behaviour is emergent,
- Long-term behaviour is typically non-equilibrium,
- Aspects of CAS are niches that need to be filled rather than are defined,
- Behaviour cannot be described by reduction,
- Structure and dynamics are the characteristics of these systems as opposed to some equilibrium state.

In order to predict the behaviour of the response of an adversary we need to look at it from the perspective of CAS theory.

Practical Aspects of EBO

At tactical level considerations we outlined a paradigm of a C^2 that is based on chaotic system control principles and identified an influence mechanism that could easily be viewed as a tactical level adjustment. Targets must be viewed as functions and the tactical actions being designed are actions to deny that function to an adversary. The fact is that BDA or Battle Damage Indicators (BDI) become more significantly to evaluate. With the move towards greater precision in strike capability, the adversary will seek to move into urban environment and use asymmetric warfare as a response.

With high precision we can perform surgical strikes that mitigate the potential for unintended secondary effects. An involvement of collateral damage in an urban environment that results in a populous that is averse to our presence resulting in getting will to resist or an active participation by civilians in the support of actions being taken on the enemy. As part of the EBO planning process, damage indicators (BDA, BDI) must be identified in conjunction with the effects being sought. This provides the intelligence gathering components of the force with guidance in the search for data that can indirectly determine the success or failure of the effects the campaign being executed (acceptance sampling either with variables testing or attributes testing). Within this sampling regime, two types of testing can be found:

- *Attributes testing* – a set of measurements are taken against a predefined metric and if a sufficient number of these measurements deviate from the accepted value the lot is rejected.
- The more sophisticated *variables testing* – in this case measurements are taken and a sample mean and standard deviation are estimated.

4.10 Warden, John A.

Warden, John A. (Col.), *The Enemy as a System*, Air Power Journal, Spring 1995, www.airpower.maxwell.af.mil/airchronicles/apj/warden.html

Strategic Warfare (SW) is different than the warfare we have known throughout history. It is not easy to understand because we need to toss out many of our ideas about war. It requires top-down thinking from the big picture to the small – a deductive methodology.

We must:

- Focus on the totality of our enemy,
- Rid ourselves of the idea that the central features of war is the clash of military forces (they are means to an end and an end itself) and
- Think of an enemy as a system composed of numerous subsystems.

Clausewitz was right when he talked about friction, fog and morale. As a consequence we can think broadly about war in the equation of $P \times M = O$.

(Physical) x (Morale) = Outcome

Looking at this equation we are struck by the fact that the physical side of the enemy is in theory perfectly knowable and predictable. Conversely the human side is beyond the realm of the predictable in a particular situation. Our war efforts should be directed primarily at the physical side. When we go to war we need objectives which go far beyond categories such as beating the enemy or wrecking his military forces. We go to war to attain something of political value. At the strategic level we attain our objectives by causing such changes to one or more parts of the enemy's system that it decides to adopt our objectives – this is *strategic paralysis* (SP). Which part of the enemy system we attack depends on our objectives. A good place to start our examination of enemy systems is at the centre. The leaders are at the strategic centre and in strategic warfare they must be targets of our actions.

The Five-Ring Model

To make the concept of an enemy system useful and understandable we must make a simplified model what does not mirror reality but gives us a comprehensive picture of a phenomenon. The model wants to describe a strategic entity – something that can function on its own and is free and able to make decisions and acts adherent to it. This requires that we think in terms of systems. If any part of the system becomes incapable of functioning, it will have a more or less important effect on the rest of the entity. Interestingly each part of the entity is in turn a system. We also can have the insight that there is a delay between strategic events and subsequent tactical effect. Departing from here there is understandable that strategic war may have nothing to do with the enemy's military forces. Strategic war is war to force the enemy state or organisation to do what we want. Therefore the whole system is our target not just its military force. Key to our success is that we start with the large entity, the enemy system, then we work our way down to the small details as required. The rings are leadership -> organic essentials -> infrastructure -> population -> fighting mechanism.

Using the Five Rings for Strategic Warfare

The concept of Centres of Gravity (COG) is simple in theory but difficult in execution because:

- It is possible that more than one centre exists,
- Each centre has an effect on the other,
- COG are sometimes indirectly related to the enemy's capability to fight,
- Every state can have unique COG, with various things most vital at the middle and least vital at the outside.

Capturing or killing the state's leader has frequently been decisive. In modern times C² have become more important than ever and is vulnerable to attack. When command elements cannot be threatened directly, then the task is to apply sufficient indirect pressure by achieving a degree of damage imposed on the surrounding rings. Organic essentials are facilities or processes without which a state or organisation cannot maintain itself. Even a minor damage to these essentials can lead to concession of the enemy because damage to organic essentials:

- Leads to the collapse of the system,
- Makes it physically difficult or impossible to maintain a certain policy or fight and
- Has internal political or economic repercussions that are too costly to bear.

Infrastructure ring is more numerous than organic essentials and this means more redundancy and a greater effort may be required to do enough damage to have an effect. The population is difficult to attack directly, although early theorists such Guido Douhet thought that wars could be won by inflicting such casualties on the civilian population that morale would break with subsequent capitulation. The last ring holds the fielded military forces, which have the only function to protect the own inner rings or to threaten those of an enemy. In history they have often had no choice but to contend with enemy armies. Modern technology makes new options possible that can put fielded forces into the category of means and not ends. For SW it is imperative to remember that all actions are aimed against the mind of the enemy command or against the enemy system as a whole.

It is pointless to deal with enemy military forces if strategy or technology either in defence or in offence can bypass them. Some additional points to the five rings hereby:

- The most important is in the middle,
- There is an increase in number of items moving outside the centre,
- Theoretical vulnerabilities decrease from inside to outside due to numbers involved.

Logic says that the purpose of war is to do something to the enemy's inner rings or to prevent it from doing something to ours. The relative importance of the outer four rings has changed over time and the vulnerability of the rings clearly change with societal systems and historical period. Today it is nearly impossible to operate directly and successfully against a single leader, therefore it will be necessary to strike several of the inner rings. COGs exist not only at the strategic level but also at the operational level.

Parallel Attack

The most important requirement of strategic attack is to understand the enemy system to reduce it to the desired level or to paralyse it. Parallel Attacks (PA) will normally be the preferred approach. PA deprives the enemy of the ability to respond effectively. Technology has made the near simultaneous attack on every strategic or operational level COG of the enemy possible. This parallel process of war as opposed to the old serial form with the *culminating point* does not allow the phenomenon of the near equilibrium when both opponent have the chance to achieve a significant effect.

4.11 Conclusions

Strategic Warfare, Parallel War and Strategic Paralysis are the theoretical background of Effects-Based Operations to regard the enemy in a systemic approach as a whole. Complexity Theories, especially the theories of Complex Adaptive Systems give information on how systemic elements react and interact if being under influence. Nevertheless understanding the enemy in an effects-based framework is not an easy task. Although the models of Warden or Barlow offer a good depiction of the enemy, not much is done to understand how the elements interrelate in different cultures and situations. The models have problems in identifying elements how to achieve effects outside the physical domain. Beside their value they offer a rather simple and linear reductionism and do not go into the cognitive domain of the conflicts.

Since Effects-Based Operations centre on the human aspect of conflicts, these static models do not provide a sound basis for a good identification of desired psychological effects. They limit our ability to measure outcomes apart from the physical domain and put a strong limitation on the full potential of EBO.

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5. Global Strike Task Force, Air Expeditionary Force, Effects-Based Targeting

5.1 Introduction

Many theorists agree upon that operations in the third dimension allow for speed, range, manoeuvrability and a perspective unachievable on the ground. Air forces are able to respond quickly and world wide on short notice to counter potential threat. Modern air forces applied in an effects-based manner can achieve objectives with theatre-wide significance. The concept of Global Strike Task Force maximises existing and emerging joint capabilities and enables military planners to meet even the toughest challenges by rapidly responding to threats. It quickly establishes air dominance and subsequently guarantee that the joint forces will enjoy freedom to attack.

In general an effects-based thinking has the potential to offer significant leverage to current and future forces by reducing the duration and force structures required for the same objective. It focuses on effects or end-results by reducing the emphasis on weapon systems or targets attacked. The 1991 Gulf War marked the birth of Effects-Based Operations as a new and principal means of conducting warfare. This transformation resulted from three different developments like advanced technologies, new concept of operations and organisational changes. The essence of Effects-Based Operations is to make the enemy conform to our strategic plan. Air forces applied in EBO paralyse rather than destroy the enemy by evading and bypassing targets that are not time-sensitive military assets. With the emphasis on precision, smaller and more accurate munitions can be selected to achieve a result. In EBO militaries can more effectively and efficiently prosecute operations but it requires systemic thinking. This systemic view helps understand how different things interrelate and where the vulnerabilities of the enemy are. EBO not only create far less amount of destruction on the ground but it allows to attack less targets and friendly assets can be used to attack other targets. It de-emphasises destruction as a mechanism for achieving effects and inflicting paralysis upon the enemy.

Effects-Based Targeting is identifying and engaging the adversary's key capabilities in the most effective manner to produce specific effects consistent with the commander's objectives. Analysts must understand more than simply the physical layout of an enemy system, by studying his culture history to understand the psychological patterns.

Only the destruction of target sets does not mean automatically victory, because intangible factors such as religion, national feeling and culture as a whole are also as important as the physical attributes. Intangible factors stand for an enemy who is motivated both by reason and passion. Although Effects-Based Operations stretch the cultural aspect of conflicts, which may act as a virtual ceiling of the concept.

5.2 Beagle, T. W.

Beagle, T. W. (Maj.), *Effects-Based Targeting: Another Empty Promise?*, School of Advanced Airpower Studies, Air University, Maxwell AFB, June 2000, www.stinet.dtic.mil/cgi-bin/fulcrum_main.pl

Chapter 1 – Introduction

This study concentrates on large-scale conventional conflicts in which American air power played a significant role. Effects-Based operations (EBO) in small-scale contingencies and operations other than war are not explored. This study concludes that:

- Senior decision makers have always been interested in creating specific effects rather than simply destroying targets,
- American airpower's most significant effects-related improvements have focused on the tactical level of war with less progress at the operational levels,
- Air power has become very effective at producing direct, physical effects and is becoming increasingly capable of creating widespread systemic effects.

Chapter 2 – Effects-Based Targeting: What is it?

EB targeting is identifying and engaging an adversary's key capabilities in the most effective manner to produce specific effects consistent with the commander's objectives. There are many methods to group effects:

- Effects can be either *direct* or *indirect*. A direct or first order effect is usually immediate and easily recognisable as the result of actions with no intervening effect or mechanism between act and outcome. An indirect or subsequent order effect is a result created through an intermediate effect or mechanism to produce the final outcome. They tend to be delayed and may be difficult to recognise.
- A more general method is to categorise them as *physical*, *systemic* and *psychological*. A physical effect is eliminating or neutralising the object targeted. Systemic effects are those aimed at disrupting the functions of a specific system or systems. Psychological effects occur in the adversary's mind and require an indirect approach.
- To group effects via the war-related function means that we differ *war-making*, *war-sustainment* and *war-will*. War-making describes the actual troops, equipment and capabilities to exert combat power. War-sustainment refers to the enemy's ability to maintain and support his war efforts. War-will expresses the commitment to fight.
- It is also possible to group *functional effects* with regarding the enemy as a whole. Thinking in military, political, economic and social terms enable us to attain the ultimate political objectives with greater economy of force.
- The *levels of war* are also good to being associated with *desired effects*. Tactical-level effects occur on the battlefield directly at the unit level and below. Operational-level effects concerns planning, conducting and sustaining campaigns and major operations within theatre. Strategic-level effects view the war as a whole by addressing the nation's military and security objectives. Strategic level effects aim at disrupting the enemy's strategy, ability or will to wage war. SEE figure on page 10!

- Furthermore effects may have *cumulative*, *cascading* or *distributive* properties. Cumulative effects result when direct or indirect effects aggregate and may occur at the same or different levels of war. Cascading effects are indirect and ripple through the enemy system from higher to lower level. Distributive character suggests that virtually no part of the enemy is truly isolated and any effects generated emanate outwards affecting other systems and subsystems.
- Planned first-order effects may generate subsequent effects that were unintended and completely unanticipated. SEE figure on page 11!

According to joint publications, objectives provide the focus for military actions. Furthermore they are essential for unity of effort. In the abstract sense the objective is the effect desired. Conceptually, unified efforts are derived from a coherent plan, which links national objectives to all subsequent military actions. EBO provide the ideal means to execute this Strategy-To-Task (STT) framework because it forces planners to consciously link efforts with objectives and lower level objectives with higher ones. Planners and decision-makers at every level must ask what the desired end-state is, before they can proceed to plan a strategy or COA. An EBO is less specific than an STT mindset focused on evaluating the achievements of desired effects, rather than the destruction of specific targets. It serves to focus diversified efforts towards a common objective. The key in assessing effectiveness at all levels (from target through effect to objective) arises in turn the question of measurability. For this three levels deserve attention:

- Delivery results – current status of the target after weapons delivery, which captures the first order physical effect upon the target,
- Subsequent order effects – one must capture the resultant indirect effects which may be functional, systemic or psychological,
- Strategy effectiveness – one must assess each effect's contribution to the stated objective (less quantifiable than the previous ones).

Much of the success of EBO is determined during the planning phase by addressing all issues, which culminate with a series of tasks and Measures of Merits (MOM). Each task specifies the desired effect along with the tasker's intent and a list of key indicators that signify accomplishment of the effect.

Chapter 3 – Theoretical Basis

Concerns over the effects of bombing are obviously not new. Each of the theorists below conceived different mechanism for forcing his will upon the enemy by recognising that the ultimate determinant lay not in destroying targets but in generating higher order effects. *Douhet* authored the first major theory of air power and was one of the firsts to consider specific effects as he developed his employment concepts. His primary mechanism for defeating the enemy was in bombing his vital centres, which would be more quicker and humane than the trench warfare of WWI. *Mitchell* considered industry to be the most vulnerable to air power unique capabilities. His beliefs evolved from employing air power in a force-on-force, tactical attrition manner to exploiting functional effects at the strategic level of war. *Slessor* considered the enemy as a system (he spoke about vital centre) and looked for ways to influence him. He believed that though first order destruction may be a requisite means, the functional effects thereof are the desired outcome. Efficacy linked with an in-depth knowledge of the target.

The *ACTS* (Army Air Corps Tactical School) developed a strategy based on the industrial web theory for targeting the enemy's national economic structure. They recommended attacking those vulnerable elements with the greatest cumulative effect by acknowledging that gathering complete target intelligence was a study for the economist, statistician or other experts rather than the soldier. In his systemic approach *Eccles* suggested that the best mean to influence an adversary was attacking his logistical control system at the operational level. *Schelling* sees the conflict in terms of psychological influence and potential to modify behaviour by employing both threat and the actual use of gradually escalated force. His strategy targets the enemy's government and its population by classifying the use of force as brute force and coercion. *Warden* contends that all strategic entities can be analysed as a system broken down into five component parts. His model consist of five concentric rings (leadership-organic essentials-infrastructure-population-fielded forces) with Parallel Warfare (PW) as a defining pillar. *Deptula* proposes that employing force most efficiently is linking effects to objectives via EB planning. He maintains that destruction is not an end itself but a means to achieve the desired effect of disabling the enemy's vital control systems. Disabling the adversary's ability to control his essential systems at the operational level will paralyse his ability to function at the strategic level. *Pape's* denial strategy seeks to thwart the enemy's military strategy and deny the opponent his objectives. He focuses on strategic effectiveness not combat effectiveness.

Chapter 4 – Operation Pointblank

The basic strategy of POINTBLANK tasked was to conduct a sustained air offensive against Germany to destroy its capability and will to continue the war and make an invasion either unnecessary or feasible without excessive cost. Other tasks, such as supporting land forces followed. From these tasks flowed the strategic targeting priorities of disrupting German electric power, transportation and oil/petroleum systems. During assessment it turned out that scenes of walls collapsing, fires blazing and smoke rising were better for morale than intelligence as they often suggested greater damage than what had actually occurred. Estimating cumulative and cascading effects on the enemy's total war effort was simply a guess. Fortunately SIGINT (ULTRA and Y-intelligence) was a good complementary to photo intelligence. Nevertheless analysts had difficulty in assessing subsequent order or systemic effects. Decision-makers were much more interested in what effects the missions were causing than what those missions destroyed. Eventually the Allies succeeded in creating systemic effects that impeded the enemy's war sustaining and war making operations. This tends to support inter-war theories that air power would create such effects by striking key points or vital economic centres. Combat experience also revealed that it was very difficult with the then existing technology to deliver weapons precisely enough to execute strategic bombing doctrine.

Chapter 5 – Operation Linebacker II

Linebacker II did not develop as the result of careful mission analysis tying strategy to specific objectives and supporting tasks with carefully constructed MoMs and a definable end state. The objectives for Linebacker II were to break North Vietnam's will to resist, demonstrate America's commitment to South Vietnam and achieve an agreement permitting US armed forces to disengage before Congress reconvened in January 1973.

The president wanted maximum psychological impact on the North. Appraisal of aerial operations relied heavily on comparing pre- and post-strike photo intelligence. Sometimes the same weather that hampered bombing operations also hampered reconnaissance attempts. Altogether, over the war America's objectives became much more limited and much more aligned with North Vietnam's.

Chapter 6 – Operation Desert Storm

The American objectives for the Gulf region were the following, (1) to secure the immediate, unconditional and complete withdrawal of Iraqi forces from Kuwait, (2) to restore the legitimate government of Kuwait, (3) to assure the security and stability of the Persian Gulf region and (4) to protect American lives. The CENTCOM commander's intent was to initially attack into the Iraqi homeland using air power to decapitate his leadership, C² and eliminate its ability to reinforce Iraqi ground forces in Kuwait and Southern Iraq. Then to gain undisputed air superiority over Kuwait so that American forces can subsequently and selectively attack Iraqi ground forces with air power in order to reduce its combat power and destroy reinforcing units. The operation Desert Storm listed six theatre military objectives:

- Attack Iraqi political/military leadership and C²,
- Gain and maintain air superiority,
- Sever Iraqi supply lines,
- Destroy chemical, biological and nuclear capability,
- Destroy Republican Guard forces,
- Liberate Kuwait City.

For Phases I-IV SEE pages 59-60! The Desert Storm offensive air campaign was indeed an EBO plan ("If the effects desired were achieved it did not matter that individual targets may not have been hit" – See Deptula). A single aircraft in 1991 achieved the same result with one Precision Guided Munitions (PGM) as had thousand plane raids in WWII with over 9000 bombs, but without the associated collateral damage. This lethal precision enabled coalition war-fighters to achieve systemic effects. Though "Black Hole" planners were effective, their closed secretive nature exacted a toll on overall operations. Even if first-order destruction is a primarily objective, a living, reacting enemy can make this task difficult if not impossible. As hard as it was to confirm first-order destruction, measuring higher-order systemic effects proved even more difficult. Equally frustrating from an EBO standpoint were the lack of higher order systemic and psychological effects from attacks on Iraq's electric infrastructure. Parallel war requires a tremendous amount of intelligence, which reveals the need for close co-ordination between operations and intelligence communities. While Desert Storm was the most intense and precise aerial bombardment to date, the outcome fails to confirm assertions that air power can decapitate a modern state or paralyse its military forces.

Chapter 7 – Operation Allied Force

There were three objectives of the allied strikes:

- To demonstrate the seriousness of NATO's opposition to aggression and its support for peace,
- To deter Milosevic from continuing and escalating his attacks on helpless civilians by imposing a price for those attacks,

- If necessary to damage Serbia's capacity to wage war against Kosovo in the future by seriously diminishing its military capabilities.

The military objectives became the air objectives of OAF. Nevertheless three issues weighted heavily on the EB-potential of the Kosovo operation:

- The lack of a long-term strategy to guide employment decisions,
- The initial absence of formal objectives,
- Conflict within and political intrusions into the targeting process.

Planning efforts, organisational structures and co-ordination process proved inadequate when the conflict extended well beyond the anticipated two-three days. Much of Allied Force's early operational struggles occurred because planners had no formal objectives to focus their actions ("objectives were never formally passed to those entrusted with planning the air operations") and concerns for collateral damage played a tremendous role. Acting in concert, short-sighted planning, lack of objectives, target selection conflicts and collateral damage concerns made it impossible to execute a coherent, co-ordinated and integrated air strategy. For selecting targets SEE page 85! Two topics with effects assessment implications came up repeatedly – Allied air superiority against the air defence system and the morale of the enemy ground troops. All together the lack of normal objectives combined with ad hoc organisational structure greatly nullified the EB potential of Operation Allied Force.

Chapter 8 – Conclusions, Findings and Implications

Senior decision-makers have always been interested in creating specific effects rather than simply destroying targets. Air power has become very effective at producing direct, physical effects and it is becoming increasingly capable of creating certain widespread systemic effects. Though the ability to even predict, much less generate specific psychological effects remains yet a hope and may act as a virtual ceiling on the potential of EBO. Objectives are the key to any EBO. The higher these objectives were stated the more far-reaching and coherent were the supporting effects. Limited, unambiguous political objectives that directly translated into military objectives and strategies made it significantly more likely that the US would achieve its ultimate objectives. To do so the air power must have a unified and clearly delineated chain of command. At some point in every operation, senior officials became heavily involved in selecting the targets for strategic effects. Outside influences were not the only ways that planners were limited in their efforts to exploit the potential of EBO. Choosing the right targets still require a vast amount of intelligence. Collecting this intelligence must begin long before the actual conflict. Analysts must understand more than simply the physical layout of an enemy system. However air power planners failed to do any detailed analysis of the enemy himself.

There was no concerted effort to study the enemy's culture or history in an attempt to understand him psychologically (planning for psychological effects remained more hope than calculation). The US has developed and improved the ability to employ air power to destroy known physical structures. A lack of timely, accurate BDA and combat assessment was consistent throughout the examined cases (the ability to assess physical damage improved the most, functional damage assessment improved less).

It is still difficult to assess any effects more sophisticated than simply determining how much of the physical target was destroyed. In the majority of the cases, information that gave decision makers confidence came not from photographic evidence of physical damage, but from signals or HUMINT concerning indirect effects of airpower's destructive bombing. Four cases saw HUMINT:

- Internal look at mass evacuations,
- Troop desertion,
- Failing popular morale,
- Failure of local personnel to report for reserve call-ups.

Often strategic success is less the result of physical or even systemic damage than it is the way those things impact enemy decision-makers psychologically. Planners need to give assessment considerably more forethought than they have in the past. Combat assessment in order to be effective must be an integral component of the targeting, planning and execution process. As a recent RAND study asserts, although military technology is increasingly available, technology alone does not determine military effectiveness. Implications can be for:

- Doctrine,
- Training,
- Air Tasking Order,
- Joint Warfighting Centre.

SEE summary on page 110!

5.3 Cordesman, Anthony H./Burke, Arleigh A.

Cordesman, Anthony H./Burke, Arleigh A., *Understanding the New "Effects-based" Air War in Iraq*, Center for Strategic and International Studies, 3 March 2003, www.csis.org/burke/mb/iraq_airwar.pdf

The US and the UK will fight a new kind of air war in Iraq. It will be designed to paralyse enemy forces, rather than destroy them. They will bypass or avoid targets that are not time-sensitive military assets. It will also emphasise precision to avoid economic and infrastructure targets wherever possible, as well as targets with historical, religious and cultural value.

It will select the smallest and most accurate munitions necessary to destroy the functions of that target. It will select aim points to destroy only the key part of buildings or facilities with minimal collateral damage. The following points may help explain what is happening and how to evaluate it:

The main difference is targeting, aim point and munitions selections – the key will be the ability to use new intelligence assets and targeting planning, which carefully match precision and the size and effect of the weapon. But targeting and the analysis of the effects of air and missile strikes will have to be based on less and less certain information as the situation goes dynamic. Rapid targeting and bombing will occur. The fog of war will remain and the ability to target with full knowledge of the consequences will steadily decline after day one.

New weapons and tactics will still emerge – new targeting concepts are key to EB air power with the understanding of changes in the full range of new weapons effect.

The bombing plan will evolve very rapidly and become fluid by day two – the US targeting will become dynamic and alter to hit at newly discovered or dispersed targets. It will stay fluid and be shaped by the changing tactical situation.

The Allies will learn major lessons – about American and effectiveness that change bombing and targeting patterns by the day. In this war even small problems or advantages will lead to rapid changes in the way we fight. The Allies will also have to carry out extensive re-strikes with the same or alternative weapons.

Battle Damage Assessment (BDA) will again be a major problem – with all of the advances in technology, there is still no way to instantly measure or verify lethality or civilian casualties or collateral damage. This is going to be a very hard reporting job.

The Allies are bombing a regime, and time sensitive targets – in the form of active enemy resistance and not a country. They seek to paralyse and destroy a regime, not a country. There is no reason to attack most urban and populated areas unless they actively threaten allied forces.

There will be kill boxes, close support and interdiction and unguided weapons – the Allies have to protect their soldiers, areas and flanks. Force protection will generally override targeting constraints.

Iraqi WMD and missiles are a wild card – targeting restraints have to be different in the case of known or suspected locations with CBW or key delivery systems.

Iraqi dispersal, deception and decoy - human shields and exaggerated claims of civilian casualties, cultural or religious and economic importance will be the rule not the exception to limit allied effectiveness.

Urban warfare can still be a mess – close-in urban fighting is likely to happen. The level of physical destruction often appears much greater than it is. There can also be a tactical necessity and sudden shift in targeting rules and bombing methods needs to be kept in perspective.

At the end the are interesting tables!

5.4 Crowder, Gary L

Effects Based Operations Briefing, presented by Col. Gary L. Crowder, United States Department of Defense, News Transcript, 19 March 2003, www.defenselink.mil/news/Mar2003/t03202003_t0319effects.html

During Desert Storm we took a radically different approach in terms how we wanted to prosecute a military operation. It was a combination of a fortuitous development of different capabilities and technologies. Advanced precision and stealth allowed the conduct of EBO, which exploits these capabilities and technologies to the greatest extent possible.

With EBO we can more effectively and efficiently prosecute military operations. Of course the first piece for EBO was the combination of stealth and precision, but the second aspect of it is the different way of thinking about what we want to achieve on the battlefield. Instead of a traditional attrition approach, we want to better achieve some sort of policy objective in a more efficient and effective manner. EBO with precision and stealth enables us to do something that is called parallel warfare. To understand the evolution of precision technologies we need to have a look at the Circular Error Probable (CEP), which was during WWII a radius of around 3300 feet but now with the Joint Direct Attack Munition (JDAM) it is a radius of around 10 feet. These improvements in capabilities give us the ability to do a large number of effects in a very short period of time. The F-117s have a capability, which requires far fewer amounts of support assets, so stealth technology can give us some capabilities in addition to the precision. It enables us to do a lot more stuff very early in a fight, for example to take out the critical C² early through the combination of creative use of Special Operation Forces (SOF) or Army Apache helicopters. With EBO we have the ability to go after targets that might be military or political leadership, essential industries or transportation by attacking the enemy as a system and working towards achieving a systemic collapse.

With the traditional attrition approach one would list all the targets of my target list and then would go through to sequentially destroy each of those targets until the list is completed. But for instance it is better not to destroy electrical power stations but just to neutralise electrical power. For this you do not have to attack each element of a system to make it not work. An effects-based approach starts with analysis and prioritisation of targets whose destruction enables us to achieve the effect by neutralising the adversary's subsystems. The advantages of this kind of approach are that (1) you create a far less amount of destruction on the ground and (2) you have to attack far less targets, so assets can be used to attack other targets. This opportunity enables us to tie more effectively specific effects to military and political objectives by creating significantly less collateral damage and causing less civilian casualties.

Once we understand what is the effect we want to desire on the battlefield, we can then figure out ways of creating that effect more efficiently, more effectively, striking less targets, using less weapons, mitigating potential concerns for collateral damage and civilian casualties. EBO on the other hand needs more clearly defined political and military objectives.

Actual operations in Iraq show us how to do EBO across the military services. In WWII to defeat the enemy one had to defeat his army. Now it is enough to neutralise the enemy's army. Evaluating the enemy as a system of systems helps us understand how the different things interrelate and where the vulnerabilities are, thus enabling us to more effectively prosecute the operations.

Fighting side by side does not mean a fighting in an integrated manner. An integrated plan brings all the different effects from each of the capabilities of each of the services together to achieve the best result possible by attacking the adversary more completely. But to win a war one needs to intimidate an adversary to make him realising that he either fights and die or he gives up. There is always the likelihood that that enemy soldiers might choose not to fight for a regime.

There is a difference between collateral damage and unintended damage. Collateral damage can be expected from the reasonable occurrence from attacking a system or a target. Unintended damage is, when something goes wrong based on mechanical malfunction or intelligence failures. Unfortunately it is not a realistic expectation that we are going into a conflict and nothing is going to happen in terms of collateral damage or unintended damage. The best way to mitigate collateral damage is only to strike the stuff you really need to strike to. But it is important to point out that not all unintended damage and not every collateral damage is caused by friendly fire.

5.5 Deptula, David A.

Deptula, David A. (Maj. Gen.), *Air Force Transformation, Past, Present, and Future*, Aerospace Power Journal, Fall 2001, www.airpower.maxwell.af.mil/airchronicles/apj/apj01/fal01/phifal01.htm

Transformation as a fundamental change involves three principal elements:

- Advanced technologies,
- New concept of operations and
- Organisational change.

Transformation also means shaping the course of change through aggressive, integrated and coherent change processes. It also embraces the notion that meaningful transformation cannot be achieved without integrating the expanding capabilities with those of the other services and Elements of National Power (ENP).

The Gulf War – Two separate military technologies had matured in the 1980's to offer an order-of-magnitude breakthrough in force application. The first was low observable or stealth technology, the second the appearance of precision guided munitions. These two capabilities in conjunction with an EB planning methodology allowed US forces to execute an innovative concept known as parallel warfare, the simultaneous application of force across the breadth and depth of an entire theatre. Technology and operational concepts do not tell the entire story. New joint war fighting structure allowed the centralised control of American forces through the joint force commander and the joint force air component commander based on the 1986 Goldwater-Nichols Reorganisation Act.

End of the Cold War – Throughout the 1990s the Air Force transformed itself into a force comprised primarily of precision capable strike aircraft. In parallel the national security strategy of containment shifted to one global engagement, with downsized forces, both deployments and operating tempo skyrocketed. Temporary deployments away from home became nearly permanent.

Expeditionary Aerospace Force (EAF) – the increased operations tempo and reduced force created the EAF concept to make it more flexible and to stem the recruiting and retention downturn. EAF has at its core the formation of 10 separate Aerospace Expeditionary Forces (AEF) in a rotational concept that provides predictability and stability to airmen. This unprecedented level of organisational flexibility occurred within the budgetary means.

Air Force Modernisation and Transformation

The deployment challenges of the post Cold War environment and the projections about the future security environment are all based on revolutionary trends. It is a process that allows for creativity by focusing not on platforms, but on requirements for future capabilities. SEE the Air Force 14 critical future capabilities on pages 3-4!

Transformational Military Technology

Space and Cyberspace – we are transforming our space force into a space-control force, that ultimately will provide persistent intelligence, surveillance and reconnaissance around the globe and will also provide critical to the evolving missile-defence system. The future offers near real time global force application, which will give us the next generation of missile defence conducted from space based platforms and the next generation of effects-based warfare in one system. If the National Command Authorities (NCA) decided what particular effect is to be achieved, Air Force can comply within minutes after decision.

Precision weaponry – the precision era has evolved to an all weather capability. Smaller and more precise munitions will produce dramatic increase in lethality. Autonomous, seeking weapons will precisely attack mobile targets to reduce an enemy's mechanised formations to dismounted infantry in hours.

Stealthy Combat Platforms (SCP) – stealth and precision work together. The operational implications are obvious especially against formidable air-defence threats, but the strategic implications might be even more important. It will cause our adversaries to change their national security priorities by dissuading them. Stealth in number has strategic meaning. Four platforms will define the stealthy Air Force of 2020, the B-2, the F-22, the JSF and unmanned combat air vehicle. It is a true asymmetric advantage and capitalising on that advantage helps shape our future.

Transformational Operational Concepts

New joint operational concepts can provide integration templates for how the US conducts military operations across the spectrum of the conflict.

Effects-Based Operations (EBO) – provides a perspective for planning, executing and assessing military operations by integrating other ENP to produce effects that compel desired political outcomes. EBO moves beyond narrow tactical viewpoints. Planners use superior knowledge to avoid attrition encounters, applying force at the right place and time to achieve specific operational and strategic effects. It promotes greater planning agility and is less plodding and is more adaptive to the achievement of specific effects.

Global Reconnaissance Strike/Global Strike Task Force (GRS/GSTF) – we must deny the enemy's anti-access strategies through the use of stealthy, long-range platforms that can apply precise force with greater rapidity with two operational concepts. First, the concept of global reconnaissance strike offers a total joint force solution to allow follow-on joint operations. Second, the global strike task force outlines the Air Force's contribution to the joint anti-access campaign.

Rapid-Halt Operations – our interest in global prosperity compels us to retain the capacity for rapid halting adversary aggression that threatens the stability of the world community. Joint aerospace forces not only provide rapid global ranging but also play a huge role in deterring destabilising behaviour. Capitalising on the precision and global reach allow for the rapid employment of tailored joint forces for isolating, incapacitating and rapidly halting aggression. It is also able to rapidly swing forces from one theatre to another, allowing fewer forces to conduct more than one major theatre war simultaneously.

Coercive campaigns – The US is interested in controlling aberrant behaviour and shaping hot spots, not annexing territory. This requires a different military campaign mind-set that focuses on coercing the target nation through co-ordinated military and diplomatic means. This kind of coercive campaign can modify an opponent's behaviour to comply with US strategic objectives. New capabilities enable new military approaches to expand strategic options.

5.6 Deptula, David A.

An interview with **Maj. Gen. Deptula**, *Air Force Operations Concept Aims at Success, Not Destruction*, "Effects-based operations" a new but ancient military concept, U. S. Department of State, International Information Programs, Issues in Focus, 28 March 2003, www.usinfo.state.gov/regional/nea/iraq/032128military.htm

The US Air Force in every military operation since the 1991 Gulf War has been functioning under an operating concept that emphasises the accomplishment of strategic and tactical goals. The essence of Effects-Based Operations (EBO) is to make the enemy conform to our strategic plan without even having to act. SEE quotation from Deptula!

EBO is not a process or a methodology, but a way of thinking in the broadest sense. If one thinks the warfare in that context, the one begins to think about ways other than simple destruction of an adversary's forces to coerce or convince him to act in the way we want.

EBO is a springboard to better linking our nation's security pillars together in an integrated, unified fashion to accomplish our security goals and objectives. Another insight into EBO is that it is not about damage or destruction, it is about accomplishing the effect that we want to achieve. It frees up weapons, which we can now use somewhere else and it reduces exposure of aircrews that would not have to face the threat to go deliver the weapon. During planning for the air campaign against Iraq we made the assumption that ultimately we are going to have to go back in and rebuild, so we wanted to do minimum damage. We targeted rather transformer grids than generator halls. Accomplishing the military goals with a minimum of force allowed us to secure those objectives much more easily than might otherwise.

If you go to war, the number of casualties is also important as a key objective. Estimates from human right groups are in the order of 3000 or less in Iraq because delivering air ordnance was done to minimise civilian casualties and collateral damage. The maturity of our precision capability allows us to reduce the lethality of the weapons. During Operations Northern Watch we used inert weapons, filled with concrete to achieve our desired effects on destroying targets.

EBO is about minimising damage and minimising loss of life. Effects, caused by precision and independently targetable weapons allow us to do what large explosives allowed us to compensate for large errors in accuracy in the past. The Circular Error Capability (CEP) was in WWII around 3000 feet, now it is less than 10 feet.

5.7 Endersbury, Garry/Fulbright, Barry

Endersbury, Garry (Lt. Col., Ret.)/Fulbright, Barry (Lt. Col., Ret.): *Effects-Based Airpower*, Aerospace Power Journal, Winter 1998, www.airpower.maxwell.af.mil/airchronicles/apj/apj98/win98/waywin98.html.

It is a widely accepted premise that air power is solely a deliverer or provider of services, a powerful adjunct to manoeuvring forces. But the Air Force looks beyond the pure surface support role and focuses on creating decisive theatre-level and strategic effects.

Background

From the very entry advocates of air power sought victory through command and exploitations of the air. Unfortunately the major wars of the twentieth century yielded results that lacked the decisiveness promised by the air power visionaries.

Air Power Characteristics

The advantages of air power over surface military forces result in its vastly superior mobility and responsiveness. Operations in the third dimensions allow for speed, range, manoeuvrability and a perspective unachievable by forces on the ground. Air forces are able to respond quickly and world wide on short notice to counter potential threat.

Effects-Based Air Power

Generally there are two ways to understand air power. The first is the traditional approach whereby it is a provider of services. The second approach is a broader definition and encompasses a more complete understanding of air power and its characteristics, which incorporates not only the conventional provider of services role but also its ability to create theatre level effects beyond the scope of the geographically oriented surface battle. At the operational level of war, theatre objectives determine military power priorities. Unlike modern ground forces, modern air forces do not need to achieve tactical objectives first before pursuing operational or strategic objectives. Effects-based air power is concentrated to directly achieve objectives with theatre-wide significance, bypassing tactical objectives. If applied so, air power can bring about a more rapid and less expensive victory. However the word victory is understood here in a broader interpretation because effects-based air power is not dependent on war per se. This concept focuses on the political-military objectives and is based on four interrelated premises:

- Air power may be employed totally independent of surface forces.
- Air power is indivisible and centrally controlled by an airforce man.
- Air power is employed from a theatre or global perspective to achieve theatre-wide objectives.
- Air power can accomplish multiple objectives simultaneously.

In order to maximise the potential of air power we need to learn to think in terms of effects it can produce rather than merely the support it can provide to surface forces.

5.8 Fayette, Daniel F.

Fayette, Daniel F., *Effects-Based Operations, Application of new concepts, tactics, and software tools support the Air Force Vision for effects-based operations*, AFRL's Information Directorate, Information Technology Division, www.afrlhorizons.com/Briefs/June01/IF00015.html

Effects-Based Operations (EBO) consists of a set of processes, supported by tools and accomplished by people in organisational settings, that focused on planning, executing and assessing military activities for the effects produced rather than merely attacking targets or simply dealing with objectives.

EBO complements rather than replaces Target-Based (TB) or Objective-Based (OB) approaches and it applies across the entire range of military missions with or without the use of various sorts of force. Since it is not platform specific it is a critical capability for INFOPS and offensive counter-information operations. An EBO approach starts from a high level systems perspective and explicitly seeks to understand, trace and anticipate direct and indirect effects of a specific action as they course through the enemy's political, military and economic infrastructure. It applies to understanding oneself, the adversary or any other context where elements interrelate, interconnect or otherwise are interdependent.

Like TB and OB approaches, an EB-approach starts from the commander's intent from which Courses of Action (COA) options are developed.

The second step is the Centre of Gravity (COG) analysis. COGs are those characteristics, capabilities or localities from which a military derives its freedom of action, physical strength or will to fight (leadership, infrastructure, population and field military). SEE Warden's model! For EBO the ultimate goal is behavioural change in the enemy's leadership. SEE also Barlow's model!

The next crucial and final piece is determining how the enemy might react to those actions and what impact those reactions might have on the resulting cumulative and operational effects (the enemy is an intelligent being that reacts). The important analytical parts involve determining the various ways of how an enemy target, target set, or target system might react to an attack. These reactions can be subdivided for example into three cases:

- How the enemy should react – the two components are the following: what is most beneficial and what is least restrictive,
- How the enemy can react given what is known about its capabilities – information can come from reverse engineering the enemy's target set or system,
- How the enemy could react if it had certain currently unknown capabilities – uncertainty of our knowledge about the first two cases.

Examples of the type of technologies and impacts on the EBO are as follows:

- Active templates for objectives, resources analysis and strategy development,
- Intelligent agents and knowledge bases for information gathering/filtering and decision making,
- Collaboration and visualisation for mixed initiative planning and
- Modelling and simulation for Course of Action (COA) development.

5.9 Glenn, Kevin B.

Glenn, Kevin B. (Maj.), *The Challenge of Assessing Effects-Based Operations in Air Warfare*, Maxwell AFB, Alabama, 24 April 2002,
www.airpower.maxwell.af.mil/aurchronicles/bookrev/glenn.html

This article reviews main findings in two books in order to understand effects-assessments challenges. It also argues that other information related challenges arise during implementation of Effects-Based Operations (EBO) in the real world, including the prediction and observation of effects.

Although no formal body of literature describes EBO in detail, a few tenets can be derived from Air Force doctrine. According to this the EBO concept: Pre-eminently focuses on effects or end-results, by reducing the emphasis on weapon systems or targets attacked (thus the old saying that armour fights armour is not valid anymore), It de-emphasises destruction as a mechanism for achieving effects (like weapons, physical destruction is secondary to the desired functional effect), It acknowledges the strategy of Parallel Warfare (PW) by inflicting paralysis upon an enemy by using multiple simultaneous attacks.

EBO has many advantages. Its critically important message is that when applying, means should not be confused with ends. Applying EBO also encourages being flexible, innovative in planning and operations, to think of and use weapons in new and different ways. EBO also reminds us that the ultimate measure of success is the results achieved rather than the goals set. Although EBO provides critical strategic clarity, it is based on two problematic premises, which suggest that assessment, prediction and observation, as a circular loop is a walk into uncertainty:

- Understanding the links between cause and effect, and
- Analysing the mechanism that ties tactical results to strategic effects.

The Challenges of Assessment

Both authors suggest that current air power strategists may have cause for concern over the validity of lessons learned from the past, due to problems with past assessment because they were in general seriously flawed, poor or misleading studies. This can lead us to the conclusion that:

- When assessing effects, a strategist has to be cognisant of personal and institutional biases,
- Tracing higher order effects back to their original causes is inherently difficult because multiple actions yield multiple potential causes,
- Our hard data on air power effects comes from predominantly successful campaigns, which may give cause for reflection.

The Challenges of Prediction

Common sense tells us that accurately predicting the same effect in advance is much easier in a simple situation than in a complex one. This phenomenon is explained in the complexity theory. Complexity is a function of the number of system elements involved and the number of relationships among the elements. The greater the number of elements, the greater the complexity. Complex systems demonstrate several unique properties:

- They are non-linear – the inputs and outputs are not proportional, the whole is quantitatively not equal to its parts and cause and effects is not evident (see the difference between air superiority and strategic attack),
- Changes in the initial environment can lead to very different outcomes even with initial inputs being the same (the phenomenon is called “sensitivity to initial conditions”),
- Living systems do not simply respond to events passively, but they try to turn situation to their advantage, which means they have the capability to adapt.

Again, when it comes to complex systems, cause and effect are often neither readily evident nor easily traceable.

The Challenges of Observation

Although air power as a combat force boasts many advantages, it must contend with some inherent limiting characteristics as well. First, it is limited in its ability to verify what it has achieved over time. Second, operating at altitude can either help or hinder observation activities. Aerial and space sensors cannot replace human intelligence, because physical proximity does have its observational advantages in terms of verifying effects. Furthermore human information may be the only source able to identify and report multi-link cause and effect chains.

In addition, as we move away from a more concrete focus on observable physical destruction (1st order effect) our observation problems become more complicated and the number of inferences expand. Fact is that EBO is information intensive.

5.10 Jumper, John P.

Jumper, John P., *Global Strike Force, A Transforming Concept, Forged by Experience*, Aerospace Power Journal, Spring 2001, www.airpower.maxwell.af.mil/airchronicles/apj/apj10/spr01/jumper.pdf

History is replete with battles, campaigns and wars that were lost because fundamental changes in the nature of warfare went unrecognised. Today we stand on the brink of technological advances that can prompt a new concept of aerospace power employment.

Stealth, all weather Precision Guided Munitions (PGM) and Unmanned Aerial Vehicles (UAV) will allow us to manoeuvre or stand off systems and networks available to potential adversaries. Also advances in information technologies enable new dimensions of C², allowing horizontal integration of air and space Intelligence, Surveillance and Reconnaissance (ISR) platforms. How well we capitalise on these advancements will depend largely on our ability to develop useful Concepts of Operations (CONOPS) such as the Global Strike Task Force (GSTF) concept.

Present for Duty: Lessons of Warfare in the 1990s

The fall of Communism and the end of the Cold War brought about sweeping changes in the way our nation and Air Force fight wars. Between 1990-97 the US military conducted 45 SSCO as compared to 16 during the entire Cold War. For the US Air Force, Operation Desert Storm was the watershed demonstrating the power of stealth and precision. Also the 1990s demonstrated, how political concerns could impact operations down to the tactical level. At the end of reorganisations the Air Force became lighter and expeditionary, preparing for the nature of future warfare characterised by:

- The expectation to fight jointly alongside partners and allies, but depending mainly upon American technological prowess,
- The fact that a limited operation should never be started if the enemy can turn it into a sustained conflict,
- Restrictive Rules of Engagements (ROE) with limiting factors like high level political involvement in the targeting process and public demand for low collateral damage and casualties,
- Possible enemies have also taken note that fighting the US does not require to win but not to lose by trying to acquire anti-access threat systems or silver bullets,
- Access assurance is the key factor in the near future although physical and political restrictions will always impact operations.

Stealth, electronic counter measures and high altitude attack profiles decrease our vulnerability significantly, but the full benefit is realised only when we add supersonic speed to the mix. GSTF maximises existing and emerging joint capabilities and enables us to meet our toughest challenges. It enables us to overcome range barriers by providing means to rapidly roll back adversary threats.

Kicking Down the Door: The GSTF

GSTF will rapidly establish air dominance and subsequently guarantee that joint aerospace, land and sea forces will enjoy freedom from and to attack. It will combine stealth and advanced weapons with a horizontally integrated Command, Control, Intelligence, Surveillance and Reconnaissance (C²ISR) constellation that provides lethal joint battle-space capability. GSTF will be a rapid reaction force employed within the AEF construct while maintaining interoperability with joint, coalition and allied assets.

The concept hinges on precision weapons and stealth capabilities. These assets will provide substantial firepower when and where it is needed. Prior to any conflict, preparation is needed and the first requirements is to call for ISR platforms which will integrate in the future dialogue at the machine level. This will enable us to precisely locate and identify critical targets, a phenomenon called Predictive Battlespace Awareness (PBA). With air refuelling and new platforms like the F-22 in service, a 24-hour stealth will be possible. Joined with other stand-off and Special Forces (SF) capability, GSTF will provide a capacity to systematically destroy hundreds of targets, roll back enemy defences and clear the way for follow-on forces. Although parts of the GSTF concept could be executed with today's force structure, it will achieve full potential only by leveraging new technology. It is a rapid reaction, leading edge, power projection concept, which will mass effects earlier, from longer ranges, and with more precision than our current capabilities and methods of employment allow.

5.11 Knouse, Edgar M.

Knouse, Edgar M. (Maj.), *Effects-based Targeting and Operational Art in the 21st Century*, Naval War College, Newport, R. I., 5 February 1999, www.stinet.dtic.mil/cgi-bin/fulcrum_main.pl

Effects-Based Targeting (EBT) can be defined as an action taken against an enemy system or infrastructure (target) which produces a desired result (effect). The action is often associated with a military activity directed against an enemy target or target set. The result or effect of this action must directly relate to achieving the operational objective or the desired end-state.

Concept of EBT is not new for example allied bombing of rail transportation in Germany was conducted to isolate the "Overlord" area to prevent German reinforcements in WWII. There are several important points regarding EBT:

- It is a must to understand the enemy as a system and this requires an intelligence collection and analysis apparatus,
- The desired effect can happen immediately or over an extended period of time and this requires not only Battle Damage Assessment (BDA) or Battle Damage Indicators (BDI) but also long term Measures of Effectiveness (MOE),

- It must be ensured that the effect will achieve or support the operational objective.

A hierarchy model of security objectives can provide a framework starting with the strategic objectives, working the operational objective next then identifying effects and finally choosing appropriate targets. These points are the cornerstone for EBT with focusing on *when, where, why* and *how*.

When?

The factors of time, space and force will determine how EBT should be used to support operational art. It should always be employed when a desired effect can be achieved which supports the operational objective. Two specific questions have significant importance to EBT:

- *The ends* – what military conditions must be produced to achieve the strategic goals and,
- *The means* – how should the resources be applied to accomplish that sequence of actions.

Where?

When determined the effect, which will achieve or support the operational objective, there is normally no tactical target at the operational level but that component of the enemy system, which produces the required effect. Warden's five-ring model with expanding concentric circles is a good example for interdependencies between the various elements. When applying EBT synergistic effects can be obtained. The important factor is not the tactical target but the comprehensive knowledge of how the enemy functions as a system. The concept of EBT emphasises that where to target operationally is on the system and the desired effect and not on tactical targets. Therefore EBT must ensure a capability to determine and quantify MOE to achieve the desired effect. It is like network-centric warfare with much faster and more effective war fighting style with a focus on speed, precision and reach. Instead of mass of force it offers the mass of effects. Obtaining the information on an enemy system is crucial before, during and after a course of action. A thorough knowledge of the enemy system where to target for a specific effect determines its duration.

Why?

The scenarios militaries face range from Operations Other Than War (OOTW) to Major Theatre War (MTW) with the possible use of weapons of mass destruction. Force reductions and limited military funding require efficient operations with a doing more with less. In this context EBT can be an extremely valuable tool as a force multiplier across the board. The capability advanced technology provides us has a hefty price tag, but it allows us to deploy an expeditionary force on short notice to face global threats in a variety of contingencies. OOTW missions have stretched the militaries' tasks. EBT in concert with advanced technology affords us a greater capability to meet operational objectives with reduced force structure. On top of that precision weapons can provide cleaner effects with less damage of the enemy infrastructure by minimising the potential for targeting fouls or collateral damage. EBT should be used as a force multiplier, not a replacement.

How?

Warden suggests that operational objectives tend to fall into three categories. *First* is the destruction of some or all of the enemy's forces. *Second* is the destruction of some or all the enemy's economy. *Third* is the destruction of the will of the people or the government to resist. These categories can help build a decision matrix – what effect is desired and for what duration. But for this we need to step back and break the targeting paradigm by saying that an effect must be given priority over a target, because the deeper in the enemy system one targets, the longer the effect may be. EBT does not mandate the use of military force. Information warfare is a good method to target the enemy's economy, C² infrastructure or IADS. To destroy the will PSYOPS could produce some effects but MOE are very hard to determine. The maturity of the theatre and knowledge of the enemy's system also influences the extent to which EBT can be applied.

Other considerations for EBT

In many of the operations Rules of Engagement (ROE) and the Laws of Armed Conflict (LOAC) often direct Course of Actions (COA) so the help of the Staff Judge Advocate is needed. Another consideration is that of the media coverage, because perception is reality. When using EBT ripple effects can not only propagate in the enemy system but to neighbouring countries, theatres and potentially across the globe.

Conclusion

EBT can be employed effectively only when there is a clear operational objective and some relevant, operational, attainable effects that can be identified and support or achieve this objective. The limitation is only our inability to relate operational effects to political objectives.

In this article effects are named and grouped in the attachment. SEE figures at the very end!

5.12 Meilinger, Phillip S.

Meilinger, Phillip S. (Col.), *Air Strategy, Targeting for Effects*, Air Power Journal, 1999, www.arpower.maxwell.af.mil/airchronicles/apj/apj99/win99/meiling.pdf

Air power operating in the 3rd dimension can bypass the tactical surface battle and operate directly against the Centres of Gravity (COG) of an enemy nation (industry, politics, economy and population). When a country wishes to influence another, it has several instruments at its disposal (military, economic, political and psychological).

In attempting to bend an enemy to our will, attacking him at the strongest point is not always necessary or desirable; rather we should hit him at his weakest point if that will cause collapse. It is also possible to group the generic COGs of a country into the categories of military forces, the economy and the popular will. Although *land actions* could have an effect on the enemy's economy or will, such consequences were usually indirect and often unplanned and such attritional contests had become far too bloody to serve as a rational instrument of policy. *Sea warfare* is fundamentally different from war on land.

Although navies do indeed fight other navies, for the most part they use the economic and psychological levers of power against an enemy's economy. *Air war* is fundamentally different from both land and sea warfare because due to its 3rd dimensional character the enemy's entire country becomes open to attack. This fact complicates the application of air power and planners must be familiar with the inner workings of an enemy nation to determine the most important COGs. Destruction of target set does not automatically mean victory. Intangible factors such as religion, nationalism, the culture as a whole, are as important as the physical attributes. At its most basic, war is psychological and the key to all war is the amorphous and unquantifiable factor known as national will.

Military capability is the sum of the physical attributes of power and when these have been dissipated or destroyed then the national will either expires or becomes unimportant. Hereby some approaches:

- Gen. Giulio Douhet (ITA - WWI) believed that the population was the prime target for an air attack and that the average citizen would panic in the face of air assault. Dropping bombs on a country's major cities would cause such a disruption and devastation that revolt and subsequent surrender were inevitable.
- Wing Commander John C. Slessor (GBR – between WWs) argued that the enemy army's line of supply and communications were the COG. If the transportation system of the enemy were disrupted and neutralised not only would the enemy army be unable to offer effective resistance but also the entire country would be paralysed and vulnerable (destruction of will and capabilities by bombing).
- Gen. Billy Mitchell (USA - WWII) developed the industrial web concept, which envisioned the enemy country as an integrated and mutually supporting system susceptible to sudden destruction. If attacking or neutralising the right bottleneck, the entire industrial edifice could come crashing down (destruction of capabilities by bombing).
- Air Marshall Hugh Trenchard (GBR - WWII) argued that the psychological effects of bombing outweighed the physical effects. According to him disrupting a country's industrial infrastructure and the normal life would be so profound that people demanded peace (destruction of will by bombing).
- Col. John Boyd (USA – Korean War) argued that the key to victory was to act more quickly, both mentally and physically than the opponent. He expressed this concept with the OODA loop. He saw victory consistently going to the side that could think more creatively and then act quickly on that insight (strategy directed against the mind of the enemy leadership – disrupt the process).
- Col. John Warden (USA – Gulf War) used a target consisting five concentric rings with leadership in the very centre and the armed forces as the outmost ring (strategy directed against the mind of the enemy leadership – disrupt the form).

A new wrinkle in military strategy stresses the cultural aspects of conflict. Although physical manifestations of power are the most discernible, cultural and social aspects of society are also crucial. This implies that the enemy is partly rational and partly irrational and who is motivated by reasons both in policy and passion.

The COGs of one country are not necessarily those of another. Furthermore COGs may change over time within the same country. An enemy country is a living organism composed of multiple COGs that act and react with one another and the outside world.

5.13 Noedskov, K.

Noedskov, K. (Maj.), *Systematizing Effect Based Air Operations*, *Air & Space Power Chronicles*, 24 May 2000, www.airpower.maxwell.af.mil/airchronicles/cc/noedskov.html

The purpose of the article is to systematise the operational level, effects-driven planning process. Since the war against Iraq in 1991 air power thinking has undergone a dramatic development. Prior to 1991 air power thinking was generally divided into two. On the one hand it was the strategic employment of nuclear weapons, on the other to support army land operations. Current doctrines like AFDD-1, NATO AJP-01(A) and AJP 3.3 emphasise the ability to employ air power independently and they organise own military operations at the strategic, operational and tactical levels of war. Effects-based targeting is about identifying Centres of Gravity (COG) at the strategic, operational and tactical level with subsequently identifying Decisive Points (DP) and the associated targets that if serviced will achieve the desired effects. SEE figure 1! The terminology however is related to surface based two-dimensional warfare, which cannot be directly related to COGs. To describe Effects-Based Targeting (EBT) we need to systematise the COGs and the effects we desire to achieve, based on the military objective.

The Five Ring System Analysis by Warden is usable for that purpose, because it has the following five concentric categories. SEE figure 2:

- Leadership (C⁴I),
- Production/industry,
- Transportation,
- Population and
- Military.

The suggested air campaign planning process is described in the following steps. *Step 1* is the identification of the desired End State (ES). *Step 2* is the identification of the military objective, which leads to achieve the ES. *Step 3* is analysing the COGs and at all levels based on the five-ring model. *Step 4* is identification of the desired state of affairs of the COG to determine the desired effect. *Step 5* is prioritising the COG and apportioning the air power assets available. *Step 6* is the identification of targets to achieve the desired effect. *Step 7* is to draft a Master Air Attack Plan (MAAP) based on the prioritised categories of air operations.

Categories of Strategic Air Operations

Strategic Air Operations are executed at the strategic level and are likely to be shaped by political aims and constraints with the aim to cause such a degree of paralysis/destruction or dissolution that the enemy loses the will or ability to continue the conflict.

SEE figure 3! Strategic Counter C⁴I sees the enemy's national command authority and national military-strategic leadership an attractive and natural target, if not *the* target or *the* COG. The desired effect is a strategic paralysis with a sense of futility and isolation. Strategic Counter Industry Operations (SCIO) are conducted against key industries with the effect that the enemy's ability to wage war will be aggravated by attacking electric power grid and oil drilling and refinery facilities. Strategic Counter Economy Operations (SCEO) are closely related to SCI operations but the desired effects are causing a collapse of the enemy's economy by attacking any form of economic transactions. Strategic Counter Transportation Operations (SCTO) are directed against vital transportation centres and transport means to prevent import and export of oil, weapons systems and the strategic transport of military forces. Strategic Counter Population Operations (SCPO) include information operations and psychological operations against the enemy population since ethics and international law rule out direct targeting of the enemy civilian population and supporting infrastructure. Strategic Counter Force Operations (SCFO) are conducted against those enemy forces and weapon systems, which have the ability to achieve strategic effect against our strategic COGs. Strategic reconnaissance, strategic air transport and strategic deterrence are also important at strategic level operations.

Operational Air Operations are executed at the operational level directed toward the enemy's military forces and the infrastructure supporting the military operations to attain the operational objectives within a designated Area of Responsibility (AOR). SEE figure 4! Operational C⁴I Operations are conducted as joint C²W against headquarters and units to degrade, disrupt or destroy the enemy's ability to orchestrate its forces at the respective level. Desired effects can be degradation, disruption, destruction, neutralisation, deception or psychological impact. Operational Counter Transportation Operations (OCTO) are against intra-theatre transport of the enemy's military forces, which cover lines of communication, transport of military forces and the supporting infrastructure, power distribution and transportation nodes, depots, Petroleum-Oil-Lubricants (POL) storage facilities and pipelines. Desired effects may be the delay or destruction of supply to military forces to prevent or slow down the enemy's military operations. Counter Air Operations (CAO) are to achieve air superiority to control the air, which is the prerequisite for joint military land, sea and air operations. The following degrees can be distinguished: Favourable Air Situation, Air Superiority and Air Supremacy. Operational Air Transport and Operational Reconnaissance are also important.

Tactical Air Missions include Counter Air Missions, which are conducted for the purpose of achieving the necessary level of control with the air. This involves destruction or neutralisation of enemy forces mostly ranging throughout enemy territory and generally conducted at initiative of friendly forces (fighter sweep, fighter escort, airfield attack, attacks against missiles or associated systems and suppression of enemy air defences. TAMs include Air Interdiction, Air Reconnaissance, Air Transport, Close Air Support and Tactical Air Support Maritime Operations.

5.14 Polumbo, Harry D.

Polumbo, Harry D. (Col.), *Effects-based Air Campaign Planning: The Diplomatic Way to solve Air Power's Role in the 21st Century*,
www.research.au.af.mil/papers/student/ay2000/affp/polumbo.pdf

Part 1 – Prologue

Operations Allied Force (OAF) was a significant out-of-area military operation by NATO, marked the most dramatic use of force by the Cold War alliance that served the European continent in the post WWII era. In OAF air force played a unilateral role in force application of the overall strategy to counter Milosevic's intentions and actions.

Part 2 – Introduction

Aerospace power has become a significant instrument of national power with its power projection capabilities to address security challenges around the world. Air power experts use Effects-Based Operations (EBO) construct to shape national interests and security objectives into specific military objectives and tasks. Since the international discussion focuses on intended and unintended effects, this construct of campaign planning must form the basis of the evaluation before, during and after the conflict.

Part 3 – Political Assessments ... Strategic objectives

Since aerospace power has the capability to strike immediately at the heart of an adversary's Centre of Strategy (COG) the strategy, objectives and desired end-state need to be clear and complete in order to effectively exploit the military advantage. Purpose of OAF were as follows:

- To demonstrate the seriousness of NATO's opposition to aggression and its support for peace,
- To deter Milosevic from continuing and escalating his attacks on helpless civilians by imposing a price for these attacks and
- If necessary, damage Serb capacity to wage war against Kosovo in the future by seriously diminishing its military capability.

The military objectives of the actions were to deter further actions against the Kosovars and to diminish the ability of the Yugoslav Army to continue those attacks. The implication of the first point is clear in terms of developing military objectives and tasks. The second and third point became critical for strategy development in this conflict. Important in developing the strategy was the degree to which to damage the Serb military and police forces to make them unable or unwilling to continue ethnic cleansing. The challenge was to develop a campaign plan that would result in a set of tasks that flowed directly from the purpose articulated by the leaders. Gen. Wesley Clark wore two hats as SACEUR and CINC USEUCOM and had the difficult task of co-ordinating planning efforts between US and NATO staffs, with a sharp disagreement between high-level military strategists. The *US plan* by Gen. Short and his planners believed the following target sets to be strategic (1) the power grid, (2) lines of communication, (3) bridges across the Danube, (4) six-eight command centres, (5) headquarters of the MUP and (6) headquarters of the VJ.

On the other hand *the NATO plan* focused on refinements of the diplomatic effort that had been unsuccessful in convincing Milosevic to change his own COA in Kosovo. The military objectives listed by NATO were as follows:

- Enable unhindered NATO Air Operations,
- Isolate VJ/MUP forces in Kosovo,
- Degrade combat capability of JV/MUP forces in Kosovo,
- Compel FRY leaders to withdraw their forces from Kosovo,
- Reduce FRY capability to conduct & sustain offensive operations.

NATO also stated that the campaign plan's strategy hinged on the three tenets:

- Enable operations by obtaining and maintaining air and information superiority,
- Pressure the FRY leadership by attacking high value targets throughout the battle space,
- Degrade FRY military capability to conduct offensive operations in Kosovo.

The list of actions Milosevic would have to take to end offensive operations, were defined in a British Ministry of Defence memorandum:

- Ensure verifiable stop to all military actions and the immediate ending of violence and repression in Kosovo,
- Withdraw from Kosovo his military, police and paramilitary forces,
- Agree to the stationing in Kosovo of an international military presence,
- Agree to the unconditional and safe return of all refugees and displaced persons and unhindered access to them by humanitarian aid organisations,
- Provide credible assurance of his willingness to work for the establishment of a political framework agreement based on the Rambouillet accords.

What was not clear to the military planners and commanders at this point in planning was the acceptable strategy to task guidance for execution of the campaign. The phased, incremental nature of the ultimate campaign plan left the air planners confused as to what effects their actions should have to the enemy's power base – there were some disconnects between strategic objectives and military objectives. The Allies did not start with clearly defined objectives of destroying Serbia's war potential, it was like the beginning of a punitive expedition. NATO was not going to achieve any decisive effects on the enemy's will to wage war against the Albanians. In fact, many argue the strikes actually encouraged Milosevic to step up the pace of ethnic cleansing since the price he was paying in the first few nights of attacks was not that costly. NATO leaders were eventually forced to re-evaluate the strategy they had chosen in phase one of OAF.

Part 4 – OAF Strategy Evolves

In order to realise political goals NATO planners needed stronger political resolve and more forces committed. But unfortunately the next phase still lacked clear guidance from political leaders on what actions needed to be taken to achieve desired effects versus just hitting more and varied targets. After recognising the limitations the strategy, OAF evolved and began to move closer to the classic US air campaign what Gen. Short proposed. Once the strategy moved to attacking important targets for strategic effects and stalking the VJ/MUP forces day and night, OAF ultimately achieved its stated goals.

However this movement toward achieving desired strategic effects happened very slowly and it was still difficult to achieve legitimate, concentrated and parallel effects even after the military leaders were given the go-ahead. Simply applying force against an enemy's military as a way of signalling "resolve" with punitive measures is an inefficient use of air capability. The campaign plan employed during OAF was anchored in an old way of thinking with attacking fielded military forces in an incremental, gradual manner.

Part 5 – If Not Overwhelming Force, Then What?

In the context that coalition forces are limited in using overwhelming force just to maintain integrity, the question is what level of force should be used to counter atrocities and crimes of the adversaries? The answer is the firm application of aerospace power, quickly and decisively at the strategic level of an adversary's system of support and power. These points of vulnerability are referred as COGs and they are the foundation for EBOs. Decisive guidance from civilian leaders should be provided by the military commanders to formulate strategies that articulate the desired effects needed to coerce the adversary into compliance with international law and order. Unfortunately fuzzy objectives and indecisiveness led to an ineffective first week of OAF. Maintaining the enemy ground forces in defensive positions might be the main effect required of the military planners – the only flaw was the limited number of allied forces available for this task. The concept of Parallel War in which a military attacks various targets simultaneously for achieving desired effects, was not practised in OAF. The current doctrine of overwhelming force is not politically viable all the time so we should consider maximum achievable force versus maximum possible force to ensure increased lethality to achieve devastating effect. The three factors of coercive operations are (1) escalation dominance, (2) threatening to defeat an adversary's military strategy and (3) magnifying third-party threats. Simply attacking certain targets deemed valuable to the adversary will rarely result in the desired end-state, let alone a cessation of hostilities. Civilian leaders and military commanders have both difficulties in predicting any outcome of specific military operations short of total annihilation. Logically, in dealing with less rational leaders the application of military force as a last resort must be decisive. Either overwhelming force must be used to quickly take control of the situation or begin with decisive attacks designed to cause immediate negative effects in the enemy's power base. Limited application of force with significant political restraint will not convince rouge leaders to stop anything

Part 6 – Restraining the Formidable Force

Being the preferred instrument for civilian policy makers, the military has had learn what operating in a politically charged, limited scale environment is like. Nevertheless there is a clear reluctance of leaders to commit US forces to battle without a clear, overarching strategy and guidance.

The significant political restraints in planning and executing the air campaign no doubt reduced the effectiveness of the military capabilities and increased the exposure to potent air defences for the allied aircrews. The reasons for political and military restraint were varied and complicated with the obvious requirement to maintain unity in the alliance and to minimise allied and civilian casualties, as well as collateral damage.

Military commanders and planners must determine both the positive and negative effects of destroying certain militarily significant targets deemed critical to the enemy's power base – with the inability to measure strategic effects accurately. Determining key COGs and desired strategic effects for military operations needs to be a collective effort and should not be left solely up to military planners and commanders. With this Effects-Based (EB) construct, aerospace power as a coercive instrument of policy will be used more effectively.

Part 7 – The American People's Role

For military operations of any kind clarity of mission, unity of command, robust ROE, political will and a well-defined exit-strategy as overriding imperatives are needed. Instead of focusing air power as a supporting aspect of the land campaign, air power proponents recognise decisive use of force by attacking COGs, employing EBO, neutralising the enemy's offensive capabilities, disabling his integrated air defence systems and protecting coalition capabilities. From this point of view a sustained air campaign is one that is designed to break the will of the enemy's leaders, incorporates elements that rip away critical assets, includes a dynamic element of surprise and overall contains the potential to shake up expectations and scares. In other words Effects-Based. Aerospace force's precision, lethality and flexibility make this element of military power a key component of any international crisis action of the future.

Part 8 – Conclusions

A thorough review of OAF reveals some significant problems with the grand strategy and COA selected by the allies. OAF reflected an intense desire to minimise civilian casualties, thus maintaining cohesion and stabilising Eastern Europe. Minimising collateral damage seems to be the norm – destroying selected targets while avoiding others in vicinity. EBO uses a strategy to task methodology which links violent attack on selected targets to achieving desired effects stated in the objectives. The explanations must be standardised and established in well-written doctrine, so terminology and definitions are the same for all participants in the strategy-building dialogue. Military planners must also develop EB campaign plans that can operate effectively in a politically restrained environment, that when military force is used, the strategy adopted must be EB, decisive and designed to produce a better political end state than existed before the war.

5.15 Steblin, Mark E.

Steblin, Mark E. (Lt. Col.), *Targeting for Effects: Is There an Iceberg Ahead?*, Air War College, Air University, Maxwell Air Force Base, Alabama, April 1997, www.research.au.af.mil/js/papers/display_abstracts.asp?guidelinks=1268

Chapter 1 – Introduction

Throughout modern history airmen contemplated grand visions of a decisive role for air power as the force to compel the enemy to do our will. The potential of the air is to take the battle directly to the enemy by using a new dimension.

The air campaign in Desert Storm was the fruition of the early theorists' ideas, with precision weapons making it possible to send a single plane and weapon against targets that once required massive formations of aircraft, dropping thousands of bombs to destroy. The improved capabilities in aircraft and precision munitions offer now a chance for air power to better support future joint strategy. Controlling the enemy through his systems means that it is now possible to target for effects instead of targeting simply for destruction. Key to the idea of controlling an enemy is selecting the right things, or systems to control. War is more about destroying or incapacitating things, as opposed to people. An Effects-Based (EB) strategy rather than an annihilation-based strategy, is controlling the enemy without having to destroy him. To realise this kind of warfare capabilities like flexibility and range are needed. Simply defined, an effect seeks to produce as a result, which can be generalised to be in control of an enemy to achieve the desired outcome. Well beyond destroying lies the ultimate purpose of war – to compel a result. This lends a different perspective to the most effective use of force. Destruction remains a key tool in the arsenal of an EB strategy, but it is not the only method of control (jamming can also render the opponents system useless). Effects-based thinking has the potential to offer significant leverage to our current and future forces by reducing the duration and force structure required to achieve the same objective. Altogether, an effects-based strategy as a part of a joint operation can add significantly to our air power and overall military capabilities.

Chapter 2 – The Strategy of Airpower: Destruction or Effects

Effects-based thinking is not new and evidence of it is found in the works of the air power theorists. The improved capabilities of air power can be seen both as a more destructive capability and as a method of exercising greater control to achieve the desired objective. *Douhet* believed that strategy depended upon the technical means of war available. Attacking vulnerable centres like cities, populace, transportation and commerce would lead directly to victory without engaging the enemy army. He sought air power for strategic effect through rapid shock followed by moral collapse. *Douhet* clearly attempted to control the things of value to the enemy nation and proposed the shock and fear of massive attack.

Mitchell thought that strikes against the enemy Centres of Gravity (COG) like manufacturing and food centres, railways, bridges and canals no longer would require the tedious and expensive process of wearing down the enemy's land forces. He demonstrated the importance of air power and the need for a separate air service. The *ACTS* believed that air power could break down the enemy's will to resist and the capacity to fight by destroying organic industrial systems which provided for the armed forces in the field and paralysing organic industrial, economic and civic systems that maintained life of the enemy nation itself. As a result of resources limitations during WWII targets were attacked in series. Multiple attacks were rarely possible and were reduced to a continuation of the series methodology over time. *ACTS* also attempted to identify service systems, which motivated or connected industries, rather than industries themselves. Vital targets included ball-bearing industries, oil and electric power. Unfortunately accuracy never allowed paralysis to meet the strategists hopes. While attempting to deny the enemy, the lack of precision led to a strategy causing multiple attacks. The *period between WWII and Desert Storm* is often incorrectly considered as a period of sheer nuclear deterrence. However the 1986 Libyan air strike showed the presence of an evolution in Effects-Based (EB) thinking.

The raid illustrated that sometimes the objective is simply to demonstrate national resolve and not destruction. The *Desert Storm* air campaign came from the capability to conduct multiple attacks and a strategy based upon effects. The air campaign framework advanced a new theory called parallel war, which comes from thinking of the enemy as a system and the characterisation of his system using a five ring model (leadership, organic essentials, infrastructure, population and fielded forces). Simultaneous and co-ordinated operations against all the key nodes in the system and in each of the rings are the essence of a new kind of offensive military campaign. Parallel war is the ability to attack the entirety of the enemy COGs simultaneously in a full spectrum and not just in a sequential pattern. With this approach we can achieve systemic effects rather than individual target destruction. The action to induce specific effects is the foundation of the concept of parallel war – a powerful exploitation of time and space.

Chapter 3 – The Parallel Evolution of Precision

One of the most important capabilities of air power is precision. The term precision and its application have undergone a remarkable change in the last fifty years. With the strategic thought evolving since WWI so did the capability of precision. An approximation for precision is the Circular Error Probable (CEP). As bombing accuracy improved, so would the CEP. SEE table on page 26! The key breakthrough was laser technology coupled with modular guidance units and stabilising fins. These new systems significantly improved the bombing accuracy. Although the accuracy of non-precision weapons also continued to improve over time, the capability of this new sort of weapons exceeded them by far. So while these new systems significantly improved the bombing accuracy, few looked to a new strategy for employment. Now this unprecedented capability of precision forms the fundamental pillar of parallel war and an EB strategy. Precision weapons reduced the number of assets required to destroy a critical target, thus making parallel war possible.

Chapter 4 – The Demonstration of Precision and Effect

The air campaign plan of the 1991 Gulf War had the aim to control the enemy. The plan itself identified 84 targets and 12 target sets originally, which then grew to 237 targets as a result of a significantly great knowledge of the Iraqi leadership and military forces. SEE table on pages 33 and 34! To better understand the EB strategy, some key factors need to be highlighted. The sensitivity of each of these factors to any strategy must be evaluated and thoroughly understood. Conditions established by military and civilian leadership can significantly impact results:

- *Intelligence* – means collection and use of intelligence information. It has become the critical input prior to the use of any precision munitions accuracy. Information helped select the target according to construction, size, aim points, Desired Mean Point of Impact (DMPI) along with determining the best type and quantity of munitions, as well as altitude and routes. Part of intelligence is the Battle Damage Assessment (BDA) process as a post-mission activity to determine the correct level of target destruction. Sources are imagery, mission reports and video recordings with timeliness and accuracy becoming critical attributes. Sometimes PGM penetrated targets leaving only a small entry hole, making bomb damage assessment nearly impossible to determine the amount of destruction within the target. The result was many unnecessary re-attacks against targets already destroyed.

Post-mission intelligence is even more critical when the specific task is not destruction but some other form of effects, such as deception.

- *Rules of Engagement (ROE)* – influence the selection of targets. A common ROE is for example the reduction of collateral damage or to avoid historical, archaeological, economic, religious or politically sensitive installations.
- *Aircraft sensor* – refers to the old saying that you can only hit what you can see. Weather restrictions are a significant problem. Even F-117s with PGMs are bedevilled by clouds, enemy gunfire, and pilot errors to miss with at least one bomb out of four, or more than that in one mission. The combination of weather and fears over collateral damage led to a requirement for visual identification of targets before weapon release, which impacted performance. A constraint imposed partly by ourselves and by variables we will probably never be able to control.
- *Weapon types* – means type of aircraft and weapon selected as an important factor since each weapon type offers its own constraints. Techniques like buddy lasing do not eliminate the atmospheric attenuation problems of weather, an obscuring factor that lasers and infrared sensors both have. Additional important factors for future multinational operations are the lack in precision delivery capability by partners and the shifting to higher altitudes to avoid anti-aircraft artillery.
- *Possible weapon failures* – are rare, but material failures sometimes can occur with disastrous results. This can be critical when collateral damage is a major criterion. A fin can always stick or weapon electronics fail.

Adequate preparation, planning and a clear understanding of the desired outcomes play a major role in each campaign's result. A template for future conflicts can be a greater reliance on airborne technology, precision strike and integrated planning with a de-emphasis of the military's ground role.

Chapter 5 – Clarifying Effects: Resources, Planning and Targeting

The current and future *resources* available to the planner directly determine what kind of EB strategy can be implemented. An effective campaign plan must extract maximum impact of weapon systems available. Current resources determine how many of the capabilities and limitations of a strategy can be accomplished today, while future procurements determine potential capabilities. Future weapons are designed to meet the primary requirements for increased standoff range and be smaller, lighter, more lethal and affordable – a rapid deployability and increased destruction at a lower cost. But thinking in effects highlights the need for weapons (maybe non-lethal ones) that allow for greater control rather than simply destruction of an enemy system. The second element is to determine where targeting is accomplished and who is responsible for EB *planning*. The Air Operations Centre (AOC) structure remains the primary location for planning activities. The centre is staffed by experts from each of the weapons systems, but there is no one trained specifically to look for effects options, which makes the current AOC structure ill prepared to support EB planning. The design of the Gulf War air campaign grew out of a mind set, questioning how to impose force against enemy systems. Although with this mind-shift every effort would contribute directly to the military and political objectives of the Coalition, the same Measures of Merit (MOM) were used like in Vietnam (the measure of efficiency).

Current training programs and targeting instructions offer little insight into EB planning, with no common language existing for effects across intelligence, planning and employment of units. The author of the thesis believes that parallel warfare does not support conflicts against non-state systems. A strategy not able to support all types of contingencies offers little help in the current environment. Since effects look not only at destruction but a variety of means to render control of the enemy, they should also be regarded as a means to develop methods to support the new types of conflicts, which we will engage. Since modern systems are extremely complex, there are three attack methods for *targeting*:

- Physical – achieved by conventional, nuclear or non-lethal weapons,
- Jamming – with a focus on particular links, messages or time periods to disrupt the network and
- Spoofing – which means injecting false information into the enemy's network to disrupt communication.

In general non-lethal technologies may be cheaper, more effective and less destructive than PGM. A holistic, systems approach is also essential for an EB strategy because of the interrelationship of many of the sub-elements of a nation's features, like infrastructure or population. But then the question of planning for adaptation, transformation and recovery rises.

Chapter 6 – Conclusions

In a true EB strategy, planners would not only be concerned with the number of targets they could attack in parallel, they would also look to all other means, including ways to actually reduce destruction. Threatening a target set is a form of effects if it gains control over the enemy. The full destruction of the target is not necessary, to render it inoperable is also enough. Theoretically dropping warning leaflets prior to every attack can also have an effect on the enemy to surrender. Interestingly the earliest theorists looked at effects but selected alternatives based on destruction. The fact is that still some campaigns will exceed the ability to strike all targets in parallel and some prioritisation must be accomplished. Control of the enemy command structure, civil and military, must be the ultimate aim of all military operations. For this we need the ability to apply selective force against specific targets and achieve discrete and discriminate effects. Unfortunately we know very little about other cultures and sometimes we do not know the importance of a target to the enemy.

5.16 Walker, Scott G.

Walker, Scott G. (Maj.), *Targeting for Effect, Analytical Framework for Counterland Operations*, School of Advanced Airpower Studies, Air University Press, Maxwell AFB, May 1998,
www.maxwell.af.mil/au/aupress/SAAS_Theses/WalkerScott/scottwalker.pdf

Chapter 1 - Introduction

In virtually every conflict in which air power has played a part, it has been used to some degree to attack enemy ground forces, with armies representing valid and vital targets. In today's environment of limited war, a field commander may well find himself restricted from attacking strategic targets deep within the enemy country. It may also be that an enemy army, more than his industrial base or infrastructure turns out to be his true Centre of Gravity (COG). Attacking the enemy's ground units has been a mission flown in almost every war since man's first flight. Earlier concepts such trench strafing and ground strafing grew into ideas of Close Air Support (CAS) and Aerial Interdiction (AI). The boundary between CAS and AI is not clearly defined in doctrines, though the term Fire Support Co-ordination Line (FSCL) is considered by many military professionals as the dividing line. For definitions based on Joint Pub 1-02, SEE pages 4-7!

Chapter 2 – The Field Army Described

To develop a practical analysis of how to attack an army with air power, we must first examine the various components that comprise such an army. According to US doctrines a modern army can be broken down into the following combat categories:

- *Infantry (Special Forces)* – comes in five basic types, light, airborne, air assault, ranger and mechanised. The difference is not how they fight but how they get to the fight, since they require some sort of transport. Light or foot slogging infantry uses unarmoured vehicles, air borne and air assault infantry are carried into battle by transport aircraft or assault helicopters. Ranger units are highly trained light forces capable of either special or conventional operations. Mechanised infantry is considerably heavier and fights alongside with armour, giving it the advantage of infantry cover without giving up mounted mobility and survivability.
- *Armour* – while not exceedingly fragile, tanks do experience a fairly high breakdown rate, particularly in the track system with a typically 2-20 percent breakdown rate per hour causing long repair times.
- *Artillery* – is the surface weapon that typically causes the greatest destruction on the battlefield, making it the first priority air power target. It is able to fire a variety of ammunitions and capable of inflicting various effects on the enemy. Artillery comes in two types, towed and self-propelled.
- *Aviation* – the helicopter is a significant enhancement to both tactical mobility and combat firepower. Many armies rely on helicopter lift.
- *Cavalry* – see infantry.

Support components are supplies of ammunition, Petroleum-Oil-Lubricants (POL), food and water. Targets that can be often attacked more easily than the combat units themselves. Command and Control (C²) includes both the physical command echelons of a ground army and the systems by which that echelon exercises command and gathers intelligence.

The same advantages and disadvantages discussed above for other tracked vehicles also apply to command vehicles. In addition their use of radio for communications makes them vulnerable to direction-finding equipment. Regarding disposition the army can be in offence, in defence and in reserve. The reserve, typically one third of the available strength is normally in the second echelon.

Defence is designed to hold territory against enemy attacks or at least to delay him while the bulk of one's army re-deploys to new locations. Offence is typically broken into two phases, the breakthrough and the pursuit phase. SEE table on page 17!

Chapter 3 – Attacking the enemy

For prosecuting successful ground attack operations, some level of air superiority above the enemy army must be established. This allows our forces to concentrate on their attacks without fear of interception by enemy aircraft or engagement by enemy surface-to-air defences. There have been several types of aircraft used for ground attack, with modern attack aircraft falling into categories like true multi-role fighters (F-18) and advanced training/light attack aircraft (BAe Hawk, Alpha Jet). The types of ground attack missions flown by fixed wing aircraft can be divided into interdiction, armed reconnaissance, pre-planned CAS and alert CAS. SEE text on pages 20-22! Regardless of mission type, the tactical problems of ground attack can be divided into four components. For a successful mission air power must:

- *Locate* – the problem of locating the enemy forces varies with circumstances and the type of missions flown. Environmental variables greatly impact the ability to locate targets. Moving targets also negate the use of pre-planned target co-ordinates, which makes most unmanned systems unusable against them. During location, a reaction of the enemy not to move can also be seen as a drawback since loss of movement makes detection much more difficult with kills going down.
- *Identify* – target identification is a greater problem with today's technology than target location. It is more important in order to avoid fratricide. As we continue to draw down into an ever-smaller force, we have fewer assets and must make every bomb and missile count, which requires prioritising our targets. At medium altitude where most modern ground attack missions are flown, even distinguishing an MBT from an APC can be difficult.
- *Target* – once identified, the target must be attacked. Air-delivered weapons cause effects through four primary mechanisms, blast, fragmentation, cratering and combustion. Results can be divided into mobility-kill (m-kill), firepower-kill (f-kill) and catastrophic-kill (k-kill). Although achieving even k-kill is much easier with PGMs, the Gulf War showed that 5-20 percent of them missed their target.
- *Assessment* – following attacks we must determine how effective the attack was. This occurs at the tactical level Battle Damage Assessment (BDA) and at the operational level.
Operational level assessment is a more difficult task (i. e. measure the percentage of supplies successfully interdicted or to determine how responsible air attack is for enemy reverses on the ground).

If we see the *desired effects*, we can see that air power can *divert, delay, disrupt or destroy* ground forces. In general terms there is a relationship between scope, scale and time of the effects of air attacks. There is also a relationship between direct and indirect attacks. Direct attacks result in fairly predictable, linear outcomes. The effects of delay and disruption often are interrelated, as forces that arrive late may be thrown into a battle piecemeal and units that are disrupted are less likely to keep to their marching schedules.

Attacks on LOCs will have indirect effects on the supplies themselves, which in turn will have an indirect effect on the combat units. SEE table on page 31! For specific vulnerabilities SEE pages 32-36! There is a synergy between physical and moral decay. Troops that were in the worst physical condition were often the first to surrender. As a generalisation we can say that an increased strain on the enemy's logistics will also cause morale decay as the enemy feels pressure from both the ground and the air. Severe losses can build adverse morale effects.

Chapter 4 – Synchronising Air and Ground Forces

One of the key factors in ground attack planning is ensuring that the right targets are hit at the right time to support the overall strategy. Both air and ground forces can support each other to more effectively defeat the enemy. If we trace back the origin of this phenomenon we find concepts like

- *Deep battle* – by Marshal Tukhachevskii, who advocated that aviation, airborne infantry, armour and motorised infantry would co-operate to penetrate into the enemy's rear echelons by breaking in, isolating and co-operating.
- *Blitzkrieg* – is also a concept of combined arms warfare with a similar focus on supporting ground manoeuvre with air power. It combined deep, rapid armoured thrusts with fighter and bomber support relying on speed and surprise to keep the enemy from reacting. Also important aspect of it was the emphasis on innovation by lower echelon commanders.
- *AirLand Battle* – describes an emerging doctrine that promotes joint operations across the spectrum of deep, close and rear portions of the battlefield. The main theme of it is that events all across the battlefield influence one another.
- *Current doctrine* – according to FM 100-5 the deep battle is designed to nullify the enemy's firepower, disrupt his C², destroy his supplies and break his morale. Deep operations enable friendly forces to choose the time, place and method to fight the close battle.

The Army doctrine defines the offensive in two different ways, attack (which can be hasty, deliberate, spoiling and counter) and manoeuvre (envelop and encircle, turning movement, penetration and frontal attack). For defence there are two forms, area defence and mobile defence.

Chapter 5 – Case Studies

Not that important but, SEE pages 45-66!

Chapter 6 – An Analysis Framework for Counterland Operations

The framework exposes the air power strategist or student to the key considerations for using air power to *destroy*, *disrupt*, *delay*, *divert* or *demoralise* enemy ground units. Good planning must begin with national level objectives and work the way down through congruent military and theatre objectives and strategies. Planning factors can change as the enemy adapts to the fighting or new intelligence comes to light. The co-ordination of air and surface components is required for true combined arms effects. Air power effects are best used when concentrated at a few key points. The true goal is a single, unified strategy to be developed, from which all of the desired operational effects can be derived. At an operational level quality intelligence becomes extremely important and remains so throughout the rest of the process. A consideration to keep in mind is whether the desired effects are first, second or third order. Time and tempo must also be considered and as the campaign develops, we must perform critical combat assessment.

Once the critical target set has been identified, we must look at matching target vulnerability with weapon lethality. As new methods of detecting, identifying and relying information about the enemy mature his vehicles and combat forces are becoming more viable as direct targets. We are becoming less reliant on the secondary and tertiary effects of hitting fixed infrastructure, which means ground attack results are becoming more predictable and targeting decisions can be made near real time.

5.17 Conclusions

Effects-Based Operations have changed the way air force is regarded in modern militaries entirely. It is not limited to the role of provider of services anymore and has become a powerful instrument with the potential to decide on the outcome of conflicts. Stealth and precision are originally operational level advantages but in mass they directly contribute to the strategic result. Air forces unique capabilities are known and exploiting future advancements in military technology will probably mean that modern Western airplanes can practically become invulnerable in the near future. With this quality the long sought air supremacy can be established, which give a truly asymmetric advantage to friendly forces.

Airplanes applied in a thoroughly prepared systemic approach can bring the battle to the vulnerable centres of the enemy thus saving life and resources. With redefining mass and military presence, air forces of the future can project power over long distances to anywhere in the world within a very short period of time. This unique capability opens a new horizon for conflict prevention and extends the possibilities for coercive diplomacy. EBO has also the potential to step penetrates into other services and become a joint guiding principle as it will be shown in chapter six.

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www.maxwell.af.mil/au/aupress/SAAS_Theses/WalkerScott/scottwalker.pdf

6. Dominant Effects, Effects-Based Joint Operations, Effects-Based Planning and Long Term Military Planning

6.1 Introduction

The effects-based approach seeks to understand, trace and anticipate the ways direct, physical actions produce indirect behavioural effects that accumulate to achieve the overall objectives. Effects-Based Operations not only explicitly link actions to desired strategic outcomes, but they also focus on the entire continuum of a conflict. Based on its non-domain specific nature, EBO apply across the full range of military operations.

Stealth and precision were the technological driving forces for EBO within the framework of the air force. The basis for a joint EBO could be the high performance, wide-area airborne ground surveillance systems. This technology offers an unprecedented ability to see and target enemy ground systems over a large area from a significant distance in all-weather conditions. It enables an easy location, identification and destruction of nodes that either support or constrain enemy movement. The idea behind the extension of EBO to a joint concept is that strategic air and missile attacks can sometimes be sufficient by themselves to contribute to military victory, but an over reliance on the air force and the supporting technology can be dangerous. Joint EBO can apply land forces by reducing the risk of casualties, because it decreases the land forces needed and diminish the close-combat requirement.

A joint effects-based approach has the potential to increase the strategic options to achieve success faster, more efficiently and with less risk. Its ultimate result is a kind of virtual attrition, in which enemy soldiers will not risk vehicular movement. Joint EBO is paralysing the enemy on a large scale. The concept of Dominant Effects builds upon the unique characteristics of EBO and regards it as a basis for joint military operations. In the construct of DE, EBO is a set of military actions designed to produce distinctive and desired effects through the application of appropriate movement, supply, attack (including fires), defence and manoeuvres. The concept focuses on functional, systemic and psychological effects well beyond the immediate physical result of a tactical or operational event. The focus of DE is upon various types of effects that transcend the immediate physical, because the real objective in EBO is often to create higher-level psychological effects. DE focus on the four operational concepts of American Joint Vision 2020 (JV 2020) on creating desired effects to achieve full spectrum dominance. Effects have also the potential to step out of an operational level force application concept and become the basis for military planning activities.

An effects-based approach in this context represents an attempt to find an unequivocal and compelling metric that can be used to make argument over weight of effort in strategic planning, force structure and budget, the very areas of the Long Term Military Planning Process. Since effects can be seen as a force multiplier, thinking in effects allows for more differentiated and accurate force planning.

6.2 Batschelet, Allen W.

Batschelet, Allen W. (Lt. Col.), *Effects-Based Operations: A New Operational Model?*, U. S. Army War College, Carlisle Barracks, 09 April 2002
www.stinet.dtic.mil/cgi-bin/fulcrum_main.pl

Proponents of Effects-Based Operations (EBO) say that instead of annihilation and attrition this new approach focuses on generating desired effects rather than focusing on objectives or the mere physical destruction of targets.

Defining Effects-Based Operations

According to *J-9* EBO is a process for obtaining a desired strategic outcome or effect on the enemy through the synergistic and cumulative application of the full range of military and non-military capabilities at all levels of conflict. They define effect as the physical, functional or psychological outcome, event or consequence that results from specific military or non-military actions. EBO is rather a process (EBO-cycle) beginning with:

- Developing a knowledge of the (1) adversary, who is viewed as a Complex Adaptive System (CAS), (2) the environment and (3) own capabilities,
- This knowledge enables the commander to determine the effects to be achieved to force the enemy to change his behaviour,
- Based on the identified effects it is to create a co-ordinated and synergistic operation that will produce those effects desired,
- Continuous assessment must measure and evaluate the impact of the desired effects (i. e. military actions achieved the desired effects, produced unintended effects, overall impact of the effort),
- Continuous assessment of the enemy, our military and political actions and if needed adjustments in the course of action in order to reach the desired end-state.

Deptula thinks that there is a fundamental change in the nature of warfare, with the conduct of warfare has changed to parallel warfare with simultaneous attacks against all the enemy's vital systems. This warfare requires precision weapons and the ability to suppress enemy air defences. The operational concept behind focuses principally on effects rather than only on aggregate destruction to achieve military objectives. He views destruction as a means to achieve control over the enemy (destruction should aim at achieving effects on enemy systems with preventing its intended use as he desires). With EBO commanders achieve the desired effects through the successful application of force to gain control of systems on which the enemy relies. *Institute for Defence Analyses* argues that EBO rest on an explicit linking of actions to desired strategic outcomes (it is thus about producing desired futures). EBO focuses on the entire continuum and not just on conflict.

The enemy has to be regarded as a complex, adaptive system driven by complex human interactions rather than just collections of physical targets. EBO is a continuous process of analysing, understanding, planning, executing, assessing and adapting which has seven attributes:

- The need to focus on decision superiority,
- Applicability in peace and war (full-spectrum operations),
- A focus beyond direct, immediate 1st order effects,
- An understanding of the adversary's system,
- The ability of disciplined adaptation,
- The application of the elements of national power,
- Ability of decision-making to adopt rules and assumptions to reality.

Common grounds shared:

- Importance of knowledge of the enemy as a complex system and knowledge of self,
- This knowledge enables commanders to think in terms of outcomes expressed through intents,
- It allows to determine the tactical actions to accomplish objectives and desired outcomes,
- The focus is on achieving an effect rather than destroying a target,
- The commanders intent has an integrative role,
- Continuous situational assessment measures success or failure.

EBO represent the identification and engagement of an enemy's vulnerabilities and strengths in a unified, focused manner and uses all available assets to produce specific effects consistent with the commander's intent. It is an execution of joint operations in a unified, holistic approach (see the six theatre objectives by Gen. Schwarzkopf). EBO can produce the most efficient and effective way to employ force, achieve the commander's intent and increase flexibility and responsiveness, by freeing up scarce assets for use elsewhere.

Conceptual implications

- Effects-Based Operations enable us to think in terms of desired outcomes and the importance of using all available assets.
- Place more emphasis on understanding the enemy and determining the linkages between cause and effect.
- Demand greater capability to assess and adopt to the vagaries and unknowns of warfare.
- Offer the potential to improving our ability to achieve desired effects through a more holistic and systematic approach to planning, executing and assessing results of military actions across the entire spectrum of conflict.
- Incorporate all the applicable elements of national power for a given situation and is relevant across the full spectrum of operations.
- Require commanders and staff to link tactical actions to operational objectives and desired strategic effects.
- Include predicting, controlling and achieving desired effects and the understanding that that goal is not always achievable.
- Do not focus exclusively on using target destruction to achieve desired effects and outcomes.

- Provide a powerful, unifying and holistic conceptual methodology that commanders and staff can apply to all operations across the spectrum of conflict.

6.3 Bingham, Price T.

Bingham, Price T., *Seeking Synergy, Joint Effects-Based Operations*, Joint Defence Quarterly, Spring 2002, www.dtic.mil/doctrine/jel/jtg_pubs.1030.pdf

The Pentagon is making a very significant paradigm shift by moving from a threat-based strategy toward a capabilities-based strategy, which could quickly and substantially enhance its war fighting posture by focusing on defeating fielded land forces. This is possible if commanders are prepared to exploit unprecedented airborne ground surveillance and precision targeting technologies. Joint Effects-Based Operations (JEBO) is the integration of precision air and missile attacks with surface manoeuvre in dynamic ways in order to exploit the synergistic effect of joint war fighting.

JEBO emphasises on exploiting movement and human factors (fear, fatigue and uncertainty) to achieve quick success in land operations. It also enables faster defeat of land forces using fewer assets and risking fewer friendly military personnel and civilians. It derives its paradigm shift from the fact that today all armies depend on vehicles to move units to the battlefield as well as on the battlefield.

Following Every Move

Recent advances in persistent, high performance, wide-area airborne ground surveillance using Ground Moving Target Indicator/Synthetic Aperture Radar (GMTI/SAR) sensors and tool-sets are fundamental to joint EBO. These new technologies offer an unprecedented ability to see and target enemy vehicles over a large area in all-weather from a significant distance, which makes it easy to locate, identify and precisely target nodes that either support or constrain enemy vehicular movement. With the information made possible through the integrated employment of manned and unmanned sensors, commanders can treat the enemy as a system, which depends on movement and vehicles. They can exploit the real-time information on vehicular movement with extremely destructive precision air and missile attacks by forcing the enemy to fight like a 19th century army without the advantages of mechanisation. Equally important is that US air forces can conduct surveillance and precision attacks beyond the reach of non-radar guided surface-based air defences with friendly forces still having the advantages of vehicles and movement.

The Fear Factor

The potential of joint EBO to transform land warfare has emerged only recently with GMTI/SAR providing precise information on vehicular movement. Technologies recently developed make it possible to have Affordable Moving Surface Target Engagement (AMSTE) contact to maintain track identification and guide the ammunition via data-link.

Although precision weapons make joint EBO far more efficient and effective in destroying targets, they have also the ability to create a powerful perception of danger and sufficient fear. Modern technology makes it possible to create and sustain sufficient perception of danger to stop most vehicular movements even in darkness and poor visibility.

Apparent Advantages

The reason why land forces are essential is that their presence requires an enemy to employ large number of vehicles, which are vulnerable to detection and precision engagements. The manoeuvre of friendly and own land forces cause an enemy to manoeuvre and mass units. Developments in ground surveillance and precision attack can reduce friendly land force casualties. Commanders can avoid high-risk close combat except when their forces possess overwhelming advantages and such combat is essential. With wide area GMTI ground surveillance information medium weight units can prevail at low risk over heavier, more numerous opponents. The capacity to conduct joint EBO will increase deterrence and help quickly defeat enemy land forces while minimising friendly casualties. Strategic air and missiles attacks can contribute and sometimes be sufficient, but the US usually cannot rely only on those.

Joint EBO can apply land forces by reducing the risk of casualties. Another benefit is the smaller number of air and land forces necessary to prevail, which saves deployment time and needed support. These reductions decrease the requirement to forward deploy large forces for quick and effective threat to response. There is no need to depend on large, vulnerable bases.

Doctrinal Failures

Joint EBO is technically feasible and affordable in the near term, because the paradigm shift relies on existing technologies. It lessens the number of land forces needed and the diminishing close combat requirement also allows these forces to be lighter. Joint EBO needs to be institutionalised to create synergies through the integrated employment of forces provided by the various services. This needs the establishment of fully manned and trained joint force headquarters prepared to conduct joint operations. Doctrines need to be revised, not to be focused narrowly on equipment and training requirements that hamper interoperability and powerful joint war fighting synergies.

Other Concerns

A challenge for joint EBO is the need for joint training that is more realistic and conducted in more demanding terrain and weather. Another challenge is to integrate land and air operations more dynamically by knowing that human factors like limited span of control and the frictions of war will still be an impediment. Perhaps the biggest challenge is the requirement for a fundamental change in the war fighting focus of personnel. Joint EBO requires that

- Air Force leaders no longer assume that defeating the enemy by strategic attacks will usually be the best use of air power and
- Army leaders rethink the assumption that close combat is the only way to defeat opposing land forces.

The success of the concept depends on recognising that making air attacks the initial and sometimes primary lethal means of preventing powerful land forces from conducting effective operations.

6.4 Bingham, Price T.

Bingham, Price T. (Lt. Col., Ret.), *Transforming Warfare with Effects-Based Joint Operations*, Aerospace Power Journal, Spring 2001, www.airpower.maxwell.af.mil/airchronicles/apj/apj01/spr01/bingham.pdf.

Effects-Based Joint Operations (EBO) will transform warfare by using a theatre team of C²ISR systems to manage the decentralised execution of US aerospace sorties for targeting enemy land forces.

Key to the transformation will be the use of friendly land manoeuvre to support this asymmetrical engagement of enemy land forces. EBO will increase strategic options by permitting US personnel to achieve success faster, more efficiently and with less risk than it is possible in operations that depend primarily on physical attrition and the close battle to defeat enemy land forces.

Importance of the C²ISR Team

The C²ISR team's battle-management capabilities make it feasible to achieve the functional effect of paralysis by targeting air attacks against machines operated by the enemy. C²ISR enhances US expeditionary capabilities by dramatically reducing or eliminating the need for US land forces to engage powerful enemy army units in close combat in several ways:

- Air attacks make it possible to halt powerful enemy units before they can move close enough,
- Air attacks create an important manoeuvre advantage for own land forces by allowing them to avoid close combat in other than ideal conditions (rough terrain, adverse weather),
- It provides real-time information needed to manoeuvre own land forces most effectively.
- Achieving and Exploiting Dominant Battle-Space Awareness (DBA)

The C²ISR team achieves dominant battle-space awareness by exploiting an army's dependence on movement and machines, which play a central role in modern land warfare. C²ISR sensors see machines in real-time whenever they move, even in darkness and adverse weather.

Why DBA Makes Transformations Possible

DBA makes transformation possible by rendering obsolete an assumption that close combat should play the major role in the defeat of enemy land forces by making information on the location of enemy army units reliable or even precise. During history without reliable information on the opposing armed forces, commanders often depended on close combat to determine an enemy's location, strength and intentions.

The Role of Danger and Jointness in EBJO

Conducting EBJO require that the Joint Force Commander (JFC) directs the Joint Force Air Component Commander (JFACC) to employ precision engagements to paralyse the enemy land force and its ability to engage friendly land forces in close combat. In this case the desired effect is an enemy force whose soldiers will not risk vehicular movement. A persistent vehicular paralysis has the advantage of allowing component commanders and their staffs to assess quickly and reliably the success of precision engagements that target this movement.

This again has the effect of causing enemy forces to attempt rapid and massive vehicular movement, which increases its vulnerability to air attacks. After the combination of precision engagement and manoeuvre has achieved the degree of paralysis and dispersal of enemy forces that will provide friendly land forces with manoeuvre dominance, enemy units would become vulnerable to being bypassed or defeated in detail.

Airborne Battle Management (ABM) and EBJO

The success of EBJO depends on Airborne Battle Management (ABM), which starts with a dynamical prioritising of targets and pairing weapons with targets, based on changing conditions created by vehicular movement and weather.

6.5 De Wijk, Rob/Osinga, Frans

De Wijk, Rob/Osinga, Frans: *Effects Based Force Planning, Towards the air power capability Europe needs, A proposal for an innovative integral approach for force planning*, Clingendael Institute of International Relations, The Hague, August 2001,

Introduction

NATO and the EU are increasingly facing problems in formulating well-defined and logical methods and concepts for force planning activities. A capability based planning has limitations because it tells little about the quantity or the quality of forces required. A new approach on force structuring is the one, which is based on desired effects or outcomes. Following assumptions underlie this:

- Armed forces must be structured as expeditionary forces capable for projecting power over large distances without limitations regarding sustainability,
- As national units will be deployed as part of multinational forces, modularity is key to successful force planning,
- Force planning must be driven by the desired effects deployed forces are most likely tasked to achieve,
- Force planning needs to focus on issues of force structuring as much as it needs to focus on capabilities.

EBP requires two distinct but related sets of analytical steps, the first relates to the needed capabilities, the second to structuring of forces to the capabilities (matching force requirements with organisational structure):

- Define characteristics of future *operational environments and objectives* -> define the characteristics of an expeditionary armed forces -> define the typical nature and range of *desired effects* -> define functionality and capabilities required for achieving the desired effects,

- Define a Standard Force Package (SFP) that has the organic capabilities and functionality to generate sufficient organic power -> define additional Specific Capability Forces (SCF) to support, augment or sustain the deployed SFP -> use operations research on scenario analysis to define the exact composition and number of SFP and SCF.

The outcome is a new way of organising air capabilities and units into identifiable and more effective forces which will also make actual and required capabilities transparent.

The conceptual challenge

Although there is uncertainty regarding the future operational environment, the current context for military operations and long range force planning is characterised by the following:

- Forces will have to operate in remote areas,
- There will not be an identifiable threat with little infrastructure,
- With varying degrees of existing C² arrangement,
- With or without coalition partners,
- For a wide variety of tasks, missions and desired effects,
- With decreasing or stagnant defence budget,
- With decreasing numbers of platforms,
- Operational risks derive from combination of low and high tech, from conventional and unconventional types of warfare,
- In combination with demanding climates and geographical restraints,
- With simultaneously increasing demands deriving from political and public scrutiny.

Air forces need to perform a wide variety of tasks and functions in unforeseen contingencies, geographical locations and adversaries. Good inputs for the planning process could be the scenario based planning, the portfolio approach and the hedging method. This new planning concept should not only answer the capabilities and technology of the future but also incorporate current capabilities and force structures. The planning efforts must result in capabilities in terms of systems, processes, organisational structures and doctrines that can successfully execute NATO tasks and missions in the future. We know what effects (or objectives, tasks, missions) we generally want to achieve at various levels. Effects are more specific than missions or objectives and they are intermediate. SEE figure on page 7! Thinking in effects allows for more differentiated and more accurate force planning. It is a conceptual force multiplier but not an excuse for further force reduction. If married to mission based task forces we can discern the contours of a new planning concept.

EBP in Europe

We should start with defining the purposes or spectrum of missions European military forces are likely to face. Departing from this we can identify certain effects to be achieved. These include physical destructive, non-physical non-destructive, psychological, temporal, military tactical and strategic level and political effects. The spectrum of missions are support and sustain, observe and inform, protect and preserve, deter and dissuade, signal and coerce, delay and degrade, dominate and defeat and secure and stabilise.

SEE figure on page 9! Forces need to be able to provide geographic reach, agility and escalation control to manage low level coercion and crisis. SEE figure and text on page 10! The premium is on long range, responsive, precise and secure capabilities.

Capabilities and structures

The basic concept is that core forces and specific capability forces should be balanced. Several standing units form the nucleus and few specific capability forces provide either the scarce capabilities or augment according to the operation's demand. The core forces should be rapidly deployable, self sustaining, standing, with organic capabilities and logistics, having fighter aircraft, reconnaissance and surveillance systems, C² facilities, deep strike capabilities, some SEAD/EW capabilities, base security forces, organic GBAD capability, preferably organic AAR, AWACS and AGS capability.

Force Planning and the structure of European air power

Thinking in EBO allows for identifying certainty among uncertainty. Effects are what the political level wants military forces to achieve and effects can be identified in scenario analysis. Thus we can organise forces into effective packages which can respond quickly to a wide range of demands. They provide opportunities for capability development and creates incentives and sponsorship for specific capability development. For achieving the results three types of scenarios are proposed: Peace Support, Peace Enforcement, Major War.

6.6 Gleeson, Dennis J. et. al.

Gleeson, Dennis J. et. al., *New Perspectives on Effects-Based Operations: Annotated Briefing*, Institute for Defense Analyses, Joint Advance Warfighting Program, June 2001, www.stinet.dtic.mil/cgi-bin/fulcrum_main.pl

A New Context for Military Operations

An Effects-Based (EB) approach is about producing desired futures. EB thinking focuses on the entire continuum and not only on the conflict itself. Future contingencies will be complex and will require a focus on a broad spectrum of effects. The US is likely to be involved in asymmetric conflicts, which vastly complicates setting objectives, willingness to sacrifice or inflict casualties and the readiness to commit national will and resources. Future operations will be knowledge-based and information driven. Information superiority is only the enabling step to decision superiority. EB thinking allows future commanders to exploit the overwhelming amount of data provided by robust Information, Surveillance and Reconnaissance (ISR) assets. The understanding of winning the war and winning the peace requires an understanding of second-, third- and higher order effects. By learning to understand and model an adversary as a Complex Adaptive System (CAS) driven by complex human interactions makes possible to focus operations more coherently. EB thinking is the critical enabler for emerging new capabilities such as precision-guidance, networked ISR systems and stealth. It holds the potential to maximise the possibilities of new levels of precision. Clearly, new technologies and capabilities like stealth, precision munitions and information operations will require an EB approach.

Description of Effects-Based Thinking

EB thinking emphasises:

- The importance of linking all actions (political, diplomatic, economic, military) to operational and strategic outcomes,
- Continuous assessment of the effect and adaptation,
- Thinking about the implications and operations in terms of their second-, third- and nth order effects,
- Thinking about the implications and consequences of effects over time.

EB thinking rests on a foundation of assessment and adaptation at all levels of warfare and with all Elements of National Power (ENP). It requires an explicit and comprehensive linking of all actions to operational and strategic outcomes. Fog, friction, ambiguity and uncertainty will continue to characterise the arena of all human conflicts. Adversaries will do their best to avoid defeat. They will react and adopt and seek to move the conflict to arenas where they have the advantage. This means assessing the operations to the actual realities of the conflict. Effects-Based Operations (EBO) are appropriate at all levels of war. EB thinking can enable the joint force to move away from solely destruction- or attrition-based warfare towards a more efficient and focused application of force. It requires planners and commanders to understand the enemy as a complex, adaptive system of systems, with linking strategic outcomes to desired effects and to military actions.

Three Discourses Required for EBO – Turning EB thinking into EBO will require uncommonly rich interactions between the operational-level commanders and the other key actors in campaign. Centres of Knowledge (COK) assist in (1) understanding the strategic operational environment, (2) identifying possible effects and their impact, (3) suggesting measures of merit or metrics, (4) reassessing their models of the adversary.

Attributes of EBO – EBO are a continuous cycle or process of analysis and understanding, planning, execution and assessment. It uses powerful tools like precision engagement, dominant manoeuvre and information operations.

What EBOs are not – throughout history, capable commanders and planners have tried to plan and execute EB campaigns. EB thinking is not new, but extraordinarily difficult to implement. It depends heavily on understanding the enemy's value system, beliefs and culture, as much as it depends on modelling physical nodes such as power, water and information infrastructure. Planners could maintain and continue to exploit information advantages throughout the conflict. US military thinkers are often guilty of mirror imaging, projecting their own values, culture and perspectives on adversaries. But commanders need to understand what is important to the enemy. *From Rules-Based and Assumption-Based Thinking to ... EBOs* – Military planning starts with rules and assumptions and virtually no plan survives contact with the enemy. The key to success in conducting EBO is to have the ability to assess and adapt.

Why Effects-Based Operations Are So Difficult

Four categories of effects were examined: desired effects on capabilities, desired effects on decisions, undesired effects and unexpected effects. It was concluded that the desired result of an EBO is to change the enemy's action, not his will.

We cannot count on adversaries changing their cultures, mindsets and bad feelings about the US. The desired effects on enemy capabilities are those that result when Blue forces change the situation and options for an enemy by affecting the enemy's current capability. Desired effects on the enemy's decisions aim to change the enemy's assessments of the situation as well as possible options. These actions attempt to deter or coerce, and depend on the enemy's reaction to blue's actions. Undesired effects are usually easier to recognise after the fact than to predict. Effects on the enemy, allies, neutrals and US public or political leaders can be undesirable. Unexpected effects resulting from fog of war or chance constitute the final category. Unexpected effects could interfere with desired effects on enemy capabilities and enemy decisions. *Effects and Time – Timing of Effects* – There might be one assessment of effects immediately after an event and that assessment may change over time as trends occur or indirect effects become clear. Effects combine in unique fashion, often depending on the timing of the actions that result in effects. The goal should be the right timing and synchronisation of actions and resulting effects. Despite extensive planning and deep thinking about the many variables of time and effects, uncertainties will remain. *Historical Perspective* – Even military campaigns that rest on EB thinking have been extraordinarily difficult to execute because the enemy is a CAS of systems that will change and transform itself when confronted by our actions. The most important attribute of EBO is the capacity of military organisations, planners and their commanders to alter and adapt their assumptions and rules when confronted by the realities of the battlefield.

What history suggests – Most campaigns have remained rules based or assumption based, for various reasons. (1) Commanders and staffs fail to adapt to reality, (2) they often rationalise away or ignore indications and warnings that contradict expected outcomes, and (3) commanders in the past had little ability to perform real operational level assessment and adaptation. Clausewitz was right: action and outcome have a complex relationship that is not linear.

Current US-Capability to conduct EBO – While US forces have superb capabilities for finding and attacking many types of an enemy's military capabilities and their supporting physical infrastructure, there are many physical targets that are still difficult to destroy or neutralise. US forces are better at planning and executing than analysing and understanding effects over time and effects on other than immediate military targets. They are not proficient at understanding enemy assessment, at analysing and understanding effects over time or assessing the effects. US forces are better at planning and executing destruction and attrition based missions than anticipating the undesired effects caused by that destruction.

What might be possible with EBO – EB thinking might lead to quicker, less costly mission accomplishment at a lower cost in lives. Planning and operating in an EB fashion should result in campaigns with greater coherence and clear linkage between strategic goals, operational effects and tactical actions. EB thinking sends a clear message that US joint forces are agile, adaptive and willing to change plans and actions to ensure that they adapt to battlefield conditions and contribute to the desired outcomes. There must be a clear linkage between actions, effects and desired strategic outcome. EB thinking is the filter and linkage between information superiority and decision superiority.

Metrics for EBO are not yet clearly defined, nor are these metrics clearly understood. In summary what is easy to measure is probably not appropriate, while what is appropriate is not easy to measure. *Potential implications* – EBO are the result of a different way to think about war and strategy. It would require:

- A new way of thinking about the organisation and integration of ISR systems,
- Maybe materiel changes,
- Changes in training, doctrine and education,
- New organisational and leadership culture.

6.7 Henningsen, Jacqueline Dr.

Dr. Jacqueline Henningsen, *A Dialogue on Analyzing Effects Based Operations (EBO)*, lead, SES, MORS Fellow of the Society, Director Air Force Studies & Analyses Agency, www.mors.org/publications/phalanx/mar02/Lead2.htm

Maj. Gen. Dean Cash – EBO is a new way of thinking about conflict resolution and the application of force, which allows us to achieve an end-state of dissuasion. The EBO concept has a profound impact on other concepts such as Rapid Decisive Operations (RDO), but in the context of EBO rapid is perhaps not the right modifier or metric. It was better if we had said that achieving the desired effects means an appropriately timely manner, as opposed to rapid actions.

Mr. Hawley – what is needed now on the threshold of the 21st century is a new way of fighting in response to a wide range of more unpredictable and shrewd adversaries that will confront us in the future. EB analysis plays a central role in meeting this challenge to the military and to think differently about conducting operations in the future. American military needs to be better prepared for these unpredictable threats by adopting new ways of thinking and new ways of fighting. Future adversaries will increasingly have access to a variety of Weapons of Mass Destruction (WMD) and some may threaten the American homeland. The military's most serious deficiency in today's force is that it is not capable to deal with an adversary, who is unforeseen by defence planners today and whose actions will likely be very unpredictable in future crises. Unexpected and dangerous adversaries must be dissuaded, deterred and defeated. The traditional US strategic approach to crisis prevention and response is a strategy of coercive diplomacy designed to successfully confront an adversary. Success in coercive diplomacy requires that policy-makers have a range of options in hand that can effectively dissuade, deter or compel potential adversaries from taking action. In the future the US must use all instruments of national power to reduce or contain these potential adversaries through persistent and effective coercion, which obviously calls for better intelligence capabilities. There is also a need for flexibility in a crisis with effective options and realistic choices for both prevention and response to resolve a crisis in the best terms. All tools of national power must be available to change an adversary's thinking, including diplomatic pressure, legal actions, military coercion, law enforcement, covert operations, financial sanctions and whatever else that can be brought to bear effectively. In this regard EB analysis is a new approach by seeking to forecast how a defiant adversary would respond to a range of US coercive actions – both military and non-military measures.

The central question in an EB analysis is how would an adversary react if the US were to take specific actions? Unfortunately the effects of most instruments of national power are difficult to forecast precisely. An EB analysis using a system-of-systems approach can help understand patterns of behaviour and the dynamics of coercion in complex crisis situations.

Maj. Gen. Deptula – EBO is in fact not new but it requires a major shift in thinking. Astute military leaders have always known that superior alternatives to attrition existed, though EB strategies and tactics were rare occurrence and employed by what were later called military geniuses. But things have changed and the advent of stealth, precision and global surveillance provides a more consistent platform from which the strategist can employ an effects-based approach. Given this overwhelming asymmetric advantage, there is no need to wait until a military genius is born. With educating EBO, no longer must the achievement of an EB approach be the purview of geniuses or a random chance. We can now systematically pursue the maximum strategic effect with a minimum of risk in friendly lives, time and treasure. Modern information age technology can help the commander efficiently employ force. Physical effects can be modelled more easily than cognitive effects. Anticipating cognitive effects is thornier. Ultimately the joint campaign plan must effect the adversary's will. If we step one vision further we can see a set of integrated physical and cognitive effects models that could help the nation achieve national security objectives without the adversary even knowing that he has been influenced.

Mr. Watts – the focus of EBO should be at the operational level and higher. From an EBO perspective the basic question is how to relate the BDA feedback on specific targets and aim points to the higher-level effect. This highlights the inherent difficulties of getting from the quantifiable tactical BDA to higher level emergent effects. First, quantifiable BDA may not be a sufficient basis from drawing accurate conclusions about the achievement of higher-level effects against a given target system. Second, the vulnerability of a target system to precision attack can change very rapidly during the course of a campaign.

Mr. Davis – EBO movement by war-fighters is a great challenge and opportunity for analysis, because EBO forces more insightful analysis which should take an unusually broad view of the system that includes cognitive and behavioural factors and allows for quite a range of difficult to predict and indirect secondary effects. Planning should routinely discuss most-likely, best-case and worst-case outcomes under the analysis.

6.8 Kemple, William G. et. al.

Kemple, William G. et. al., *Effects-Based Planning: An Empirical Examination of the Process*, Graduate School of Operations and Information Sciences, Naval Postgraduate School, Monterey, 1 May 2002,
www.dodccrp.org/Activities/Symposia/2002CCRTS/Proceedings/Tracks/pdf/111P_DF

The United States Joint Forces Command (USJFC) is leading a transition toward a new approach to warfare. A cornerstone of this approach is the concept of Rapid Decisive Operations (RDO), which integrate knowledge, C² and EBO to achieve the desired strategic outcome or effect on the enemy through the synergistic application of the full range of military and non-military capabilities at all levels of conflict. Focusing on effects enables a highly co-ordinated level of inter-service, interagency and international co-operation.

1. Introduction

The world and operating environment for the US military are changing. Future conflicts will not be necessarily between nation states, but also between drug cartels, international criminal and terrorist organisations. Despite the reduction of the US forces and loss of overseas bases there is a desire for more rapid resolution of future conflicts. A cornerstone of this new approach is RDO, which integrates all elements of national power to understand and reduce the adversary's critical capabilities and coherence. It requires a highly knowledgeable understanding of direct, indirect, intended and unintended consequences or effects of our actions. Effects-Based Operations (EBO) effect both planning and assessment, EBO emphasises the overall outcomes that will be achieved. The Effects Assessment Process (EAP) is a continuous feedback process, which allows for decisions in an intensely dynamic situation.

2. Effects-Based Operations Planning Process

EBO process is conceptualised as a continuous and iterative planning and execution cycle with five phases:

- Developing a comprehensive knowledge into the nature of the adversary, the environment and own capabilities with conducting an operational net assessment,
- Articulating the desired effects necessary into an Effects Tasking Order (ETO) to break the adversary's cohesion and change his behaviour,
- Determining and applying the elements of national power (diplomatic, informational, military and economic – DIME) that will be most effective in achieving the desired effects,
- Conducting an integrated and continuous assessment process to measure and assess the impact of the effects created,
- Making decisions regarding ways the commander can adapt and adjust the current Course of Action (COA) to more effectively reach the desired end-state.

Characteristics, that distinguish Effects-Based Planning (EBP) from traditional Objective-Based Planning (OBP) include a broader and deeper insight into the adversary through the fusion of information from a broad spectrum of sources. A networked and distributed team of cultural, behavioural, technical, economic, political and military experts develop this insight through a complex System of Systems Analysis (SOSA). EBO goes a step further than consideration of which actions will produce an objective.

3. Operational Net Assessment

The challenge in EBO is to accurately identify the causal linkages that determine whether or not the action taken will achieve the desired effect. This challenge is addressed through the Operational Net Assessment (ONA), a product of collaboration among analysts at the strategic, operational and tactical levels. ONA is an action-oriented process that provides a continuous stream of knowledge from adversary vulnerabilities to effects and to tasks. It also helps develop situational awareness and understanding.

4. Concept Experiment on the Effects-Based Planning Process

5. Survey Administration

Three surveys were administered during the experiment, (1) the collaborative tools and the training provided, (2) knowledge management and collaboration and (3) the Effects-Based Planning and Assessment process.

6. Results

Not relevant yet.

7. Conclusions

Several consistent themes emerged across the participant comments to the survey. The first was that the assessment process would be critical to the success of EBP&A and this part presented a challenge. The second theme was the far greater complexity entailed in the planning process and in co-ordinating all the elements of the overall planning process. The third theme was the need for clarification regarding how the new processes and procedures dovetail with existing procedures. The fourth was the need for articulating the relationship between the various players and the responsibilities involved in planning and conducting EBP&A. Finally noted that defining success was the most challenging aspect of the EBO process.

6.9 Kreighbaum, Jay M.

Kreighbaum, Jay M. (Maj.), *Force Application Planning: A System-and-Effects-Based Approach*, School of Advanced Airpower Studies, Air University, Maxwell AFB, Alabama, June 1998

Chapter 1 – Introduction

According to Joint Publication 0-2, in the abstract sense the objective is the effect desired. In the concrete sense the objective may be a physical object or the action taken. In this sense it is very important to determine what effect will contribute to the fulfilment of an objective, by determining against what objects should force be applied to produce the desired effects. A mechanism is a belief about cause and effect relationship which links target with effects. See figure on pages 1-2! For this, planners must shift from input driven targeting to output driven targeting to produce effects that accomplish objectives. First they should select an effect that relates to the objective, then determine what target can be associated with achieving that effect.

This philosophy unveils the paradigm change of targeting for destruction versus targeting for effect – a clear shift in focus on destruction as a means to effects and not on destruction of targets as an end in itself. Because the nature of higher order effects is not well understood, there is a tendency to focus solely on first order effects, which are more objective and measurable. But over reliance on first order effects is not necessarily the most efficient or effective means to achieve objectives.

Methodology – by thinking in terms of effects we can cross service lines and focus not on who or what induced the action but on the deliverable itself, the effect. The EB approach places effects ahead of targets. In a joint context, an effects-based strategy represents an attempt to find an unequivocal and compelling metric that can be used to make arguments over weight of effort in strategic planning, force structure and budgets (effects are the equivalent of profit and market share in the business world).

Chapter 2 – Concept and Terms

One key concept of operational art is the idea that coherent force application takes place through strategy by linking objectives to targets at all levels of war (ways-end-means). The intermediate concept that links objectives and targets is effect.

Established Concepts – COGs are analytical tools for focusing strategy and force application. They are centres of enemy resistance that encompass hostile ability and hostile will. SEE figure on page 11! The concepts of hostile ability and hostile will are interrelated and interactive, one usually cannot affect one of them without affecting the other. COGs are dynamic and require frequent assessment to justify their value.

Criticality refers to the potential value of affecting a given system, and *vulnerability* refers to the susceptibility of a system. SEE figure on page 13! With criticality an adversary can be pictured as being composed of three overarching system (1) war making, (2) war sustainment and (3) war will, each of which includes further sub-components. If one affects a critical component of a COG, then one affects the whole COG without having to affect each component in detail. *Vulnerability* means that a system is affected by identifying its physical objects and locating its complete layout and the component functions. From this point of view exposure describes the relative ease or difficulty of applying force. When affecting a system, it can recuperate or substitute. Time is a subtle factor of both criticality and vulnerability. *Leverage* can be defined as being able to achieve disproportionate results with relative small effort as a product of timing, manoeuvre, fires and asymmetry. Two other aspects of leverage are important, the dual ideas of *resistance* (reduce or conserve) and *balance* (disrupt or maintain). Traditionally, applying force on force has been envisioned as being symmetrical like land force on land force, which is being challenged through the concept of asymmetry, which seeks dissimilar force-on-force pairings. *System analysis* is frequently used as a means of target assessment. It is a methodology that decomposes an adversary into interconnected and related sub-systems and target complexes. *Nodal Analysis* is a subset of system analysis. They are both mental routines that seem to make an adversary comprehensible by reducing it to a network of systems to decompose an adversary's composite resistance into exploitable forces and functions.

With an EB approach the destruction of targets is the means to achieving effects, which are linked to objectives and not on destruction of targets as an end in itself. Effects can be seen as intermediate objectives between targets and objectives to help link the process. Target is significant because of its relationship to a greater system. SEE figure on page 19! *Strategies-to-Task (STT) Methodology* was originally developed for planning force structure, capabilities and requirements. It is a planning process to link national objectives and strategy to operational concepts, capabilities and tasks in a coherent and accountable fashion. The STT framework logically links a hierarchy of objectives to tasks and tasks to targets. This linked and hierarchical nature of objectives is called a Z-diagram SEE figure on page 21! STT forces clarification in decisions on objectives at multiple levels of policy by imposing order and structure, in which objectives are prioritised, then sequenced, compartmented and monitored. It facilitates a rational process and clear audit of objectives, tasks and targets at a price of being static, sequential and target-based, without recognising effects within the process. It also does not recognise the nature of effects which cross over the bin partitions to multiple objectives. SEE figure on page 22!

Levels of War – the strategic, operational and tactical levels of war are well established. *Strategic level* of war describes activities associated with the war as a whole. The adversary is considered in terms of a whole system, a dynamic composite of the major war functions of war making, war sustaining and war willingness. Strategic effects contribute to reducing and unbalancing the enemy's overall political, military and economic capabilities and its psychological stability. Strategic effects require a longer time to manifest themselves. *Operational level* of war describes activities associated with campaigns and major operations. System efforts focus on the war-making function of the enemy like enemy forces or the enemy's centre of hostile ability. Operational effects contribute to reducing and unbalancing the enemy's capacity to conduct successful campaigns and wage war. They take less time to be realised. *Tactical level* of war describes activities associated with battles and engagements and focus on the enemy's war-making capacity of individual units. They contribute to reducing and unbalancing the enemy's capacity to conduct battles on relatively localised basis. These effects are immediate and of short duration. SEE figure on page 23! Effects in general have a tendency to become distributed and exploit the interconnected and synergistic nature that exists across the levels of war, despite planning and compartmentalisation.

Emerging Concepts – Several new concepts allow for a less mechanistic and procedural approach by better representing the nature of operational art as experimental and heuristic in nature, suggesting that military strategy is better approached as a process than a set of procedures. Effects possess a dual nature they are both results and triggers for subsequent outcomes. They are the bridges between objectives and targets serving essentially as intermediate objectives. SEE figure on page 26! A mechanism couples targets to effects, to objectives and to ultimate political outcomes. A mechanism should answer the “why” and the “because”, it is a rationale, a logic of causality. A mechanism is also a declaration of an act on a target in a certain manner to destroy or damage with the aim to trigger following order effects. Behind it is the idea of modifying material in order to modify behaviour.

The target modification should modify the adversary's behaviour. SEE figure on page 29! *Tight and loose coupling* assessment examines a node's functional relationship within the system it is part of and its function in relation to other connected systems. It describes connectivity within a system and/or its connectivity to other systems. By understanding this relationship we can achieve disproportionate functional effects. SEE figure on page 30! Tightly coupled systems have a greater potential to be affected by disruptive influences because they depend on input and control to sustain and regulate them. It implies that there is little or no slack for compensation and that disturbances will immediately propagate throughout the system and potentially outside of it. *Newtonian Paradigm* offers reductionism and linearity, which are increasingly being challenged as poorly fitted to war.

Linearity with its properties of proportionality (changes in system output are proportional to changes in system input) and superposition (the whole is equal to the sum of its parts) provides for predictability. Reductionism divides a given whole into smaller parts then solves the parts individually adding the parts back together in the end to form a whole solution – the whole is assumed to be the sum of its parts. The consequence of this method is oversimplification and a tendency to fragment analysis efforts into individual pieces. Lost is a holistic analysis that deliberately considers the enemy as a complex system. *Complexity theory* has a greater capacity to account for the interactive and non-linear phenomena of warfare. Non-linear systems generally disobey proportionality, changes in the system output are erratic, because they exhibit disproportionately outputs involving synergistic interactions where the whole is not equal to the sum of its parts. It holds that opponents in warfare are interactive and continually evolving, which anticipates that outcomes are more dynamic and less certain than a more linear view would assume. The cornerstone of complexity theory is non-linearity, which means that effects need no longer be proportionate to causes. SEE figure on page 33! Implications for an EB approach is that in a linear system effects are not recognised as having any influence or distributed effects outside the system. Non-linearity with its interconnections and interactions allows for a far richer context and potential for effects, which cross over systems and act simultaneously upon multiple systems and can be disproportionate to their causes. Non-linearity provides effects to occur in parallel. Complexity, inter-activity and connectivity provide the potential to begin to examine non-linear effects. Although some cause-effect relationships are linear, complexity theory provides a greater sense of the dynamics of warfare.

Chapter 3 – Systems Approach

Systems analysis is popular because it decomposes a given system into sub-systems, components and elements. It is so accepted, that it is institutionalised in the Joint Warfare Analysis Center (JWAC – established in May 1994). Virtually from the beginning air power theorists have sought for means to influence an adversary in ways other than just directly attacking his armed forces. This endeavour was characterised by pursuing a strategy to affect an adversary as a whole, with an indirect approach focusing on functions. This kind of thinking has led to reduction of the enemy into comprehensible and related parts. *Douhet's* approach addressed both forces and functions. The centre of his theory was that bombing civilian population centres, the material and moral resistance of the adversary would be broken and its national resolve shattered.

Mitchell considered forces, transportation, the industry and will as vital in a system. He considered the will of the people and later the industry as the primary mechanism to victory. *Slessor* recognised that detailed intelligence and analysis would be required to identify vital centres and decisive points for aerial attack. He emphasised that the functional effect was the outcome sought (to decrease the output of the war industry is important not the material destruction of plant and stocks). His alternatives to defeat the enemy were not necessarily mutually exclusive, which were (1) the defeat of the actual forces of the army and (2) disruption of its critical supply function. A force did not need to be defeated in detail if its fighting efficiency could be crippled by other means. The *Army Air Corps Tactical School* (ACTS) held that air power could be decisive by attacking an adversary indirectly through its economy. Targeting was based on the “industrial web” theory that attacking the economy from material destruction to functional disorganisation and dislocation could lead to victory. For this, gathering information was not only the task of the soldiers themselves. Identifying and disabling vital common functions within the economy would be critically to weaken the collective will to resist. *Warden* views air power as potentially decisive. His primary mechanism is strategic paralysis and views the enemy as a whole with five concentric rings. According to him the greatest leverage is derived from attacking inside out. The theories above tended to overestimate airpower’s ability and underestimated the will of the people to resist, the resilience of the economies and the time required for functional effects to mature. Infrastructure and economy is not always vulnerable to attack. Two broad schemes are discernible (1) the emphasis on reducing war will and sustainment by disabling critical functions and (2) the idea of attacking the war making capacity of the adversary. The *JWAC* supports planners and generates intelligence on the material basis of an enemy’s war effort like in-depth analysis of infrastructure network, critical industries, commodities and military logistics focused on precision targeting and effects. It divides its analytical efforts into the following core competencies as an integrated whole like (1) electrical power, (2) petroleum-oil-lubricants, (3) lines of communication, (4) telecommunication, (5) critical industries, (6) commodities and (7) military logistics. *JWAC* produces targets that are subsequently assessed in terms of potential effects on the state’s element of national power (military, political, economic and social). Missing is the non-material basis of the adversary like values or behavioural basis to generate psychological effects. *Mancur Olson* argued that a better metaphor for an economy was rather a tree than a watch. He does not reject the idea that selective bombing can yield disproportionate result. According to him, economies were not as fragile and critically dependent as it was often assumed. He differentiated tactical and strategic scales of an economy. SEE figure on page 50! From his point of view strategic supply was rather loosely coupled (oil industry, transportation system) while logistics were more tightly coupled at the tactical and operational level of war. A modern economy is not a fragile, rigid national structure. Economies can suffer a loss of a part and continue to function, instead they have a great capacity to substitute and compensate for disruptions.

Systems Approach to Force Application – there are two aspects of systems analysis that could complement by an EB approach. The first aspect is the timing of systems analysis in the overall targeting methodology by developing the effects required to achieve the objectives and then system analysis can develop the systems to attack to produce the desired effects. The second aspect is an expansion of the system analysis to consider not only the material basis of an opponent but also its non-material basis. Effects-based thinking enhances consideration of the non-material aspects and better integrates material modification to behavioural modification by shifting the focus toward desired intermediate results rather than targets. Effects should open up greater possibilities for influencing the enemy and reframe the perspective on targets to one of means rather than ends. This facilitates an approach that accents targeting for influence and not for destruction. Once the desired effects are developed a systems analysis can develop the targets that will in turn generate the intended effects.

Chapter 4 – Effects: Applicability, Complexity and Planning

Compelling an adversary to modify his behaviour in accordance with one's objectives is a basic goal of war. Force application is the primary means to influence an adversary's behaviour. An EB approach links effects to objectives and promises greater effectiveness and economy of effort than does a target-based approach. But achieving effects on interconnected and interactive systems do not necessarily imply effectiveness, because effects are complex and usually difficult to predict.

Focusing on Effects – with an EB approach it may not be necessary to influence an opponent solely through a strategy of annihilation or attrition. *Annihilation* is victory through physical elimination of the enemy. *Attrition* is a means of defeating an opponent over time. Both strategies rely on destruction as their operative means to victory. *Virtual attrition* uses destruction to generate functional effects to influence an opponent to modify his behaviour in terms of control. Targets are struck as a means of influence to generate functional effects without inflicting great physical destruction. The shift to effects requires a projection forward in time by effects as a planning consideration before targets. SEE figure on page 59! Once the desired effects are determined, the next step is to assessing what targets can be acted on to generate them. Second order effects are the result of first order effects, which is commonly destruction. SEE figure on page 61! Thinking in terms of effects linked to objectives should theoretically be more effective than thinking in terms of targets and then taking whatever results to come from their destruction. An EB philosophy increases the likelihood to accomplish the objectives by achieving linked effects. SEE figure on page 63! *Effectiveness* reflects that there is a difference between effects and effectiveness. The distinction between effects and effectiveness is that effects may be generated from a given attack, but if they don't contribute to the accomplishment of the objectives, they are not effective. There is an increased difficulty of measuring effects and effectiveness as we move from the tactical to the strategic level of war because tactical and operational objectives tend to involve forces while strategic objectives tend to involve functions. Generally there are three levels, at which to measure the effects and effectiveness:

- The physical destruction of the target resulting from the weapon effects,

- The attempt to capture all indirect or higher order effects generated from the initial destruction of targets, which may be functional, systemic or psychological with a decreasing material basis and delay in time,
- The attempt to determine if the effects contributed to the achievements of the planned objectives. SEE figure on page 65!

But there are two principal disconnects that can occur, (1) the first order effect may not generate the intended higher order effects, (2) and the generated effects do not actually influence or fulfil their intended objectives. Another premise of an EB approach is that the nature of effects intended from actions against a system are closely related to the nature of that system. The nature of a complex system is closely related to principles associated with complexity theory. SEE figure on page 67! Because the complexity, disturbances to complex systems are usually characterised as having long cause-effect trains. Actions taken against a complex system can yield unintended effects that are often delayed. From this standpoint effects are either complex or simple.

Planning for Effects – there are two different views of a cause-effects relationship, (1) it is non-linear, highly interactive, disproportionate and complex, (2) it is linear, serial, proportionate and simple. Some target-effect pairings are less uncertain than others, for example annihilation can have a relatively simple cause-effect chain. Virtual attrition has a relatively complex cause-effect chain. SEE figure on page 71! Planning to achieve effects can enhance the overall effectiveness of efforts achieved by working out the target-effect pairings that make the best sense for accomplishing objectives. Effects will always contain an element of uncertainty based on the complexity of the system attacked. By knowing the resilience of complex systems, multiple attacks may be required to achieve desired effects. In general, the more the system attacked and the more complex the effect desired, the less certain the desired outcome. Theoretically some effects may not be achievable, at all. Planners should balance overall efforts between simple and complex effects.

Chapter 5 – A Primer on Effects

A basic distinction among effects is whether they are first or second order (direct or indirect). Effects can be described in three dimensions of time based on their rate, development period and duration. Some effects are intended, while others are unintended.

Properties of Effects – First and Second Order Effects. First order effects are those that result immediately from the action of the weapon upon the target. They occur immediately after the physical destruction of the target. Second order effects are downstream resultants from first order effects. Second order effects usually have some kind of systemic influence, which can be within a system or can progress to affecting an outside system (third or higher order effect). SEE figures on pages 75-76! *Temporal qualities of effects* describe the fact that effects vary in the time it takes them to mature to their designed levels of influence and their duration. Tactical level effects are likely to have shorter life spans than effects at the strategic level in terms of both rates and duration. Operational level effects can be said to fall somewhere in between the two other levels in terms of immediacy and duration. SEE figure on page 78! *Intended and Unintended Effects* describe that out of any given planned intent, both unintended and intended effects occur.

Unintended effects can be positive, negative or neutral to the achievement of the intended objectives. Two issues arise from this, (1) how to know whether a force applied has yielded intended or unintended effects which is the field of measuring effects, (2) and what to do about unintended effects because intended effects are evident and contributing to influencing the objectives as planned. SEE figure on page 78!

Organising Schemes for Classifying Effects – the task of organising effects desired to fulfil the objectives, which on the other hand can be regarded as master effects. Objectives are the end results of a planned stream of actions and effects, so effects can be seen as intermediate objectives. There are existing criteria to help organise effects to develop coherent cause-effect rationales. *War making, war sustainment and war will*. A key concept in an EB approach is that objectives and therefore effects can be organised according to the major functional areas of warfare. War making describes those forces and capabilities that actually apply combat power like men and equipment. War sustainment represents those forces and functions that enable the enemy to sustain the war. War will animates the enemy's overall commitment and resolves to continue to resist and attempt to achieve their own objectives. *Forces and functions* stand for effects that can be classified according to whether they will affect an enemy's forces and functions. The category of functions encompasses any system and its functions that the enemy relies on for prosecution of its war effort. Forces are a category directly related to an opponent's war making capability. *Physical, systemic and psychological effects*. Effects can also be classified according to whether they are primarily intended to have physical, systemic or psychological component. Most effects will contain elements of all three categories. A physical effect is destruction. Systemic effects are those, which are planned to disrupt a specific system or systems functionally. Psychological effects affect the will of the adversary. *Intra-systemic and exo-systemic effects*. Effects with a systemic impact are usually planned in anticipation of affecting one or more systems.

Effects planned to affect a singular system are intra-systemic, those planned to affect multiple systems are exo-systemic. *Military, political, economic and social (MPES) effects*. These categories describe the context of any given international crisis. These areas not only describe an organising scheme but are also useful for classifying major instruments of power that one state can bring to bear upon another. *Material and non-material effects*. Almost every effect starts off as material effect. Material first order effects can generate non-material second order effects. Effects falling along a continuum containing material and non-material elements, with physical effects at the material end and psychological effects at the non-material end. Systemic effects fall roughly in between. SEE figure on page 83!

Effects Related to the Levels of War – Planning for effects to achieve objectives is the basis of an effects-based approach. Tactical objectives are derived to fulfil operational objectives and operational objectives in turn contribute to strategic objectives. Although there is a tension between effects to affect a single level of war and the tendency of effects to spread across multiple levels of war, the levels of war can serve as a master scheme for organising effects as rules of thumb to forecast time, abstraction and complexity relationships. *Strategic Effects (SE)* are intended to affect the war as a whole by influencing major functional areas of war sustainment and war will.

It focuses on COG associated with functions such as infrastructure to reduce and unbalance the enemy's overall political, military and economic capacities and its collective psychological stability. SEs generate slowly and require a long period to mature fully, but their influence generally endures for a long time. *Operational Effects* (OE) are intended to affect campaigns and major operations. They are planned to influence the major functional areas of war sustainment and war making. In this context the focus is on COGs associated with an enemy's forces to reduce and unbalance his capacity to conduct successful campaigns and war. OE require an intermediate period to mature and their influence endures usually for an intermediate period. *Tactical Effects* (TE) are intended to affect individual battles and engagements to influence the war making functional area. They focus on affecting forces and may not directly relate to specific COGs. They contribute to reducing and unbalancing the enemy's capacity to conduct battles on a relatively localised basis. TE generate and mature immediately and their influence is rather brief. SEE figure on page 86! In order to plan with effects, they must be bounded, classified and simplified, otherwise the possibilities and the sheer complexity will paralyse the planner. An EB approach requires timely feedback in form of effects-assessment. For war-level effects see also page 134-135!

Chapter 6 – Target-Effect Pairings and Mechanisms

Planning the right effects to achieve the desired objectives is vital, as it is vital to plan the right targets to achieve the effects, which emphasise consideration of pairings between targets and effects.

Effects Thinking Past and Present – Slessor's work is unique for upholding and detailing airpower's role in contributing to the defeat of an enemy by treating him as a system and analysing how air power could best reduce his capacity for resistance. He favoured functional effects rather than physical ones by identifying two sub-systems, communication and supply. He developed a systemic approach with two principal means, focusing (1) on enemy troops and (2) on enemy supplies consisting of production and supply of war material. The alternative strategies were not mutually exclusive. He also developed several specific target-effect pairings. SEE figure on page 91! He suggested that air power be best used at the operational and strategic levels. His implicit mechanism was that enemy land forces would be influenced, by attacking their dependencies (supply and transportation). *Eccles* proposed thinking about affecting the enemy in terms of control and influence, not strictly destruction. The means of control focused upon enemy logistics, which he described as the link between a nation's economy and its combat forces. He also suggested that the best means to influence an adversary was to act at the operational level to control his logistics and influence his ability to sustain war. SEE figure on page 93! His approach was directed against functions rather than forces. His implied mechanism was that by denying and interdicting an enemy's logistical ability to sustain war, the enemy's ability to control his economy and combat forces would be critically reduced. According to *Schelling* the military use of force was based on terms of its psychological influence and its potential to modify behaviour by threat and actual use of force. Military forces were used to do two things, to hurt and destroy value. A primary construct in his strategy of influence is a differentiation between coercion and brute force. Coercion intends to modify enemy behaviour through judicious and selective force to induce the enemy to co-operate by selectively hurting him and damaging what he values.

Brute force is a strategy to eliminate behaviour through destruction by displacing and disarming the enemy. In his theory compel and influence stood against displace and disarm. In his strategy coercion was best applied at the strategic level of war, aimed at the will of the people and government, the political and social aspects of the state. *Deftula's* systems approach essentially holds that the enemy relies on vital systems that in turn control vital functions. By attacking and disabling these systems one can achieve control over the enemy. He proposes an ideal employment of force, in which all efforts are linked to objectives. His primary effects are systemic with an intra-systemic focus, rather than physical or psychological. He emphasises targeting for effects in which destruction is just a tool to achieve the desired effects, to functionally disable vital systems of control. SEE figure on page 99! According to him it takes less effort to control a system through selective force than to destroy the whole system. His mechanism is that functionally disabling the adversary's essential systems of control at the operational level will paralyse his ability to function at the strategic level.

Synthesis of Effects Thinking – as we could see in the various theories destruction provides the means to generate effects, which can be targeted against specific components of a system. Vital components or systems can be affected with small, selective application of force and yield system-wide effects. This approach leads to greater economy of force and less cost in terms of blood and treasure. SEE figure on page 101! EB stresses coercive functional effects rather than brute destructive effects. This approach emphasises physical, systemic and psychological effects as a primary means of influencing an enemy mostly at the operational and strategic levels of war.

Chapter 7 – Coercive Force Application and Effects

Coercion states that force can be selectively applied within an opponent state against various targets in order to modify the opponent state's behaviour. A key concept of coercion is targeting for influence versus targeting solely for destruction. Its intent is to persuade an opponent by applying force and offering alternative negotiated solutions to the violence. By keeping the idea of influencing over destroying, it holds the prospect of greater economy of effort and force. The reason behind coercion is that it takes less effort to destroy some things and to make the enemy capitulate, than to destroy all things and annihilate him. *Brute force* concentrates on destruction for eliminative purposes. Its focus is not to influence, but to defeat the enemy through the strategy of annihilation. *Clausewitz* developed a formula that the enemy's resistance is a product of his available means and will. *Schelling* differentiates brute force and coercion to modify behaviour through the power to hurt. *Pape* defines a strategy of denial as one that seeks to deny the opponent from obtaining his objectives. His second strategy is punishment, the attacks on civilian populations. His third strategy is risk, which holds that one can coerce an opponent most efficiently by gradually escalating the amount of punishment inflicted. The last strategy is the hybrid strategy of decapitation, which is attacking leadership and C³ with elements of denial and punishment.

Challenges to coercive FA – the critical task to planning and implementing coercive FA is assessing an opponent's behaviour and then linking this to material means to modify that behaviour.

An opponent should be understood through a series of alternative assessments and reassessments. *Mindset analysis* is largely a collection of beliefs to understand the opponent's mindset as possible, to discover the fundamental basis of his behaviour. *Biases* can either be mirror imaging or attribution. Mirror imaging is to project own motivations and cost-benefit calculus unto the adversary. Attribution is when the own behaviour is viewed as a composite of many influences and constraints while the others is viewed as being deliberate and purposeful. Predicting effects intended to have an influence beyond destruction is difficult, as is measuring those effects after the destructive action.

That is the reason while coercive force application requires regular feedback otherwise there is only one to do, to hedge. The challenge for coercion is how to get the most influence from the least possible force by reducing the enemy's total means and will to resist. Will can be subdivided into three elements, to increase insight into the material basis of an opponent's will, which are:

- The body, which can be associated with physical effects or war making capacity,
- The support system which can be associated with systemic effects or war sustaining capacity and
- The mental-moral being which can be associated with psychological effects or collective war will.

To address the will of the enemy first we need to isolate him by blockade or all other means. The next step is linked to psychological effort by moving forces into place while continuing the diplomatic negotiations. The third step contains the systemic efforts by disabling the enemy state's essential functions with reducing its C⁴I network, infrastructure, critical industries and military logistics. The last step is for the physical efforts, which are analogous to the actual physical displacement of the adversary from the area of interest, usually effected by attrition and annihilation of his armed forces. SEE figure on page 118! From moving from psychological to physical, the levels of effort, resistance, destruction and public scrutiny increase. SEE figure on page 120! Nevertheless there is a need to make tradeoffs between idealised efforts and pragmatic ones in order to balance the overall efforts. Effective coercive efforts should integrate the strategies of denial, punishment, risk or decapitation. It should proceed heuristically, checking the results through mission assessments to regulate future actions.

Chapter 8 – Framework for a Systems-and-Effects-Based Approach

There are two basic tracks that run concurrently in military strategy with both sides acting simultaneously. The first is the *imposition* of our strategy, the second is the *negation* of the opponent's strategy (by denying and controlling his ability to impose his strategy). SEE figure on page 124!

Planning Framework – in military strategy there is a need to distinguish the essential from the unessential and to do first thing first. Planners must plan in a way that they accomplish the objectives. The principal means to act upon an opponent is assessing the opponent in terms of COGs and leverage. It is also needed to view the enemy holistically in order to realise opportunities to affect the enemy as a whole. The benefit is synergy and economy of effort.

The seven system competencies of JWAC extended with behavioural analysis are a good start for viewing the enemy systematically to gain insight into how to potentially influence his behaviour. To select mechanism is important, because they are the basic cause-effect assumptions supporting the strategy.

Conventional warfare has three fundamental tasks (1) to isolate the enemy by means of alliances, blockade, embargo, international condemnation, (2) to reduce the enemy by blockade, siege, bombardment and (3) to displace the enemy by land invasion and combined arms assault. In this context, when using effects it is important to pair effects to objectives and to targets. After force is applied results from the attacks need to be measured and assessed to see whether or not planned effects are actually being achieved. Measuring effects, especially indirect ones require developing new techniques as well as improving current ones. SEE figure on pages 132-134! Although coercion should be the preferred means, added persuasion of overwhelming force is usually a useful hedge for the strategists.

Chapter 9 – Conclusions and Implications

The basic premise for inserting effects between objectives and targets is to improve the overall efficacy of the force applying process. Effects help bridge the cause-effect gap between objectives and targets by forcing an articulation of intermediate results required in order to fulfil objectives. Planners in the past tended to underestimate the enemy in three areas, its will, the resilience of its industry and the time required to mature effects. The continuum between coercion and brute force can be seen as seeking an ideal or pragmatic solution. On the one pole ideal coercion has a purely psychological solution, the other is characterised by a pragmatic, overwhelming brute force. This continuum is also an acknowledgement that a great deal of warfare is non-linear. It results often out of proportion to actions. Behavioural analysis can provide insight into the enemy's motivation, interests, stakes and mindset and enables to better link the paradigms of material modification and behavioural modification.

By thinking in terms of effects, one can cross service lines and focus not just on the result. Effects can clarify the individual service competencies to produce unique and complementary effects, which taken together, create a rich palette for joint operational art.

6.10 Mann, Edward C./Endersby, Gary/Searle, Tom

Mann, Edward (Col., Ret.)/Endersby, G. (Lt. Col., Ret.)/Searle, Tom,
Dominant Effects: Effects-Based Joint Operations, Aerospace Power Journal, Fall 2001, www.airpower.maxwell.af.mil/airchronicles/apj/apj01/vorfal01.html

The basic premise of Effects-Based Operations (EBO) is to focus on the conditions desired – the effects – to achieve assigned objectives instead of focusing on destruction. The statement is simple but experience shows that to maintain such focus is difficult.

Interestingly the US military has struggled to apply effects-based principles for over 50 years, but despite the EBO roots the military has never really institutionalised the thought processes necessary to ensure consistent adherence to EBO principles. EBO is only now incorporated into service and joint doctrine.

Broader views consider EBO equally applicable and useful to all forms of military operations.

More than ten years after the end of the cold war the United States is still struggling to understand the dominant characteristics of the New World Order. Traditional military planning has at its basis the conquest paradigm rooted in the Napoleonic warfare. The ultimate goal of this kind of warfare is to impose a political settlement by capturing or threatening the opponent's territory or capital. The way to achieve this aim was to disarm or destroy the enemy's military. The twentieth century extended this paradigm to a concept of total war, with almost everything even remotely connected areas becoming subject to attack or destruction. During the Cold War a war of conquest became less and less likely, the objectives of military operations less and less clear. Military operations represented just a small part of a much larger effort aimed at achieving limited political objectives. Current history shows example of application of military forces besides conquest or even coercion. The Napoleonic paradigm of destroying the enemy army is of little use in the current geopolitical structure. Instead we have peacetime engagement, like Military Operations Other Than War (MOOTW) and Small Scale Contingency Operations (SSCO). The conquest paradigm no longer offers a sufficiently broad view of the purpose and nature of military action and that a new paradigm has arrived, which says that achievements of national political goals defines military success.

The concept of Dominant Effects (DE) captures the idea of EBO. DE posits that appropriate movement combined with supply, attack, defence and manoeuvre create functional, systemic and psychological effects well beyond the immediate physical result of tactical or operational events. It explicitly considers potential effects of planned operations. SEE figure on page 4! For this reason it is crucial to predetermine the indicators useful in measuring successful achievement of the desired higher-level effects. An idealised model with the following phases is both continuous and iterative. SEE figure on page 5!

- *Phase 1* is strategic environment research, which asks and attempts to answer several broad-ranging questions like what kind of effects might one seek, how to produce them and under what circumstances, what indicators would be appropriate to determine them.
- *Phase 2* is determining policy goals, which include a statement of the intended effects and the outcomes that will lead to achieving those goals.
- *Phase 3* is developing a strategy to employ resources available to achieve the desired effects.
- *Phase 5* is mission parsing and integration to determine the elements of national power best suited for each task.
- *Phase 6* is the assessment of effects to determine whether policy goals are achieved and what needs to be done next.

The emphasis on effects becomes apparent in two critical ways. The first is an expansion of the phase involving the determination of military objectives. The second is in the assessment phase to evaluate progress in terms of positive and negative effects of the operation.

Assessment must provide the commander more information than the physical and functional effects of weapons employment. Commanders need assessment of both systemic and psychological effects. This part requires great effort to deal with a number of complex issues to avoid mistakes like mirror imaging. The most appealing aspect of EBO is that it applies across the full spectrum of engagement.

Proposed lexicon and definitions are in the article. SEE figure on page 6! It is extremely important.

6.11 Mann III, Edward C./Endersby, Gary/Searle, Thomas R.

Mann III, Edward C. (Col., Ret.)/Endersby, Gary (Lt. Col., Ret.)/Searle, Thomas R., *Dominant Effects, Effects Based Thinking for Joint Operations*, Draft, ARI Paper, 2001

Chapter 1 – Time for a new Paradigm?

The military leadership is struggling with new understandings of the post Cold War Era, but much of their conceptual thinking and development are stuck in an old paradigm – the conquest paradigm. This paradigm holds that use of the military should be a last resort when diplomacy and politics have failed. There is a need for a new paradigm based not on conquest but on achieving success across the entire spectrum of engagement – maybe a success paradigm. The concept which the authors call Dominant Effects (DE) will focus the four operational concepts of JV 2020 (1) dominant manoeuvre, (2) precision engagement, (3) focused logistics and (4) full spectrum protection. JV 2020 focuses on effects the military create to produce full spectrum dominance. Each service and the joint staff have taken halting steps in the direction of DE by experimenting with at least some aspects of Effects-Based Operations (EBO). The DE concept will provide a systemic approach to planning, executing and assessing results of military actions across the entire spectrum of engagement ranging from peacetime to global war and back to peacetime. It will help military planners focus on output not input and on national goals not being the capabilities and prerequisites of the services.

The USAF has embarked upon a path to an expeditionary aerospace force to integrate the air operations centre as a weapon system and the Developing Aerospace Leaders (DAL) initiative. These actions are aimed at developing more agile, more capable and more relevant airforce. *The Imperative to Change Now* – The Cold War brought relative clarity and stability to the US military and foreign policy. The end of the Cold War, following collapse of the world communism and subsequent disappearance of threat from the Soviet Union and Warsaw Pact allies changed everything. The end of the Cold War conflict let the world with several local and regional conflicts. The threats in the Post-Cold War world are numerous, but they are much less clear, stable and predictable than was the Soviet threat. *The New Environment* – The Cold War was black and white in which the US had a clear understanding of foes and friends, with a relatively small number of states falling into the grey area between these two poles. Today, a relatively small number of states are constant allies, while a larger number fall into that grey area of neither friend nor foe. The notion of universal, world wide threat doctrine is clearly outdated. In this changed climate, military actions will be radically more complicated.

US forces need to develop concepts of military action to meet the challenges and exploit the opportunities presented by the current geo-political environment. In this new era one cannot assume that future conflicts will typically be between nation states. Globalisation and new technologies are also facilitating transnational threats to national security. The future of military involvement requires a seamless melding of capabilities into a joint, inter-agency and international effort that mitigates the immediate humanitarian crisis, creates the basis for sustainable long-term recovery and improves living conditions. Joint forces need to meet initial objectives for crisis response and then work in concert with other appropriate agencies for smooth transition to normality. *Revolution in Military Affairs? – Geopolitics* is not the only thing that has been changing. Since the end of the cold war, expanded application of rapidly developing (information) technologies, combined with new business practices and organisational concepts have enabled commercial firms to radically transform the way to do business. Many of these developments have served as force multipliers. They present also new and different kinds of vulnerabilities and no one is sure how all these changes affect traditional military actions. To benefit fully, planners and operators must avoid the trap of simply using new tools to do the same old things in better ways. Instead they must take a fresh look at everything to determine what exactly they are trying to achieve and whether they can achieve assigned policy goals more effectively by using new methods and organisational schemes.

The US military has undertaken several major initiatives to help harness new and emerging capabilities to meet challenges of the Post-Cold War world with the key to the success by incorporating information superiority and technological innovation:

- The Air Force established the Air Force Doctrine Centre, adopted the concept of Expeditionary Aerospace Force, took the initiative of Developing Aerospace Leaders,
- The Navy changed its focus from control of the seas to projecting power ashore,
- The Marine Corps has shifted toward solving problems of urban warfare,
- The US Army is proposing a radical transformation away from heavy armoured forces toward a much lighter, more strategically agile expeditionary forces.

What is Dominant Effects? – The authors propose a joint EBO concept called Dominant Effects which considers the full spectrum of engagement, but not focused on conquest or necessarily even warfare as traditionally defined.

The Continuing Need to Revise Military Thinking – most current military doctrines are rooted in the concept of conquest paradigm, which is rigorously fight-centric and almost obsessed with the big fight, wherein armed forces concentrate on physically destroying opposing military forces. The conquest paradigm does not provide an adequate basis for understanding the totality of military actions. Military actions in today's geo-political environment often require considerable restraint, not necessarily using every available weapon and not attacking every possible target, but understanding the full political context of all actions.

Chapter 2 – Old Wines in New Bottles? Or ...

Historical Examples of Effects Based Thinking – During WW II some air planners were trying to implement the essential concepts of EBO. In the late 1930s USAAC thinkers developed a number of theories about air warfare, including one which came to be known as the Industrial Web Theory. The basic idea behind it was that a war machinery requires support of a huge industrial complex comprised of many inter-linked sub elements, like manufacturing plants, transportation, power production and delivery systems, called the web. It was also thought to be finite and determinable number of vital links or critical nodes that if successfully destroyed would bring about to collapse the entire web. In 1941 USAAC set out to define these critical links hoping that strategic bombardment alone could bring the enemy's war machinery to halt. The US and UK developed plans for strategic bombing campaigns against Germany believing that the German economy was fully mobilised in support of the war effort.

With this in mind the planners decided to focus on the ball bearing industry like the German aircraft industry, which was listed as first priority. Based on this mirror imaging bombing lowered the maximum possible output at any given time, but did not result in reduced overall output until very near the end of the war. Attacks on the ball bearing plants produced a great deal of damage to factories, but not as much as it was thought – due to errors in assessment. Photo Interpreters (PI) did only see the external damage to a building but could not assess the internal destruction. They found that photos taken during a raid tended to exaggerate the damage inflicted by raid. The smoke, dust and explosions captured by photos looked spectacular but made near misses look like direct hits. But eventually the allies did succeed in finding and seriously degrading two target systems that proved critical to the German war effort: transportation and oil. Attacks on these two systems were highly synergistic. Some remarks to this:

- The effectiveness of strikes versus post-strike photography is influenced by the state of technology,
- To make a proper Battle Damage Assessment (BDA) besides post-strike photography other sources of intelligence are to be considered.

In the Gulf War Col. John Warden and the Air Staff (AS) developed a new concept of strategic air warfare called Parallel Warfare (PW). Their view of the adversary's military-industrial capabilities and requirements were similar to the industrial web theory, but they proposed to take down the critical elements so fast that capability to support the war effort would collapse. Attacking Iraq's electrical power production and distribution system was a key element of the plan. Once again US planners did not understand the Iraqi political, social and economic system (perceptual errors). On top of that there was no real way to measure the will of people or leadership. The USAF has been implementing Effects-Based (EB) concepts for decades, but little is known about imposition of systemic and psychological effects through military actions. There is also no comprehensive understanding of how to create such effects, whether it is truly possible or how to assess the progress and extent of such effects. *Dominant Effects For Air Force (AF)* planners, achieving effects often translates into selecting targets which sometimes is referred to as Effects-Based Targeting (EBT). The Effects-Based (EB) concept asserts that affecting a particular target set in a particular way may have functional, systemic and psychological effects well beyond simple destruction or degradation of it.

In this context destruction of targets should more logically be viewed as a means (desired effect) to achieving an end (policy goals). The challenge is to shift from input- to output-driven planning for military actions. The premise of EBO is to use both lethal and non-lethal means at the tactical level to produce predetermined direct and indirect effects at the operational and strategic levels of employment. Effects should be the integral linchpin that binds together the planning, execution and assessment of all military actions and the actions of other agencies as well. A considerable challenge for Dominant Effects is to translate the EBT view into a less air centric joint EBO view that leads to effects based thinking and processes that are applicable across the entire spectrum of engagement. It is also important to buy more sophisticated intelligence, surveillance and reconnaissance systems to collect and disseminate more complete information for combat assessment. In Objective-Based Operations (OBO) objectives do not specify operational actions, a further difference is the relative focus on desired versus undesired outcomes. Objectives are things the planning forces want to happen. Effects-Based Planning (EBP) also explicitly considers additional things beyond what the action is intended to accomplish, that may happen as a result of planned actions.

Chapter 3 – If It’s a Rose, Why Not Just Say So?

Definitions and categorisations – According to Merriam Webster Collegiate Dictionary an effect is the power to bring about a result, i. e. to influence. Expanding this definition to EBO it is important to note that the effect of a given action may set off other changes or effects, one event may trigger or cause subsequent outcomes – effects have a dual nature. An effect is the physical, or psychological outcome, event or consequence that results from a specific military action. It stipulates that effects can occur at all levels of employment, from tactical to strategic and may by themselves produce secondary or follow-on outcomes. Effects have also a multidimensional nature which the following definition expresses best:

- An effect is the functional, systemic and/or psychological outcome, event or consequence that results from a specific military action. Effects may occur at all levels of employment and may by themselves produce or trigger secondary outcomes or indirect effects.
- In the most basic sense effects can be broken down into direct and indirect effects. A direct effect is the result of actions with no intervening effect or mechanism between act and outcome. It is immediate and easily recognisable. Direct and indirect effects may be physical, functional or psychological in nature.

First, Second and Third Order Effects – First order effects are synonymous with direct effects, which result immediately from an action while second and third order effects constitute indirect effects, created through an intermediate effect or mechanism producing a final outcome or result. Indirect effects may be functional, systemic or psychological. They tend to be delayed and are typically more difficult to recognise.

Cumulative and Cascading Effects – Direct and indirect effects can be cumulative or cascading. Cumulative effects result from the aggregate of many direct or indirect effects with lower order effect accumulating to higher end result.

Effects in general have a ripple or disruptive impact throughout the target environment or system whether a nation-state or a loosely knit international terrorist group. The cumulative and cascading nature of direct and indirect effects contributes to their distributive nature.

Collateral Effects – Collateral effects are those outcomes that result when something other occurs than what was intended. In negative sense, collateral effects may be incidental direct or indirect effects that cause unintended and unwanted injury or damage to persons or objects. On the positive side collateral effects may generate outcomes that prove beneficial to ongoing military actions.

Physical, Functional, Systemic and Psychological Effects – Physical effects are created by the direct impact on an object or system targeted by the application of military resources (direct, first order effects). The primary purpose of it is to damage, disrupt or neutralise a target or group of targets through the application of military force. Functional effects represent the direct or indirect effects of a military action on the ability of a particular target or object to function properly and perform its mission. Systemic effects are those indirect effects aimed at affecting or disrupting the operation of a specific system or set of systems. Psychological effects are the impact of military actions on the mental domain of a target audience. Psychological effects may be either direct or indirect effects resulting from such military actions.

Tactical, Operational and Strategic Level Effects – Strategic effects contribute to affecting a specific target audience's overall political, military and economic capacities as well as its psychological stability. Operational level effects contribute to reducing and unbalancing an adversary's capacity to conduct campaigns or wage war. Tactical effects are the result of an action or actions at the individual unit level and are immediate and of short duration. Fundamental relationship of various effects (SEE figure 4! – extremely important).

Chapter 4 – A General Theory on Joint Effects-Based Operations

How it works – to discuss DE it is necessary to define two key constructs of EBO and DE. In the DE construct EBO is: “*Military actions designed to produce distinctive and desired effects through the application of appropriate movement, supply, attack (including fires), defence and manoeuvres. EBOs focus on functional, systemic and psychological effects well beyond the immediate physical result of a tactical or operational event. Furthermore, EBOs are equally concerned that military actions trigger additional effects beyond those that are desired.*” The focus is upon various types of effects that transcend the immediate physical, but does not address results in terms of outcomes, which may or may not include destruction.

Even where destruction, attrition and annihilation are used, the real objective is often to create higher-level psychological effects like breaking the will of people to resist. EBO is not centred upon an adversary but on the conditions necessary to achieve success in any action. This will require military professionals to undertake a wide range of studies to define desired effects possible in a given situation and how to create them. More concrete studies will need to be continued, like nodal analysis of military systems and organisations, war industry and national infrastructure to understand desired physical, functional and systemic effects.

DE are defined as: “An EB concept of joint operations, applicable across the entire spectrum of engagement and at all levels of employment. It focuses the four operational concepts of JV 2020 on creating desired effects to achieve full spectrum dominance.”

An idealised joint EBO Process for DE – the model described here is intended to idealise the process national leaders, commanders and planners should follow in directing, planning, executing and assessing EBO. It could completely replace current planning processes with a single comprehensive one. The new model would allow the services to jointly evaluate the possibility:

- The first phase begins with a definition of national objectives, planning for actions of all types must begin well before the crisis develops with a Strategic Environment Research.
- The second phase is the definition of the policy goals and objectives for the overall action, which must be defined in achievable terms of effects to accomplish the stated policy goals.
- Next phase is to develop what elements of diplomacy, force and other elements of national power will be applied in the specific instance to achieve the identified objectives and policy goals (national strategy),
- Once it is decided what to accomplish by what means the missions must be distributed to the appropriate agencies. SEE figure 5!

Strategic Environment Research (SER) – SER begins well before any specific crisis develops and really needs to be a national-level effort in which the military are major players. SER consist of three major types of research:

- *Contextual Research (CR)* – is conducted to understand audiences that are potential targets of future actions, and what capabilities, strengths and weaknesses they possess. These groups may be informal soldiers of a drug cartel, terrorist groups, sub-national ethnic groups or other non-national groups. This type of research must begin well before a specific action is ordered. Subject of CR is the general geo-political environment prevailing in the world, the nature of human interactions and general human psyche. These are wide ranging studies that would require tapping outside expertise from universities, private and commercial think-tanks, industry experts and other similar places. The next sub-category of CR is regional.
- What can and cannot be done in a given action will be heavily influenced by regional and sub-regional issues. In this realm there are cultural issues as well as geo-political ones. A target audience specific contextual research is needed on an individual basis to determine specific strengths and vulnerabilities of all potential target audiences.
- *Nodal Research* – must be conducted in parallel with contextual research and at all the same levels, though more closely intertwined and less distinct. It is the study of sub-systems that make up a target group.
- *Assessment Research* – provides the groundwork for analysis to determine how well the plan is developing in actual operations. This area probably represents the greatest planning challenge in transitioning to the DE strategy. Traditionally US forces were less than satisfactorily prepared to assess their level of effectiveness, especially as related to systemic or psychological effects. Even years after conflicts, effectiveness of systemic and psychological effects assessment remains more a matter of a debate than scientific study.

For DE the entire conceptualisation of assessment must be expanded to include effects assessment at all levels of employment and across the spectrum of engagement. Effects assessment research must look for discrete indicators that will tell whether actions are moving toward achieving objectives or not.

Determination of Policy Goals and Desired Grand Strategic Effects – As mentioned earlier basic national security objectives are established in the National Security Strategy and the ensuing National Military Strategy. SEE figure 6!

Strategy Development – One commonly used definition of strategy is relating means to end, which constitutes the principal thrust of this specific phase in planning for DE. In strategy development planners and analysts would build a comprehensive list of the range of possibilities and determine which combination of actions is most likely to create the desired effects to achieve policy goals. Next they would compare capabilities to the range of strategy options based upon the current situation and what is already known about the host nation's situation from strategic environment research.

Mission Parsing and Integration – Once a national strategy for implementing policy goals is established, missions must be assigned to the appropriate agencies with an overall lead-agency determined and the actions of the various agencies integrated. Most of the military actions will have to be integrated with those of other governmental and non-governmental agencies. The military will not be acting independently, they will nearly always be operating alongside State, Justice, Treasury, law enforcement, other agencies and when warranted, Non Governmental Organisations (NGO). The key point here is that which agency has primary responsibility for which portions of the action and which has overall leadership responsibility for the entire action.

Effects Assessment – As agency actions proceed, effects assessment must provide feedback to the overall process so, that strategic effects assessment of national policy goals may proceed and that the national level process can continue to cycle. SEE figure 7!

Agency-level Process – Once the military has its mission assignment, it enters its own planning process to develop, execute and assess actions designed to achieve the grand strategic effects the national process has determined are likely to lead to achieving national objectives.

Operations Environment Research – is focused on gaining and evaluating information about friendly and adversary capabilities and intentions, doctrine and the environment in which the actions take place. In other words – know the enemy, know yourself and your friends, allies and neutrals.

Military Objective and Effects Determination – in this phase strategic, operational and tactical objectives for the military actions are defined in terms of effects necessary to achieve the assigned national objectives.

Identifying the Military Strategy – This is the means-to-ends part of the joint planning/execution cycle, that is how to best employ the capabilities and forces available to create the desired effects and achieve objectives.

Identifying Centres of Gravity (COG) – considers adversary and friendly COGs relative to the planned actions. It is important to understand where each side may be vulnerable, as well as where US forces might gain leverage to achieve desired effects and accomplish military objectives. COGs can be defeated and/or protected, but they can also be exploited in other ways.

Joint Campaign Plan (JCP) Development – Once US military planners know what and how they want to do things and what resources they plan to employ, they write a comprehensive and cohesive campaign plan for conducting the action.

The JCP lays out co-ordination and integration of resources and broad guidelines for conduct of the entire campaign or operation:

- Execution,
- Assessment – should be the beginning, middle and the end of the entire planning, execution and assessment cycle. Assessment begins long before an individual action is even envisioned and continues long after it is complete (continuous and iterative cycle). It is critical that assessment is conducted at all levels of employment and that it is directly related to the effects desired at each level. Effects assessment must continuously feed back to the military planning cycle.

Summary: DE Theory – in preparing for warfare or contingency actions, planners must carefully examine the scenario and relevant circumstances to determine the effects required for achieving the objectives established by the National Command Authorities (NCA). DE require greatly expanded knowledge of potential target audiences including a well developed understanding of the strategic environment background as a preliminary phase. Subsequent phases include the determination of objectives and by extension desired effects to achieve those objectives. Applied properly, the DE concept can achieve results out of proportion to the amount of military forces applied.

Chapter 5 – What Are the Major Challenges in Implementing Dominant Effects?

What are the Major Challenges in implementing DE? – Implementing DE will not be an easy task. It will require a culture change within the military forces, which will take many years, because many members of the military community will fall into the pitfall of reverting to their previous war-gaming and operational experiences. They probably also get bogged in the old routine with focusing rather on the input and not on the output part of the process. The authors see two major areas of challenge in fully implementing DE:

- Modifying both service and joint doctrine to fully articulate what can be accomplished with EBO. The important matter is the development of a comprehensive EB concept that can be agreed upon and implemented jointly. The full utility of DE is heavily dependent upon the NCA and inter-agency support. It is also important to define an EB terminology to make sure everybody shares the same understanding.
- There are major issues in the area of C² that must be addressed. Current and pending advances in C² are improving capabilities to observe, detect, analyse and disseminate exactly the kind of information necessary to EBO. Two of the most serious shortfalls in past attempts at EBO have been the ability to collect and analyse information on results of operations and the ability to determine what effects the operations have achieved.

6.12 McCrabb, Maris “Buster” Dr.

McCrabb, Maris “Buster” Dr., *Concept of Operations For Effects-based Operations*, draft, www.eps.gov/EPStdata/USAF/Synopses/1142/Reference-Number-PRDA-00-06-1KFPA/LatestEBOCONOPS.doc

Executive Summary

Effects-based Operations (EBO) is an approach to planning, executing and assessing military operations. It focuses on desired effects more than on merely attacking targets or simply dealing with objectives. EBO applies across the range of military operations, its not domain specific and applies to lethal or non-lethal, kinetic or non-kinetic application of force.

Section I: Introduction

The purpose of this Concept of Operations (CONOPS) is to describe the concept of EBO. EBOs are those set of processes that focus on planning, executing and assessing military activities for the effects they produce rather than the targets or even objectives they deal with.

EBO complements target-based and objective-based approaches. Although EBO is not an attrition-based approach and is not platform specific, it applies across the range of military missions. EBO complements two larger ideas: Expeditionary Air Force (EAF) and Dynamic Tasking (DT). SEE figure on page 3! EAF levies many requirements on operational level C² like the need:

- To quickly employ forces,
- To quickly, decisively and at minimal cost accomplish commander's intent,
- To portray as accurately and as timely as possible the progress towards attaining the commanders intent,
- To achieve as much of the commander's intent as possible given the relatively scarce resources.

DT is to turn the commander's intent into tactical actions rapidly. Target queues are dynamically executed as they are built and relevant target data is extracted from the Joint Battlespace Infosphere (JBI). EBO fits into this vision but can be viewed independently from each. EBO offers distinct advantages:

- It provides a capability not currently available, it allows continuous or periodic EB, OB, TB approaches based on the commander's desire, across the tasks of planning, execution and assessment,
- EBO CONOPS offers a model of the enemy as a system,
- It offers economy of force by allowing discriminate force to be precisely applied against the key links and nodes that provide the most discriminate effects,
- EBO offers an approach to effects-based dynamic Intelligence, Surveillance and Reconnaissance (ISR) management by providing additional flexibility to the commanders.

EBO has also some very crucial concepts. 1) Whether an effect is direct or indirect depends upon point of view and how finely effects are broken down. 2) A cumulative effect (nth order) can be composed of many direct and indirect effects. 3) It is in predicting and assessing indirect effects that EBO gains its military utility. The most important point is that EBO encompasses OB and TB approaches. These are differentiated just by their focus and are not mutually exclusive. EBO explicitly consider the spatial and temporal dimensions of military operations. The key insight of the OB approach is that objectives are decomposed into finer and finer levels of detail to the lowest possible level. The TB approach is the oldest and most common one with the goal to identify specific enemy entities.

It is identical to the OB approach when objectives are physical and not behavioural. SEE table on page 7!

Section II: Planning

If choosing a model to conduct EBO in a wide spectrum of operations in often unforecast locations, some criterions like operational usage, technological adaptability, sparseness and generalisability are important. For military planners it has always been important to know oneself, the enemy and the environment in which one intends to operate. If modelling the enemy, at the tactical level target quality modelling is required, at the operational level it is required that modelling must provide sufficient detail to support decision-making. The model here covers the enemy-as-a-system, as well as the scale from Centre of Gravity (COG) down to specific Desired Mean Point of Impact (DMPI). A major advantage of EBO is that it explicitly seeks to understand, trace and anticipate direct and indirect effects as they course through the enemy as a system. This is the heart of EBO, predicting, then assessing behavioural effects at the strategic or operational (macro – COG) level resulting from physical effects occurring at the tactical level (DMPI). EBO starts from the commander's intent, the end state, purpose, method and risk of the anticipated military mission. During Mission Analysis (MA) specified, implied and critical or essential tasks are developed – if chosen an EBO approach the desired effects are to be determined. If analysing tasks in terms of their desired behavioural effects, the following D^{II} taxonomy can be utilised for COG analysis: deter, destroy, disrupt, degrade, decapitate, divert, dislocate, delay (or isolation), deny (or halt), deceive and defend (plus demoralise). For COG Analysis Warden's model, which regards the enemy-as-a-system with the five concentric rings is helpful because of its key insights:

- It covers the scope and scale of a state,
- It provides replication of each element at ever finer levels of detail,
- It explicitly allows the identification of interconnections between various COG, target system and so forth.

The relationship between desired effects, objectives and tasks is the following. Tasks are defined as work to be done and are tied to the physical actions that cause physical effects. At the other end, the desired cumulative effect is the same as the desired strategic or operational level objective. Between objectives and tasks an EB approach seeks to understand, trace and anticipate the ways direct, physical actions produce indirect, behavioural effects that will accumulate to achieve the overall desired effect or objective. Another key element is that effects-analysis explicitly considers the spatial and temporal dimensions of effects. For both the EB and OB approach the ultimate goal is behavioural change of the enemy. Barlow's National Elements of Value model identifies seven areas. The variable sizes of the spheres relate to how important each NEV is to the national leadership. The thickness of the linkages relates to the varying importance of each NEV to each other.

The enemy reactions are broken down into three cases (SEE Figure 10):

- How the enemy *should* react – is either most beneficial or least restrictive,
- How the enemy *can* react – what is known about the enemy's capabilities,
- How the enemy *could* react – the enemy has certain capabilities not now known to possess.

Based on the composite of the models above various strategy options can be formed to provide a fully specified COA option: *what, why, how, with, who, where, when*. To be successful EBO has strong information requirements from which three information needs that especially apply, (1) political military leadership data, (2) interaction data and (3) indicators of effects, which are usually quite different than traditional indicators of battle damage. Because this is so, EBO lends itself to effects-based dynamic ISR management. EBO has also a strong modelling, stimulation, simulation and analysis requirement.

Section III: Execution

The classic tasking order process like Air Tasking Order (ATO) bundles targets, weapons and platforms into a single usually time bounded package and sends that to the executing tactical units with little direct interactions between executing units and tasking organisation. The Dynamic Aerospace Execution Orders (DAEO) breaks the classic model into two locations. First it is a continuous process and secondly it is highly interactive between tasking and executing organisations. Furthermore it offers three advantages:

- As a continuous process it more closely connects planning and execution, therefore tasking organisations and executing units are more fully aware of each other's limitations,
- Operational level commanders can more closely control operations if they desire and
- It can be continuously built over any period of time and enhances flexibility and responsiveness to planned military operations.

The last one is important especially when dealing with Time Sensitive Targets (TST) or Time Critical Targets (TCT) which are defined as fleeting opportunity targets that require immediate response (like aircraft, missile, downed pilot). A key point is that TST/TCT must go through the entire cycle fair quickly – countering dynamic events with F²T²EA (find, fix, track, target, engage and assess). A derivative benefit of both an EB approach and DT is a more effective means of allocating scarce ISR assets. Since EBO is focused on direct and indirect effects, it provides a wider set of indicators. By having the widest possible set of indicators, planners can be best optimise their ISR asset fleet.

Section IV: Assessment

COGs are often not accessible directly and indicators are often not readily available to directly show the desired behavioural or even occasionally physical effect. Among indicators the most common one is physical, to support operational assessment (tools are like taking images, COMINT, ELINT, SIGINT and HUMINT). Behavioural indicators for behavioural effects are the hardest to quantify and to determine. This process starts with predicting the cumulative effect and then separating out the direct from indirect contributions and then separating out the physical and behavioural effects. The next step requires connecting physical actions and effects to behavioural effects. The third step is predicting indicators of behavioural effects. The last step requires ascertaining collection assets capable of observing directly or indirectly the behavioural effects. Both physical and behavioural indicators of effects are generally required, which are closely tied to mechanisms. SEE task lists on page 25! The rest is interesting with the sorts of assessment.

Section V: Summary

EBO as a cross-disciplinary approach rests on few key principles:

- A rigorous approach to dynamical systems analysis,
- An understanding of the direct and indirect interactions between elements within the dynamical system at each level of aggregation,
- An understanding of the different ways the elements within the dynamical system might react to perturbations of the dynamical system,
- This understanding must consist of both past explanation and future prediction.

Biggest impediment is the re-orientation in perspective when applying EBO is “mirror imaging” and “ethno-centricity”.

6.13 Miller, Charles B.

Miller, Charles B. (Lt. Col.), *Enhancing The Strategic Application of Effects-Based Operations Concepts*, U. S. Army War College, Carlisle Barracks, 09 April 2002, www.stinet.dtic.mil/cgi-bin/fulcrum_main.pl

The US must develop a system that integrates and synchronises various elements of power (diplomatic, information, military, economic) in a way that maximises the potential for achieving the desired effects.

Purpose

The world has become increasingly complex, confusing and dangerous. Question is how the military concept EBO can enable the effective integration of (national) elements of power.

New global environment

The global environment is characterised as volatile, uncertain, complex and ambiguous. Today’s global problems are based on two phenomena: first the disappearance of the bipolar world order of the Cold War, the second is globalisation with the technology’s impact on the world’s economic, communications and transportation infrastructures. The lines between war and peace, domestic and international, combatant and non-combatant, friend and foe have become increasingly nebulous, indistinguishable and dynamic. In addition to these changes the nature of war has also changed, some call for a Revolution in Military Affairs (RMA). Innovative application of new technologies, changes in military doctrines and new operational and organisational concepts characterise this trend. Diminishing protection by geographic distance, increasing regional threats by weak and failing states, diffusion of power and military capabilities to non state actors go together with increasing unpredictability of locations of future conflicts. Rapid advancement and ready availability of military technologies, increasing proliferation of CBRNE and ballistic missile technologies make the challenges more dangerous. Nobody can afford to continue relying on a concept based on attrition and annihilation.

Effects-Based Operations

EBO has a potential to planning, executing and assessing the conduct of complex crisis operations. It is rather a shift in mind-set than it is a system or technology. It examines the causal effects and linkages between actions and desired outcomes by providing a framework that highlights linkages to other elements of power through the effects they can have in influencing desired conditions and outcomes. EBO “is a process for obtaining a desired strategic outcome or effect on the enemy through the synergistic, multiplicative and cumulative application of the full range of military and non-military capabilities at the tactical, operational and strategic level”. SEE figure on page 5! With EBO each action has the potential for more than one effect and that particular effects may be influenced simultaneously by more than one action. Some effects may be obvious and expected. Others can be unexpected or undesirable, resulting as 2nd, 3rd and nth order effects of an action or combination of actions and effects. In EBO knowledge of the enemy is vital to clearly discern the connections between the desired outcomes in terms of behaviour and reactions of the adversary, the potential actions we can take to achieve the desired causal effects and ability to assess, monitor and adjust effects application in real-time.

EBO process

EBO is designed to be a continuous cycle. SEE figure on page 3! Five distinct steps can be observed in an effects-based approach:

- The first step is gaining full and near complete knowledge of the enemy. EBO requires a complete and clear understanding of the political, military, economic, cultural and informal environment that shapes the behaviour of the enemy at a given moment.
- Next step is to determine the desired effects, determined on detailed understanding of the adversary and his environment. This step defines how to shape the enemy’s environment through effects in order to achieve the desired objectives. It requires the identification of causal links between actions and desired outcomes.
- Next step is the application, which determines the best mix of available elements of power (DIME) best suited to achieve each necessary effect to achieve the desired outcome.
- Parallel to the application the assessment steps starts to predict the effects various planned actions will most likely have.

Adjustment is needed if the current approach to achieve desired effects, fails. An assessment may be made to assumptions, environmental factors, interpretation, and/or balance of the application of elements of power to achieve success.

EBO focuses on understanding the enemy as a complex interrelated network or system of systems. EBO approach is aimed at the means of an adversary to conduct undesirable behaviour. This approach is aimed at those effects that can impact the enemy’s will to continue with that undesirable behaviour. EBO focuses on targeting those critically vulnerable areas where the effect created goes directly to the heart of the enemy’s COG or will continue. The two critical parts of planning EBO are:

Identifying the causal linkages between the desired outcome and those n^{th} order effects that could result in the desired outcome,
Matching required effects with the most elements of national power to achieve those effects.

COG and NEV model with two FIGURES!

6.14 SAS-025 Technical Team on Overall Long Term Defence Planning

Technical Team on Overall Long Term Defence Planning, *Handbook in Long Term Defence Planning*, NATO Research and Technology Board, Panel on Studies, Analysis and Simulation (SAS), SAS-025, Final Draft, August 3, 2001

Preface

Long Term Defence Planning (LTDP) deals with shaping tomorrow's defence forces for an alliance or a nation. Given the long period of implementing a new force structure, LTDP focus on issues ten to thirty years ahead. Factors like the pace of scientific and technological change and the complexities of the international environment make it a challenging task. Limited defence budgets, difficult to define threats are also factors contributing to the difficulties of establishing a LTDP Process (LTDPP).

Executive Summary

Long-term Planning (LTP) is essential for organisations characterised by the combination of uncertainty of the future and poor flexibility with regards to resources employment. Cold War planning was characterised by a single major scenario dominating LTDP with a focus on short-term adjustments to capitalise on new technology and to counter developments by the threat. Recent operational experiences have shown that forces designed for Cold War high intensity operations are not appropriate anymore. SEE figure on page 4! LTDP takes national security interests and goals as inputs and typically produces sufficiently ten to thirty-year force Structure Development Plans (SDP) including defence objectives and capabilities. To match the national security policy with a cost-effective force structure development outlined in the LTP, a portfolio of scenarios is needed. After scenarios have been built with taking policy and environmental constraints into consideration, force package options are generated to fulfil mission objectives within each scenario. Force packages are then tested to ensure that they are viable and suitable for the campaign, i. e. they will meet the objectives with the minimum required level of force consistent with the level of risk outlined in the scenario. This set of ideal force packages are then turned into an overall force structure, taking account of factors like concurrency, rotation, maintenance and training. The difference between the final force structure and the current one gives rise to the SDP to align the long-term force goal with current structure and future programmes.

Introduction

Long-term Planning (LTP) is essential for organisations characterised by the combination of uncertainty of the future and poor flexibility with regards to resources employment. LTDP deals with shaping tomorrow's defence forces and allows organisations to learn to anticipate and respond more appropriately to events as they unfold in real time.

Long Term Planning Definition and Approaches

Defence LTP is a process that investigates possible future operating environments and develops a force SDP to best fit the organisation to those environments with a number of constraints. Major new developments and investments, implementing new required capabilities and competencies as well as changing organisational structure take a long time.

A carefully designed LTDPP ensures cohesion across various planning horizons and sub-disciplines to achieve overall force cost-effectiveness over the long-term. It gives the organisation an opportunity to reflect about the future by anticipating and responding more appropriately to events as they unfold. Different planning approaches have been applied to this complex area over the years, with focuses on the planning process itself, the technology developments and functions of concrete scenarios. Any long-term planning method will include elements from beneath, but two approaches seem to be prevalent, the resource consciousness and scenarios:

- With a focus on the planning process we can differentiate (1) top-down planning and (2) resource constrained planning. *Top-down planning* is a Strategy-to-Task (STT) approach and begins with the specification of top-level policy interest and objectives with the strategies supporting policy objectives (cascading down through lower levels in the process). *Resource-constrained planning* provides a viable capability that is sustainable within the provided budget. No effort is made to investigate force structure options that are more expensive.
- With focus on the technology developments there are (1) technology optimism, (2) risk avoidance, (3) incremental planning and (4) historical extension. *Technology optimism* has the goal to obtain operational and strategic superiority through technology. The force structure is designed so that it can keep pace with the state of the art in technology. In *risk avoidance* proven concepts and structures are extrapolated and extended. It continues with current ways as long as they are deemed to be successful – or maintain the status quo. *Incremental planning* uses existing capabilities as a foundation for new capabilities. Initiated changes attempt to evolve these capabilities with well-known improvements. The exploitation of near term developments and options are central. It is an instance of risk avoidance approach. *Historical extension* has legacy thinking as basic premise – what worked in the past, will work in the future. The analysis of future operations is based on historical analysis, with filtering out those factors, which contributed to the results to take advantage of the positive ones while avoiding the negatives.
- With focus on functions of concrete scenarios we can find (1) capabilities, (2) scenarios and (3) threats as foundation. *Capabilities-Based Planning (CBP)* involves a functional analysis of expected future operations. The outcome is not concrete weapons systems and manning levels but a description of the task force structure units should be able to perform.

After the capability inventory is defined, the most cost effective and efficient options to implement these capabilities as physical force units can be found. *Scenario-Based Planning* (SBP) utilises a representative set with environmental and operational parameters of situations for the employment of resources. Capability or system requirements are determined from assessments of the ability to achieve objectives.

Threat-Based Planning (TBP), the preferred planning methodology of the Cold War involves identifying potential adversaries and evaluating their capabilities. Own capabilities and requirements are chosen so as to outperform the opposition.

LTDP: Its Wider Context

Security interests define defence goals as part of the defence policy development. The LTDPP is hence the link between the defence policy and mid- and short-term planning activities. Since LTDP is but one component of the overall defence planning context it must accept inputs from the other processes and provide outputs to other processes. SEE figure on page 12! The overall process starts with the desires of the nation to uphold and promote its values and interests. It then identifies how defence will contribute to achieve these desires by generating defence forces capable of achieving defence goals, subject to economic and other constraints. The process has many feedback loops allowing reverse casualty (future force concepts influence the defence policy and existing programs influence the planned force structure). LTDPP converts broad categories of goals (like defence policy developments) into operational tools for sensible force structuring and turns broad force concepts into a concrete structure development plan (like medium and short term planning). If we take the Defence Policy Developments (DPD) as a process, then the following inputs can be defined according to figure 2:

- *Economics* – stand for affordability. An LTDPP must produce a plan that corresponds to the size of the future budget constrains. Given the uncertainty, plans must consider robustness to changes in budget levels to achieve best operational effectiveness in the most likely budget forecast.
- *Technology* – technology changes cause often changes in warfare. Significant new operational capabilities may again require new doctrines. A technologically change can radically shift the balance of force effectiveness between potential military adversaries as well among the candidates for capabilities within a nation's force structure. A forecast of trends and potential quantum jumps in technology are major assumptions into the cost-effectiveness of various defence capabilities, which are a major part of the LTDPP itself.
- *Geopolitics (general)* – the efficiency of the LTP process is increased if security priorities are crystal clear. Unfortunately the nature of the world and politics makes defence policy often vague. Defence policy begins with an assessment of the future strategic environment, which is then linked to the goals and desires of a nation in the context of protecting and promoting own interests. Potential adversaries, world regions and the nature of potential conflicts and operations are typically sketched out. After that the policy identifies the responsibilities and expectations placed on the defence community. The defence policy provides goals, objectives, roles and responsibilities to counter those threats.

- *Geopolitics (regional) and scenarios* – scenarios provide focus and detail against which issues can be explored and assessed. They enable detailed evaluations of proposed concepts and force structure options. Although they do not predict the future, scenarios address variables and their interactions in a tangible and comprehensible picture of a plausible future, while prediction is aimed at forecasting a specific future. In this context scenario selection is a critical activity to capture the full spectrum of potential future tasks that taken together represent the main different challenges to the future force (hierarchy of operations and the range of objectives and interests must be addressed).
- *Current force structure* – and contracted programs mirror the fact that military equipment remains in service for decades. Defence development and procurement programmes will typically appear out of phase after a long-term planning cycle. This can cause that previous goals may become obsolete with acquisition programs being abolished. The stopping of ongoing programs can be seen as a consequence of not having a robust LTDP.

Best Practice In Long Term Planning

For backbone SEE figure on page 15! For the best practice the following steps are recommended:

- *Step 1* – inputs (policy, environment and a set of scenarios). Essential starting point is defence policy, which may not exist in a way sufficiently clear for LTP and therefore the LTDPP must develop one. Another essential is the scenario set, consistent with that policy and representing situations in which the forces might be used.
- *Step 2* – campaign options with campaign plans to sufficiently describe the future operating environment. Objectives, aims and missions of the opponents within a scenario are assessed and clarified. Within non war-fighting operations Rules of Engagement (ROE) need to be well understood. Further important part is assessing the opponent's Courses of Action (COA). With the broad campaigns defined, the implied tasks need to be determined by successively decomposing the scenario until the tasks of individual force elements are defined.
- *Step 3* – (as initial guess) force packages for operations are defined with the aim to succeed in the respective missions with the lowest possible cost. Although the entire range of force elements need not be formulated for all scenarios, but the entire force structure need to be tested in a sufficient number of scenarios.
- *Step 4* – operational analysis involves the optimisation of the force packages, mostly in an iterative process with testing and refining the packages in light of each scenario and over all of them in order to achieve a high quality result (involves also sensitivity testing). Force generation means that a fully functional force package is in theatre, because the units and people have been trained and materiel acquired and well maintained. Deployment stands for the fact that sizeable homeland and expeditionary operations pose deployment challenges. The right operational force mix should be available at the right place and the right time. Early forces have to accept a higher degree of risk, and good estimates between front line and support quantities are needed. The support package must contain a certain redundancy. Performance in theatre means the assessment of the ability of forces to meet objectives.

In war-fighting cases a traditional role of Operations Research (OR) but in non war-fighting cases a less mature area. Sustainability and rotation stand for one of the most important determinants of the success of a force, the continuous provision of logistics. Concentrating on the immediate needs of a mission such as getting the required forces into a theatre and maintaining them there underestimates the needed force size. Two to six times the forces in theatre may be required in total and so although analysis can take the form of simple ratios, how these are derived is very important. Command and information means that having the force, a check needs to be made that the processes above would not have been unduly constrained by lack of information, information processing and the limitation of communications.

- *Step 5* – concurrency testing means that operations theatres may well need to be served in parallel. Two or more operations are to be carried out sometimes at the same time. Concurrency analysis needs to examine a wide combination of scenarios and tasks. Many may not be demanding war-fighting but simpler ones such as garrisoning in remote areas. Decisions will need to be made of how important these tasks are relative to others as forces may sometimes be subtracted from low priority ones to participation in more vital missions. Taking concurrency into consideration, substitution should be considered (infantry with cavalry).
- *Step 6* – total force structure or force pool is the cost effective optimal force structure. It is the summation of requirements deriving from the operational scenarios, including concurrency issues, adjusted upwards for force production issues. Once this is done, the total force structure costs may be calculated.
- *Step 7* – costing means that the total force structure is assessed in the long-term perspective to ensure that it is within the budget constraints (resource limit influences the security goals and the scenario set). Total force structure costing can be done in two different ways, either by discounting all costs back to a common start year with the Equivalent Annual Cost method (EAC), or with the Discounted Cash Flow (DCF) method.
- *Step 8* – risk/cost tradeoffs are needed, because even the cheapest force structure required to meet aspirations could not be affordable. Policy goals and budget constraint cannot be both met. There must be options with regard to reducing the level of ambition in the policy goals. By deleting force structure elements cost can be reduced. This action reduces the performance and increases the risk within each scenario. Another option is to delete entire scenarios (missions). Deletion of scenarios and reduction in security ambitions is really the heart of making defence policy.
- *Step 9* – recommended force structure with options are presented here for the areas where inconsistencies exist. The recommended force structure is presented in the form of a structure development plan where organisational units and consequent investments and major competence building programmes are made explicit.
- *Step 10* – feedback stands for the sequence and bi-directional nature of the LTP process. There is feedback between the end product and the policy goals and constraints, and also between and within all steps. The essence of LTDP is to focus on key drivers, broad conclusions and concrete force structure capabilities.

Organisational and Implementation Issues

Seen from the decision-makers perspective the output of the LTDPP is a small set of internally and externally consistent and resource balanced force SDPs describing how defence capabilities and supporting manpower, equipment, infrastructure etc. evolve over time.

Key Insight and Recommendations

SEE pages 25-26!

6.15 Smith, Edward

Smith, Edward. A. *Effects Based Operations, Applying Network Centric Warfare in Peace, Crisis, and War*, CCRP Publication Series, www.ccrp.org/publications.

Effects-Based Operations (EBO) is a very simple idea. In the Cold War era views of the national security and the role of the military was narrowly focused. Wars were defined as conflicts among coalitions. Industrial-age warfare was very symmetric, with air to air, tank to tank and submarine to submarine encounters. In this context measures of attrition and territory as direct results of military actions made sense. Now the mission space and the environment in which we operate have changed. The missions are no longer purely or predominantly military; they require balance of military and non-military means to achieve. EBO shifts our focus from targets and damage to behaviour and in a broad multi-level interaction the stimuli that alter behaviour. It allows the attrition-based metric of Probability of Kill (PK) to be replaced by an effects-based Probability of Options (PO) metric to provide a useful option to deal with a given situation.

Chapter 1 – Why Effects-Based Operations? Military Operations in a New Security Environment

The working hypothesis is that EBO constitute the conceptual framework of turning our network-centric capability into a national advantage. In essence EBO provide the end for our network centric means.

The attacks of 11 September 2001 fundamentally changed our security environment. The system of strategic deterrence that had provided stability in a changing world visibly collapsed. Now we have a threat from non-state terrorists armed with weapons of mass effects to overturn the status quo. This demand changes the way in how we create and apply military power. This security environment calls for a more nuanced approach depending heavily on a forward, prevention-based, conventional deterrence and the balanced application of civil and military power. The overt hostility towards the so-called American globalisation makes the transformation to a single international system with the free movement of people, investment, goods and ideas not easy and not without significant peril. The course of this internationalisation has not and will not be smooth. There will be violent reactions and destabilising changes in established cultures and institutions. The lasting solutions to the unrest wrought by globalisation are political, social and economic in nature, not military.

The stability of Cold War strategic nuclear deterrence rested on the facts that an attacker could be immediately identified and the attacker had roughly equivalent forces or population at risk. Now the problem has shifted to that of a deterring non-state adversary armed with weapons of mass effect and acting either alone or as the surrogate for some hidden state sponsor. Such an adversary has little at risk in such an attack. Conventional deterrence differs significantly from nuclear deterrence in its complexity, logic and execution. The logic revolves around the factors retaliation and prevention. *Retaliation* – conventional deterrence can rely on the threats of retaliation, which may also take the form escalation threatening to expand the conflict beyond the confines of a foe's desired battle space. *Prevention* – involves closing any niches an adversary might seek to exploit.

Our current approach to warfare is largely attrition based with a focus on the destruction of an opponent's physical capacity to wage war. Attrition (rendering an enemy physically incapable) is not a product of the Industrial Age, it has been found throughout history but the following needs to be taken into consideration:

- Attrition warfare has not been an arbitrary choice, rather a last resort. No participant in any of the wars (cited) set out to fight a war of attrition. The industrialised state provided the physical means and nationalism the cohesive popular will.
- We cannot assume that an opponent will fight the kind of war planned. Opponents adapt to challenges in unexpected ways. Approaches to warfare must be flexible and dynamic enough to deal with intelligent opponents.
- Attrition warfare is characterised by an overall strategy of the participants with a focus on the cumulative destruction of the opponent's physical capacity to wage war in order to achieve victory.
- In many of the wars the ultimate determinant of victory was not physical destruction but the enemy's will to continue the struggle. The underlying rationale was to induce a collapse of the enemy's will.

These physical and psychological dimensions point to the degree of complexity that is involved in understanding of success and failure. This non-linearity between means and will represents the fact that war is a clash between Complex Adaptive Systems (CAS). A CAS is an entity that evolves and adapts to its environment and has a never entirely predictable behaviour. This model of complex behaviour combining physical and psychological dimensions leads us to examine the impact of symmetry on the nature of conflicts. This symmetry of will and means allows measuring engagements and campaigns in terms of forces and capabilities destroyed, which shaped our traditional perception of war. Asymmetry in warfare with differences in will and means has been remarkably successful in history. In the current strategic environment asymmetry has come in addition to symmetry. In general the more the will and means of the adversaries are symmetric the more realistic is a fundamentally attrition-based conflict. In contrary an asymmetry in will and means of the adversaries will lead to an effects-based approach of the conflict. SEE table on page 43! Attrition-based operations do not work well against an asymmetric adversary with a minimum of dependence on conventional physical dependence on waging war. The effects-based approach with a focus on will and behaviour promises to give the non-linear impact needed to succeed. With this approach we can achieve our military objectives without protracting the conflict with massive casualties.

The core of this approach is not to destroy targets, but to set up an action-reaction cycle to produce certain behaviour. In this framework we can apply the full range of actions that a nation may undertake in a unified national strategy to deal with the combination of both old and new threats.

Chapter 2 – Network-Centric Operations: The Starting Point

Given the radical change in the existing world order we should think in terms of some form of Revolution in Military Affairs (RMA). Network Centric Warfare (NCW) and EBO constitute an embryonic form of military revolution. NCW link all aspects of war fighting into a shared situation awareness and shared understanding of command intent so as to achieve unity and synchronicity of effects that multiplies the power of military forces in the physical, informational and cognitive domains.

NCW is closely aligned with the emerging new technologies of the information age with the search for greater combat efficiency as common thread. The driving force behind NCW is the revolution in information technology, an interlocking set of three different technological revolutions:

- *Sensor technology* – consist both of a move toward sensors that are able to achieve a comprehensive, near real time surveillance over vast areas and a move toward smaller, cheaper, more numerous sensors that can be netted to detect, locate, identify and track targets. These trends can provide the quantity and quality of data to create a situational awareness that is global in scope and precise in detail.
- *Information technology* – the military success of the sensor revolution is contingent upon an equal and parallel success in networking them into a system of systems. New information technology provides this network backbone. At the end this information technology allows distributing information to any shooter anywhere in the world at near real-time speed.
- *Weapons technology* – the focus of this weapons revolution is towards smaller, cheaper and more numerous weapons that are precise enough to exploit the data provided by sensors and information systems.

Combat efficiency is figuring out which technologies in which combinations might best enable us to meet our strategic objectives and provide the best return of invest. The triple technical revolution poses five challenges:

- The three technological revolutions are largely independent of each other and almost inevitably out of synch.
- There will be a continual interaction among the new technologies. Innovations in one area may be expected to have a direct impact on the utility of technologies in other areas.
- The synergies that emerge from the interaction of the new technological developments can be both positive and negative.
- There is no monopoly on the system, because this triple revolution is either civilian or readily available on the international market.
- None of the three revolutions is close to being finished.

By applying the principles of a system-of-systems engineering we can identify some of the potential synergies, which are the essence of transformation. NCW applies the new technologies to two ends (1) to explore new ways to do existing missions better and (2) to find ways to undertake missions that we might never before have attempted. Explanation of the OODA loop in the following pages. SEE also figures on pages 78, 80, 82, 86, 88, 89! The changes wrought by new technologies and NCW must enable us to something more than just improve the efficiency of our attrition. Network centric operations may enable us to get inside the enemy's OODA loop.

With NCW we can use the increased pace of our operations to overwhelm the enemy and lock him out of an effective response. In fact, the real efficiency that we seek with the new technologies and network-centric thinking is something very different from destruction.

Chapter 3 – What Are Effects-Based Operations?

EBO is shaping the adversary's thinking and behaviour rather than simply defeating his forces. EBO is neither simply a tactical level warfare nor peculiarly military in nature, it encompasses the full range of political, economic and military actions that a nation might undertake to shape the behaviour of an enemy. The objective of an effects-based strategy is to induce an opponent to pursue a Course of Action (COA) in keeping with our interest. EBO offers the scope and flexibility to do much more. It offers to look at military operations in peace, crisis and war in the context of a cohesive overall national, political, economic and military effort. EBO increases combat efficiency by concentrating efforts on enemy will and by applying operations across the spectrum of conflict. Attrition remains at best an indirect assault on the will of the enemy to continue the struggle. It also points to an obvious fact, that the vast majority of our military operations do not involve either combat or destruction. A military force capable only of war fighting will be of small help in preventing wars, containing conflicts or building a stable deterrence. The political reality is that although we may focus on defeating the enemy, our military operations almost must also seek to support our allies, reassure neutrals and deter adversaries. Thinking in terms of EBO can provide a basis for looking at how military operations might best be orchestrated to shape the behaviour of friends and foes alike to prevent war and preserve peace. *EBOs are co-ordinated sets of actions directed at shaping the behaviour of friends, neutrals and foes in peace, crisis and war. The definition reflects the reality of today's broad-spectrum military operations.* The reality is that the most frequent and persistent military missions have been preventing wars. In this context military forces are used in conjunction with political and diplomatic actions to shape behaviour either by actions of or by the very presence in a particular area. The term effect refers not only to the direct impact, but also to the chain of successive events or indirect impacts. *An effect is a result or impact created by the application of military or other power.* They may be either kinetic or non-kinetic and physical or psychological/behavioural in nature. From this point EBO can be seen as stimulus and response interactions and explains what we are attempting to do with it. By destroying capabilities we create a physical effect that in some way delimits the enemy's physical behaviour. Actions as stimuli include all moves that a military force makes to influence the decision-making process.

This approach opens the way to link physical with psychological effects by combining a superior knowledge of the enemy and of a given situation with the increased speed, precision and agility to attack enemy decision-making. Destruction for example sets a psychological process of perceptions and decision-making in motion.

EBO focuses on more efficient destruction, but upon the enemy decision-makers and their ability to take coherent action. Destruction has clearly an impact on enemy will and psychology and not just on physical capabilities. This also means that we would not so much get inside the enemy OODA loops as we would disrupt them. SEE figures on pages 118-119, 121, 125! With this in mind the action (stimuli) focuses on the human dimension of the battle with a very non-linear outcome. The more frequent the stimuli, the greater the chance that they will occur at the right time to obtain the desired effect on the enemy decision-making process. The other approach would be to organise and plan differently builds on the concepts of self-synchronisation and shared situation awareness. SEE figures on pages 128-129, 131, 132! Finally we could both multiply the number of cycles and compress the time needed to execute each cycle. With this we provide so many stimuli that adversaries can no longer act coherently, but would be constantly forced to recycle their decision-making. A classic psychological effect encountered in military operations is the creation of chaos on the battlefield. With EBO a relatively small application of military or national power at the right time might have disproportionate and potentially decisive impacts. In this context chaos encompasses all those military operations that are uncontrollable and therefore unfocused and incoherent. The opposite is order, which is controlled, co-ordinated and focused on a given objective. SEE figure on page 136, 138! If we can consistently operate beyond the other's edge of chaos, we may be able to induce a state of despair in which further resistance is futile. In an asymmetric conflict forces are not likely to be similar in character and the strategies and courses of actions followed by each side are likely to be very different. The side that is bigger and better equipped does not necessarily wins the battle. One side in the conflict might choose to fight asymmetrically, that is to define a niche within which it can operate. SEE table on page 147, 149! Since the desired psychological effect depends more on pace and scope than on damage to specific targets, control can remain highly decentralised and still successful. If actions can be anticipated or instantly detected and responded to, then much of what enemies gain can be negated.

Chapter 4 – Shaping Behaviour: Operations in the Cognitive Domain

The key in this working concept is the process that takes place in the mind of a man. With the OODA context we can intuitively understand that operating faster than our opponent confers an advantage. Military-strategic and geo-strategic dimensions point to the need to consider actions in terms of multi-level, multi-arena impact that spans friends and neutrals as well as enemies. The farther we move away from the tactical level, the more we are obliged to look to what might be termed as operations in the cognitive domain or the human dimension of war. The process of decision-making can be described in terms of three different domains: (1) physical, (2) informational and (3) cognitive.

The domains extended well beyond just military operations to all of the actions that a state, government or non-state actor such as a terrorist organisation might take.

These three domains provide a general framework for tracing what actually goes on in the stimulus and response process inside human minds and human organisations and how physical actions in one domain get translated into psychological effects and then into a set of decisions in another domain. The domains in detail:

- *Physical domain* – actions in this domain may be political, economic and/or military in nature. All can affect the opponent's decision-making process or can change the way in which an opponent or other observer understands or makes sense of a developing situation. It also encompasses those physical effects that our actions create. SEE table on page 162!
- *Information domain* – includes all sensors that monitor physical actions and collect data. It also includes all the means to create an information stream. The information domain is the means by which a stimulus is recognised and conveyed to a human or to a human organisation. SEE table on pages 165, 168! The character of the information domain and the nature of what can or cannot be observed are irrevocably tied to the process of decision-making in the cognitive domain. Human-derived information is far more difficult to handle than sensor data. It involves a cognitive process on the part of the analyst.
- *Cognitive domain* – is the locus of the functions of perceiving, making sense of a situation, assessing alternatives and deciding on a COA. It relies on reason and belief, which are pre conditioned by culture, education and experience. The challenge is how human decision-makers perceive the actions in the physical domain as reported to them and then how they make decisions. The human dimension reflects the condition of the individual decision-maker and factors such as emotions, physiology (like fatigue) and beliefs – how human beings in general perceive and understand a given situation. SEE table on page 175! In general humans tend to reason largely by analogy, a process of comparison of a given set of circumstances with generalised mental models. The issues of prior knowledge of culture, training, education and mental models are crucial because they affect how a situation is perceived and thus, the rest of the cognitive process. The prior knowledge, mental models and resulting understanding of a situation, provide the basis for sense making. SEE figure on pages 178, 180, 183! The real problem lies in the interface between the cognitive domain and the information domain.

The cognitive cycle provides the conceptual base for understanding three essential aspects of actions or stimuli that we are trying to use to shape behaviour.

There is a VERY IMPORTANT REMARK:

To proceed we need to assume that decision-makers in a confrontation would be rational with a substantial degree of rational thinking and calculation even though this rationality may not be the same rationality that a Western mind would pursue.

Chapter 5 – The Rules of the Game: Putting Effects-Based Operations into a Real-World Context

This ex-post facto analysis uses three examples of the 1967-1973 Arab-Israeli hostilities as a background to examine Soviet and American actions. By doing this, the following observations – which indicated dynamism in the use of military forces very different from attrition-based models – were made:

- None of the operations involved actual combat. The principal objective was to avoid such hostilities.
- There were actions in each case that were carefully targeted by operational commanders and national leaders to shape the opponent's behaviour.

The critical question was how certain military actions would be perceived and by whom.

- The military operations were just a part of a still larger, longer and more complex diplomatic, political and economic effort involving all the regional actors.
- The interactions of both fleets during the operations were dynamic.

With the examples and observations we can discern some general operating principles or rules of the game for EBO. The military responses in each of the three crises consisted of a succession of what might be termed action-reaction cycles or a series of two-sided interactions. Six basic rules of the game describe and define EBO:

- *Actions create effects* – in the cases the focus was on moves or actions rather than on targets and destruction. The actions of the military forces did not need to include the destruction of opposing forces and capabilities in order to have an impact or to create a desired effect. The focus of the actions undertaken was to use manoeuvre itself as the agent for creating the desired effect. In this context we can conclude that in an EBO it is not necessary to destroy an opponent's capabilities to create an effect.
- *Effects are cumulative* – in the responses of the militaries the action-reaction cycles clearly followed a similar pattern. The lessons learned from one interaction affected the actions and reactions of the succeeding cycles. In EBO, actions and their effects are not and cannot be isolated. They are interrelated and create a cumulative overall effect.
- *Reaction cycles will have active and passive participants* – interactions were essentially action-reaction cycles involving two active players in a tactical level engagement. But surrounding these players were successive layers of interested parties, which would have been immediately and directly affected by its outcomes.
- *Action-reaction cycles occur simultaneously in multiple dimensions* – interactions at each level and in each arena took place simultaneously. This indicates that in an EBO we have multiple complex interactions on at least four levels and in more arenas.
- *All actions and effects at each level and in each arena are interrelated* – the military actions took place in the context of complex diplomatic, political and economic manoeuvring. Actions and effects at all level and arenas must be treated as interrelated and cumulative over time.
- *Effects are both physical and psychological* – a physical action had a direct physical effect, which gave rise to a series of subsequent actions and decisions, which manifested as changed behaviour. Effects have both physical and psychological dimensions. The central thesis of EBO is that physical actions can produce physical and psychological effects. These psychological effects in the decision-making process become manifest in behaviour. SEE table on page 224!

Chapter 6 – The Challenge of Complexity

At the heart of EBO is the idea that our actions can affect the outcomes of an interaction. The link is more than a general loose relationship and with specific, well-chosen actions we can drive specific effects to take place.

The problem is the complexity involved, although the task translating actions into effects is clearly not impossible. We should not seek exactness, when only approximation is possible.

- *The nature of actions* – It is to determine the variables associated with the *what* and *how* of an action. *What* is the nature of the physical action undertaken and it describes the object or event to be observed. *How* is the nature of the power used to undertake the action. *Scale* stands for the effort and the impact, which set together the quantitative size of the problem. *Scope* encompasses the geographic dimension (the physical battle space) and the operational dimension (defines the nature of the battle space or the warfare environment). *Timing* encompasses the dimensions of speed (the ability to execute or reaction rapidly enough to create an effect), duration (defines how long an action endures), synchronicity (the ability to cause action to occur at exactly the right time or the right sequence to achieve a disproportionate impact) and visibility (stand for the fact that any observable action creates some sort of effect).
- *Effects: To do what?* – EBO revolves about the assumption of a causal link between a stimulus and a response and it is about the human dimension of the conflict with human decision-makers and human organisations involved. Since the behaviour of CAS is non-linear, it cannot be entirely predicted. But if one deduces a series of most likely actions and reactions it is possible to predict at least a limited cause and effect chain. Effects are produced by some physical action and they can either be predominantly physical (altering behaviour by dealing with physical means) or predominantly psychological (altering behaviour by affecting the cognitive processes). Physical effects focus on destruction, while psychological effects span the domain of reason and belief. SEE table on page 257! Effects can be categorised as (1) *destruction* of physical capability may lead to or be the agent for other effects. (2) *Physical attrition* is wearing down enemy capabilities in repeated operations, an effect that takes longer time to result and can therefore provide more opportunity for psychological factors to operate. (3) *Chaos/entropy* is both physical and psychological in nature and works from the premise that rendering a foe unable to react coherently or to control the forces he has available. This idea is reflected in the concept of entropy-based warfare. The greater the degree of confusion and disorganisation the less able the enemy will be to use own capabilities. (4) *Foreclosure* is a fundamental tenet of positional or manoeuvre warfare, which can be either active (the use of military forces to block a COA that the enemy has already initiated) or passive (the prevention of a destabilising COA from being carried out). Foreclosure is in the domain of reason. Like chaos the effect of foreclosure is not permanent. (5) *Shock* is in the domain of emotion and centres about a sudden collapse of the enemy's belief in his ability to produce an acceptable outcome in a given situation (despair and resignation to a fate). It is always in the eye of the beholder. (6) *Psychological attrition* is a product of gradual erosion of the will. This is the primary effect sought by the physically weaker adversary in an asymmetric conflict.

The kinds of effects outlined above are not mutually exclusive. The central notion in EBO is that all effects and actions can and should be carefully orchestrated to produce a decisive effect on the enemy at one or more levels and in one or more arenas.

Therefore we can depict varying configurations of effects in a series of vector diagrams. Each effect can be rendered as one vector. SEE table on pages 268-271, 273! At the tactical level the configuration of effects might reflect an emphasis on destruction. At the operational level the focus would be on foreclosing a particular COA. At the military strategic level the focus would be on physical and psychological attrition and foreclosure. There is also an additional aspect because effects do vary from observer to observer and from situation to situation. SEE table on page 276! Although the cognitive process may be too complex to identify or to permit us to track a cause and effect chain, we can arrive at an INTUITIVE SENSE of the relationship between actions and effects. Here we can see attributes at work like (1) focus, (2) type of force, (3) scale of force, (4) scope of military operations, (5) and the seed of actions and reactions. By varying the nature of our actions we can vary the kinds of effects we are likely to create. Executing EBO is to create a unity of effect that focuses all actions and thereby masses their effects toward a particular behavioural objective. From this point of view the effects we create may cause or prevent some behaviour. SEE table on pages 283, 285-286, 288! Therefore we must synchronise not only military actions, but also all of the actions of all of the different forms of national power that might be observed. Although synchronisation is needed in EBO, the requirement is not constant. SEE table on page 288! Nevertheless the picture of EBO is above all one of complex co-ordination requirement.

Chapter 7 – From Dealing with Complexity to Exploiting It

EBO is about translating actions into effects to shape behaviour. To plan EBO we must anticipate how a CAS might adapt and respond to the stimulus. SEE figure on page 299! Much of the problem in the planning and execution of EBO derives from a need to predict the responses of the individual or organisation that we intend to stimulate. As we see a direct physical effect can create additional indirect effects and some combination of these effects will bring changes in behaviour. This means that physical destruction can cascade into psychological effects. Since behaviour is the real focus of EBO, the cascade from direct or indirect physical effects to indirect psychological effects needs further examination. Translating physical actions into psychological effects is another way of looking at the stimulus and response interactions in EBO:

Psychological effects do not need to be observed in the same sense as those of a cascade of physical effects. The cascade of psychological effects may be largely independent of the physical cascade, or it may be independent of any physical reality at all.

The scope of effects possible in the psychological domain is far greater than that possible in the physical domain.

We hope that the initial direct effect will not be the end of a stimulus and response interaction and it will cascade into at least one or more indirect effects. SEE figures at pages 313, 315! The indirect effects are not limited to a chain reaction of indirect, physical effects. The cascades of effects can also jump from physical to psychological effects. The impact of the indirect psychological or cognitive effect is not necessarily limited to a first cascade. Instead we hope that it will produce successive cascades of other psychological and cognitive effects, which then again produce other indirect psychological and cognitive effects. SEE figure at page 315, 316!

The difficulty is to determine where these cascades of physical and psychological effects might actually lead. In EBO we seek to engineer the right set of relatively small actions to create a set of disproportionate effects. Here we can identify two distinctly different sorts of complexity at work:

- *Falling dominoes* – stands for a chain reaction of physical effects and describes a relative predictability. The relationship between a physical action and a direct physical effect, and between physical effects is relatively straightforward and understandable, but we cannot predict all of the potential cascades that might take place. *Pruning* or risk calculus means that we bound the complexity involved in some way. We can either ignore the course of a cascade beyond some certain point, or we ignore some entire chains of effects that our actions might set into motion. With pruning we set the limit to how far we are willing to pursue a particular chain of cascading effects. SEE figure on page 325!
- *Ping-Pong balls* – stands for the chain of psychological and cognitive effects and describes a more complex and instantaneous relationship. The degree of complexity involved here is multiplied by two factors, the speed at which the cascade can propagate is far greater and the ultimate scale and scope can be global. Links in the chain of psychological and cognitive effects is usually indirect and non-linear, they are not predictable and nor easily quantifiable. We will never be sure of the form of the cascades since the number of possible outcomes from an action become nearly infinite. To bind the scope of this complexity we again need first to prune the number of chains and cascades of psychological and cognitive effects. Secondly we need to assume that there would be a structured flow to the cognitive effects created. SEE table on page 329! In essence we prune the decision tree as we proceed. With this we are aware of additional chains of psychological and cognitive effects but subordinate these considerations to the most dangerous concern. Nevertheless we still have the problem of trying to anticipate the flow of effects along those chains that remain. (2) We can bind the complexity also by assuming that the flow of psychological and cognitive effects *would not be* random and infinitely varied. Within this construct we also assume that observers are rational decision-makers who operates in a rational decision-making structure (they would perceive and react logically within the rationality of their own national and institutional cultures) and psychological and cognitive effects would flow in some logical pattern. But we must be careful with this, because effects of any military action can not be limited to the military outcome and they may extend to anyone who could observe that action. Cognitive effects create a single overall effect that would shape the observers behaviour in the desired direction. SEE table on page 333, 335!

When conducting coalition operations we must be aware of the following facts. (1) We need to recognise that there is no single unified objective and no single unified effect that can be created. (2) The adversary will be looking for exploitable discord in the coalition and will search out any indication of such discord in the actions of individual coalition members. (3) Effects are cumulative over time and create a history of previous actions that either can be built upon or that must be overcome. SEE figure on page 339! There are two conclusions, first the better the situation awareness and understanding of intent, the better we can achieve a unity of effect. Second the more experience nations and forces have in operating together, the more able they are to deal with the complexities of coalition operations.

This is also true for the opposing party. Five aspects of the coalition complexity are of primary concern:

- Any accord on a COA within a coalition is likely to be time sensitive. Interests, organisations and factions do change over time.
- An ad hoc coalition may be considerably more susceptible to fracture.
- Stimuli applied to the nest at any level will tend to produce a chain reaction of psychological effects that propagates throughout the nest.
- The opposing coalition will also have some rational decision-making structure through which the stimuli and the psychological effects will flow.
- The speed at which the flow of stimuli and effects occur will depend on the shared awareness and own organisation and sophistication.

The better able we are to deal with the complexity the less likely an opponent will be to use it successfully against us and the more likely it is that we will be able to exploit complexity to our advantage.

Chapter 8 – Dynamic Effects-Based Operations: The Challenge of Effects Assessment and Feedback

We can be sure that in no war will the enemy neither fight in the manner expected, nor co-operate with commander's plan. We must plan for an intelligent adversary who will adapt in forms we are never be able to predict entirely. To cope with this fact we need some form of continual feedback on the effects of our actions. The question is how do we measure effects, and even more how do we measure the behaviour of complex adaptive organisations we can never entirely and precisely know or predict. The answer probably lies in mixing intuition with ad hoc metrics when dealing with ambiguities and uncertainties, which are part of the planning and execution of the campaign.

The lessons learned are the following:

- *Measurement of physical damage* – is direct effects assessment, which resembles the classic attrition-based bomb damage assessment. This measurement remains valid, though the ends for which the assessment is used differ fundamentally. Such assessment of physical damage we can quantify relatively promptly. The indices of direct effects can take either the dimension of physical effects we can monitor and quantify or behaviour we can monitor in some context before they can be useful as feedback.
- *Measurement of performance* – is central to performance assessment. It helps determine whether the cascade of indirect physical effects is occurring. Here we measure the changing delta between the baseline and the post-strike performance. The process of measuring such performance is again something, which is largely quantifiable. To obtain any meaningful data on the performance of the targeted system we must first have a relatively good picture of what the system is. Then we need to find out how the component parts relate to each other, how the system performed in the past to develop some idea of how it may react to the stimulus provided by the direct effect. A critical element in performance assessment is the availability of a data or knowledge base from which to calculate change. We can also recognise that in larger systems the effects we create will not remain confined in the physical domain but will cross over into the psychological domain and set off a series of indirect psychological effects.

Here we can seek for indices of changed performance in the sense of system behaviour by setting norms from which the delta (divergence from the sliding norm) can be monitored. We can distinguish two types of performance assessment. (1) *Aggregate indicator*, for which there is a performance reckoning of how the system performs after the target has been destroyed. (2) *Point indicator*, for which there is a behavioural performance metric manifest in the ongoing actions. Both indicators demand a significant database on the system in question to determine the norm. Performance assessment is assessing behavioural changes. It focuses on the changes in system behaviour monitored as indicators of an ongoing, adapting decision-making process.

- *Loose set of diverse intelligence information* – is for indirect psychological effects assessment. Normally decision processes have been uncertain and ambiguous. They represent conscious and unconscious consideration of variables hard pressed to explain. Particular expertise enables decision-makers to integrate an extensive set of variables to deal with the ambiguities and uncertainties based on the own knowledge base, but this expertise remains highly idiosyncratic. Human-based metrics are needed to measure the reactions and behaviour of human beings and human organisations. For that we cannot dismiss the attrition-based metrics entirely.

Even in EBO destruction does matter but attrition-based measures alone are unable to provide a meaningful feedback for the non-violent uses of military power. What we are looking for is a series of observable indicators from which to gauge a particular effect, but unfortunately there will always be an element of uncertainty depending on how well the indicators were chosen and aggregated. Here the most fundamental criterion is observability, i. e. reflecting what is going on in the cognitive process. Nevertheless it is necessary that we accept from the beginning that we cannot know everything that we might want to know and that we cannot know anything precisely. We are limited to examine those reflections of the cognitive domain in the decision-making process that occur in the information and physical domains – things, which depend on how good our surveillance and intelligence systems are. SEE table on pages 387, 389, 394! For this we need to create situational awareness. There are two parts of the effects-based process that are so complex as to require some assistance. The first is the dynamic planning and execution of an EBO. The second type might revolve about the feedback process. There are also two threads that run through EBO, the first is the need not only for information, but for knowledge and understanding (knowledge base and the intuition to understand a situation), the second is the degree to which uncertainty will be part of EBO. It should be noted that neither the model nor its results are exact, quantifiable or certain. We cannot eliminate error, but to refine information.

Chapter 9 – Effects Beyond Combat: Deterrence and Reassurance

Thus far we have been examining how EBO works in combat or Crisis Response Operations (CRO). It is also important to examine the peacetime dimension as well, like deterrence, reassurance, forward defence, presence and containment. We need to prevent wars, contain crises and conflicts and deal with threats to our citizen and interests. Asymmetric adversaries are niche challengers, with a strategy hinged on

damage infliction and not victory and on psychological and not physical attrition.
The focus is on surprise by exploiting new vulnerabilities.

Therefore it is very important to demonstrate the means (physical capabilities to be used to shape will) and will (the principal thrust) to respond to any challenge. In this context EBO stands for a non-kinetic, peace-time use of military force and we moved beyond focusing solely on a hostile opponent and into the multi-sided interactions of deterrence/reassurance regime. SEE figure on page 417! In a cognitive domain no action or effect occurs in a cognitive vacuum, it is embodied in prior knowledge and mental models. Hereby some facts:

- *Focus* – is the nature of the physical actions that can be undertaken to deter or reassure either immediately or over time.
- *Forces* – it defines how the action might be undertaken and how plausible a threat or promise of support might actually be.
- *Scale* – establishes the quantitative size of the problem the potential enemy must deal with and indirectly affects the range of options available to deter or reassure.
- *Scope* – equates to the geographic and operational range of action that the potential enemy may have to face and in this capacity scope becomes a prime consideration in the challenger's planning.
- *Timing* – is broken into elements of speed, duration and synchronicity, which shape a challengers risk/success calculus and the reassurance provided to friends and neutrals.
- *Visibility* - refers for seeing and understanding the capabilities in question.

The rules of the game are similar to that of Chapter 5, but in this context the rules set two more things:

- They indicate that a stable deterrence regime is a cumulative effect to be built gradually over a period of years. Here is where deterrence and its components of presence and crisis response operate and EBO must be considered within this context.
- Where strategic nuclear deterrence might be considered to be global in dimension, all conventional deterrence is local.

In shaping the local security calculus that is at the heart of a stable deterrence, our challenge is to create a local constellation of capabilities that would force a challenger to ask the series of hard questions about the risks and chances of success that we have discussed above. The military component of any deterrent will be marked by a balance of three factors (1) what local powers can do for themselves, (2) what American or other allied capabilities are routinely present and (3) what American or other allied forces can be brought to the scenes. Deterrence is far from being a peacetime-only mission that disappears when combat begins. It is a fundamental facet of military operations in combat as well.

Chapter 10 – Putting the Pieces Together: An Operational Example

This chapter is the description of the anti-Libya operations in 1986. Here decision-makers thought in terms of actions rather than simply of targets and they clearly considered those actions in the dimensions of *what* and *how*. Fact is that in no way did the commanders have all of the feedback they needed and in no way were they able to eliminate uncertainties of a complex operational problem. Rather they improvised and innovated and then made do with what was available.

Chapter 11 – Network-Centric Contributions to Effects-Based Operations: Options, Agility, Co-ordination, and Knowledge Mobilisation

There were three different levels of potential improvement in military effectiveness to be derived from new technologies:

- The basic level of improvement accrues from simply applying the new technologies to existing military doctrine, organisation and concepts.
- The second level is to apply the technologies to a new doctrine, organisation and concepts.
- The third level is applying our newly found, network-centric military level improvement to EBO. EBO is based on two ideas, (1) it is about ends rather than means and (2) its focus is on human behaviour and specifically on the use of military operations to shape that behaviour (a human-centric, stimulus and response approach to military operations).

The real issue in moving from network-centric operations to EBO is how we might best use the concepts and technologies of a network-centric transformation to carry out a classic effects-based approach to military operations in a new and better way. The challenge is to apply the network-centric capabilities of today to the EBOs of today (tomorrow?). Effects-based situational awareness poses two major challenges for network-centric capabilities:

- In EBO we must deal with human beings and their responses to the stimuli presented by our actions. Our awareness must integrate large number of imprecise, subjective data and information containing complex variables.
- Because the variables are not exact we must create and maintain a knowledge base to provide a context to cope with the uncertainty. The knowledge is required (1) to predict how the opponent will the actions perceive, and (2) to detect and assess feedback on the effects our actions create.

EBO is about coping with the problems of culture and language, of creating and using communities of expertise and of tapping resources beyond a formal intelligence chain of command. Factors, that apply to asymmetric warfare and peacekeeping operations elsewhere in the world. Knowledge required supporting our effects-based actions fall into three categories:

- *Knowledge of the enemy* – means that we have to rely expert judgement, on the part of a knowledgeable regional analyst and on the part of the local operational commander with expertise on the military dimension of his battlefield.
- *Knowledge of ourselves* – is reflected in command intent, for which a multi-level understanding is needed. In a dynamic situation EBO is never final.
- *Knowledge of the situation* – gives the commander means of pruning the complexity of a nearly infinite range of potential responses so as to assess the options or actions best suited to the effect to be created. For this damage and performance assessment lie in the physical domain and are subject to current metrics, behavioural change lies in the psychological/cognitive domain and is subject to all of that domain's ambiguities.

Network-centric operations have the potential to make four major contributions to the conduct of a successful EBO, which are options, agility, co-ordination and knowledge mobilisation.

6.16 Williams, Brett T.

Williams, Brett T. (Col.), *Effects-Based Operations: Theory, Application and the Role of Airpower*, U. S. Army War College, Carlisle Barracks, 09 April 2002, www.stinet.dtic.mil/cgi-bin/fulcrum_main.pl

Critics of Effects-Based Operations (EBO) think the concept relies on perfect information, advanced technology and precise air attacks, therefore it is an unachievable, narrowly focused war fighting panacea that ignores the fog and friction of war.

EBO theory

According to DePupla technological advances in air power, specifically stealth aircraft and Precision Guided Munitions (PGM) enabled the first application of the concept in Operation Desert Storm by changing the targeting paradigm with a focus on desired effects instead of target destruction. Attacks on critical nodes in the air defence system achieved the effect of functional system breakdowns with minimal operational risks and lower costs in terms of sorties and weapons.

According to him EBO is a tool to support parallel attacks on critical targets to cause paralysis in an enemy's system of system. The desired effect is to control an enemy by eliminating his capability to employ forces. Furthermore EBO reduces force requirements, casualties, forward basing needs and conflict duration. The US Joint Forces Command (JFCOM) also focuses on achieving desired effects, not processing through target lists. EBO is a knowledge-based process that predicts enemy reactions. By understanding the enemy, EBO can direct attacks against critical nodes/links that should cause a breakdown in cohesion and destroy the adversary to resist. EBO generates strategic effects "through the synergistic, multiplicative, and cumulative application of the full range of military and non-military capabilities at the tactical, operational, and strategic levels". The result should be a quicker, cheaper victory especially when compared against a conventional strategy. EBO can become a general guide for employing national power to achieve strategic objectives in almost any scenario. Effects can physically, functionally or psychologically impact the enemy to coerce or compel him to change his behaviour thus leading to a desired outcome.

Effects-Based Planning (EBP) and Execution

Conventional approaches like Objective Based Planning (OBP) assumes a linear relationship between action and objective. SEE figure on page 3! But war is a non-linear activity, where actions produce multiple reactions that are difficult to predict. Small, insignificant actions can cause large and frequently unforeseen effects.

Actions produce a variety of effects and the effects determine whether or not the objective is achieved. SEE figure on page 4! The environment in which wars are fought is a host of complicating factors and most adversaries will take advantages of these factors by adapting, substituting and compensating, manipulating or influencing. EBO offers a methodology to cope with this non-linearity. The steps for EBO are the following:

- To determine effects that will attain the desired strategic outcome (political aim -> theatre objectives -> physical, functional and psychological effects that might generate the desired behaviour of the enemy).

- Analysing potential Courses of Actions (COA) with analysing the strategic, operational and tactical environment beyond military capabilities, which will impact the conduct of war (like culture, religion, economics and diplomacy). This net assessment depends very much on information since information is a critical enabler for EBO.

There are four differing effects: predicted-unpredicted, desired-undesired. SEE figure on page 6! In war there are three sources of friction:

- Chaotic, non-linear nature of war,
- Unpredictable human behaviour due to pressures and dangers and
- Uncertainty of information.

The goal is to be less affected by these three sources than the enemy. After COAs are selected, it is important to establish Measures of Effectiveness (MOE) to determine if operations are producing the predicted effects. Unfortunately sometimes it is not apparent what to measure. MOE is critical because evaluation against those measures determines resource allocation, movement between campaign phases and strategy changes. Once combat operations are underway, EBO facilitates the reassessment process with two components:

- Continuously evaluate combat operations against established MOE and
- Adjust strategy as required to generate the desired effects.

Effects higher order can make the assessment process more complicated because they are separated from the action in either time and space making it difficult to determine which action generated the effect. EBO do not rely on technology, precision strike, air power, perfect information or any other 21st century war fighting tool.

Effects-Based Missions

There are difficulties in linking actions and effects. The reassessment process must attempt to identify causal linkages to help determine why an action failed to generate the desired effect or why it produced an unpredicted effect. EBO help synchronise and integrate elements of power and from this point of view military force is a means of coercive diplomacy in support of limited strategic objectives.

6.17 Athor unknown

Athor unknown, Force Planning Concept 21: Towards an effective air capability for Europe, The Challenge for force planners, source unknown,

Introduction

As a lack of appropriate force planning concept, NATO and EU are increasingly facing problems in formulating well-defined and logical standards for force planning activities. In this paper the contours of new planning concept are developed which is suited to the fundamental insecurity that characterises the current security, strategic and operational environment.

The contextual challenge

The following premises affect the environment of defence planners within NATO and the EU:

- Forces will have to operate in remote areas,
- There will not be an identifiable threat with little infrastructure,
- With varying degrees of existing C² arrangement,
- With or without coalition partners,
- For a wide variety of tasks, missions and desired effects,
- With decreasing or stagnant defence budget,
- With decreasing numbers of platforms,
- Operational risks derive from combination of low and high tech, from conventional and unconventional types of warfare,
- In combination with demanding climates and geographical restraints,
- With simultaneously increasing demands deriving from political and public scrutiny.

The conceptual challenge

Planning based on maintaining legacy systems (TBP, BDP, GBP and TBP) is too costly and unaffordable with the current and foreseen budget. Instead scenario based planning, the portfolio approach and the hedging method may provide inputs for the planning process. We know the formal missions of NATO and the EU and the tasks European forces may be called upon to execute. Now we need to figure out differently what we need and how much. The planning efforts must result in capabilities in terms of systems, processes, organisational structures and doctrines that can successfully execute NATO tasks and missions now and in the future. We also know what effects we generally want to achieve at the tactical, operational and strategic levels, although we call them objectives, tasks, missions etc. Effects are more specific than missions and objectives and they are intermediate. Coercive operations call for entirely different Measures of Merit (MOM) and Measures of Effectiveness (MOE). This is effects-based (EB) thinking from which the term Effects-Based Operations (EBO) is derived by the US Air Force. SEE figures on page 4! Thinking in terms of effects instead of destruction allows for more differentiated and accurate force planning. It allows for more discriminate force application and for less force application, freeing assets for executing other tasks. EBO is a conceptual force multiplier but not an excuse for force reduction. EBO is foremost a force application concept. If we want define the purposes of European military forces we find physical destructive and non-physical non-destructive effects, psychological effects, temporal effects, military tactical and strategic level effects, political effects. The current basic purposes of European military forces are broadly the following SEE figure on pages 5-6!

- Support and sustain -> observe and inform -> protect and preserve,
- Deter and dissuade,
- Signal and coerce,
- Delay and degrade -> dominate and defeat,
- Secure and stabilise.

To achieve objectives that lay in this spectrum, forces need to be able to:

- Provide geographic reach, agility, escalation control to manage low level coercion and crisis,

- Demonstrate the ability to respond forcefully on short notice,
- Acquire and share knowledge of time, place conditions and operations,
- Bring fires and forces to bear quickly,
- Gain control of the pace of conflict and its domains,
- Protect units, objects or areas against attacks and,
- Destroy an enemy's ability, capacity and will to fight and threaten again.

This list contains many capabilities, which are air power related. The numbers that are required are as much a product of ambitions, budget realities and sustainment requirements.

Capabilities and structures

SEE figures on pages 14-15! Very relevant to EBO!

6.18 Athor unknown

Athor unknown, Introduction in Effects Based Thinking (Adapted from //), source unknown

Historical Examples of Effects Based Thinking

During WW II some air planners were trying to implement the essential concepts of Effects-Based Operations (EBO). In the late 1930s US Army Air Corps (USAAC) thinkers developed a number of theories about air warfare, including one which came to be known as the "Industrial Web" theory. The basic idea behind it was that any war machinery requires the support of a huge industrial complex comprised of many inter-linked sub-elements, like manufacturing plants, transportation, power production and delivery systems – called the "web". It was also thought to be finite and determinable number of vital links or "critical nodes" that if successfully destroyed would bring about collapse the entire web. In 1941 the USAAC set out to define these critical links hoping that strategic bombardment alone could bring the enemy's war machinery to a halt. The US and UK developed plans for strategic bombing campaigns against Germany believing that the German economy was fully mobilised in support of the war effort. With this in mind the planners decided to focus on the ball bearing industry like the German aircraft industry listed as first priority. Based on this mirror imaging bombing lowered the maximum possible output at any given time, but did not result in reduced overall output until very near the end of the war. Attacks on the ball bearing plants produced a great deal of damage to factories, but not as much as it was thought – due to errors in assessment. Photo Interpreters (PI) did only see the external damage to a building but could not assess the internal destruction. They found that photos taken during a raid tended to exaggerate the damage inflicted by raid. The smoke, dust and explosion captured by photos looked spectacular but made near misses look like direct hits. But eventually the allies did succeed in finding and seriously degrading two target systems that proved critical to the German war effort: transportation and oil.

Attacks on these two systems were highly synergistic. Some remarks to this:

- The effectiveness of strikes versus post-strike photography is influenced by the state of technology,
- To make a proper Battle Damage Assessment (BDA) besides post-strike photography other sources of intelligence are to be considered.

In the Gulf War Col. John Warden and the AS developed a new concept of strategic air warfare called Parallel Warfare (PW). Their view of the adversary's military-industrial capabilities and requirements were similar to the "industrial web" theory, but they proposed to take down the critical elements so fast that any capability to support the war effort would collapse. Attacking Iraq's electrical power production and distribution system was a key element of the plan. Once again US planners did not understand the Iraqi political, social and economic system (perceptual errors). Unfortunately there was no real way to measure the will of people or leadership. The US Air Force has been implementing effects-based (EB) concepts for decades, but little is known about imposition of systemic and psychological effects through military actions. There is also no comprehensive understanding of how to create such effects, whether it is truly possible or how to assess the progress and extent of such effects.

Dominant Effects

For Air Force planners, achieving effects often translates into selecting targets, which sometimes is referred to as Effects-Based Targeting (EBT). The EB concept asserts that affecting a particular target set in a particular way may have functional, systemic and psychological effects well beyond simple destruction or degradation of it. In this context destruction of targets should more logically be viewed as a means (desired effect) to achieving an end (policy goals). The challenge is to shift from input- to output-driven planning for military actions. The premise of EBO is to use both lethal and non-lethal means at the tactical level to produce predetermined direct and indirect effects at the operational and strategic levels of employment. Effects should be the integral linchpin that binds together the planning, execution and assessment of all military actions and the actions of other agencies, as well. A considerable challenge for Dominant Effects (DE) is to translate the EBT view into a less air centric joint EBO view that leads to effects based thinking and processes applicable across the entire spectrum of engagement. It is also important to buy more sophisticated intelligence, surveillance and reconnaissance systems to collect and disseminate more complete information for combat assessment. In Objective-Based Planning (OBP) objectives do not specify operational actions. A further difference is the relative focus on desired versus undesired outcomes. Objectives are things the planning forces want to happen. Effects-Based Planning (EBP) also explicitly considers additional things beyond what the action is intended to accomplish that may happen as a result of planned actions.

Definitions and categorisations

According to Merriam Webster Collegiate Dictionary an effect is the power to bring about a result, i. e. to influence. Expanding this definition to EBO it is important to note that the effect of a given action may set off other changes or effects, one event may trigger or cause subsequent outcomes – effects have a dual nature.

An effect is the physical, or psychological outcome, event or consequence that results from a specific military action. It stipulates that effects can occur at all levels of employment, from tactical to strategic and may by themselves produce secondary or follow-on outcomes. Effects have also a multidimensional nature, which the following definition expresses best:

- An effect is the functional, systemic and/or psychological outcome, event or consequence that results from a specific military action. Effects may occur at all levels of employment and may by themselves produce or trigger secondary outcomes or indirect effects.
- In the most basic sense effects can be broken down into direct and indirect effects. A direct effect is the result of actions with no intervening effect or mechanism between act and outcome, it is immediate and easily recognisable. Direct and indirect effects may be physical, functional or psychological in nature.

First, Second and Third Order Effects

First order effects are synonymous with direct effects, which result immediately from an action while second and third order effects constitute indirect effects created through an intermediate effect or mechanism, producing a final outcome or result. Indirect effects may be functional, systemic or psychological. They tend to be delayed and are typically more difficult to recognise.

Cumulative and Cascading Effects

Direct and indirect effects can be cumulative or cascading. Cumulative effects result from the aggregate of many direct or indirect effects with lower order effect accumulating to higher end result. Effects in general have a ripple or disruptive impact throughout the target environment or system whether a nation-state or a loosely knit international terrorist group. The cumulative and cascading nature of direct and indirect effects contributes to their distributive nature.

Collateral Effects

Collateral effects are those outcomes that result when something occurs, other than what was intended. In negative sense, collateral effects may be incidental direct or indirect effects that cause unintended and unwanted injury or damage to persons or objects. On the positive side collateral effects may generate outcomes that prove beneficial to ongoing military actions.

Physical, Functional, Systemic and Psychological Effects

Physical effects are created by the direct impact on an object or system targeted by the application of military resources (direct, first order effects). The primary purpose of it is to damage, disrupt or neutralise a target or group of targets through the application of military force. Functional effects represent the direct or indirect effects of a military action on the ability of a particular target or object to function properly and perform its mission.

Systemic effects are those indirect effects aimed at affecting or disrupting the operation of a specific system or set of systems. Psychological effects are the impact of military actions on the mental domain of a target audience. Psychological effects may be either direct or indirect effects resulting from such military actions.

Tactical, Operational and Strategic Level Effects

Strategic effects contribute to affecting a specific target audience's overall political, military and economic capacities as well as its psychological stability. Operational level effects contribute to reducing and unbalancing an adversary's capacity to conduct campaigns or wage war. Tactical effects are the result of an action or actions at the individual unit level and are immediate and of short duration.

Fundamental relationship of various effects (SEE figure 4! – extremely important).

6.19 Conclusions

Effects-Based Operations in a joint framework builds upon the most important characteristics of the concept. It integrates all the services into a single unified fighting body resulting in synergism. A joint approach also better identifies the capabilities and areas for specialisation. It solves the problem of having an effects-based air force together with a rather legacy-based army and navy.

The philosophy of joint EBO can also become the foundation for the Long Term Military Planning Process, in which scenarios are used to filter out the effects we want to achieve. These effects can then be transferred into military capabilities revealing the quality and quantity of forces required. The concept of Dominant Effects is a good approach to integrate Effects-Based Operations with Long Term Military Planning. A marriage of them has the potential to produce a more accurate and balanced force structure, which can better align organisational design, weapon systems, personnel and military training with operational challenges. This kind of planning hopefully can bridge better the gap between political-military intentions and available resources in terms of people, technology and money.

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7. Influence Net, System Dynamics, Input-Output Modelling, Objectives to Metrics Methodology, Net Assessments and others

7.1 Introduction

Effects-Based Operations establish high requirements to understand the cognitive domain, because the concept itself is about to influence the decisions of enemy leaders, military commanders and population. This high ambition requires strategic intelligence and an understanding of the enemy's Centre or Centres of Gravity. With EBO wars and contingency operations happen as Complex Adaptive Systems with variables behaving in unpredictable ways. Coupled to certain dynamics, many of the changes are observable only after a certain time delay. Developments in complex systems have no respect for hierarchy and are often mysterious, affected not only by a particular action taken not only by us but other factors, as well.

Suggested principles to analysis and supporting models and simulation of EBO should focus around output, based on soft issues like qualitative modelling with a focus on modelling cognitive processes. To achieve balance among breadth and depth to connect EBO-analysis to the real world, a family of models and games is needed and a lot of empirical work must be done. Based on the systemic character of EBO the decision processes and interdependencies between the sub-systems and elements must be understood for which realistic and conceptual models are needed. In planning to achieve a given effect it is crucial to model the likely response, taking soft factors into account to assess estimates of the enemy's response enabling the identification of critical vulnerabilities.

The concept of Operational Net Assessment is an attempt, which tries to give a common knowledge base on societal coherence, will and capability to provide a continuous stream of knowledge from adversary vulnerabilities to effects to tasks.

7.2 Bullock, Richard K.

Bullock, Richard K., *Using Influence Nets to Model a Nation-State*, Air Force Studies and Analyses Agency, January 2002,
www.mors.org/meetings/ebo/ebo_reads/Bullock.pdf

Effects-Based Operations (EBO) are the tactical actions taken to achieve strategic effects. A strategic effect is anything that disrupts the enemy's strategy, ability or will to wage war. In this context well placed strikes propagate throughout an opponent's system yielding catastrophic output or strategic effects. Despite an extensive literature there is a lack of a common framework for planning, executing and assessing political and/or military actions designed to produce distinctive and desired effects.

A Nation-State Model is proposed for capturing the decision processes and interdependencies between the government, people and military within a Nation-State.

Introduction

War is complex and it is a collision of systems of systems. The key ingredient and catalyst for complexity is the human element. An especially difficult to capture phenomenon of war is the concept of strategic effects. Strategic effect is anything that disrupts the enemy's strategy, ability or will to wage war. Strategic effects are indirect effects that have a major impact on war. They start as tactical actions or EBO. These actions can be naval blockades, economic sanctions, freezing of assets and/or violent military conflicts, which ripple through an opponent's system in a cascading or domino like manner inducing friction and eventually yielding strategic effects.

Foundations for a Nation-State Model

War is a complex, continual feedback process and can be seen as a non-linear phenomenon. Clausewitz captured this in a trinity of reason, chance and emotion, which can be translated for our times as the trinity of government, people and military. The ultimate goal was for Clausewitz as it is for us, to balance between these three elements. A key aspect is that war is an interaction between opposing Nation-States, with the collision having the effect of pushing the trinity out of balance. Collision means also the presence of internal and external influences. Internal influences consist of the push and pull between the government, the people and the military, the external influences are composed of the opponents intentional collision into each other.

Implementing the concepts

Fundamental to modelling is to capture the international linkages, which describe the relationships between the government, the military and the people. When these elements become unbalanced the model can collapse. The external linkages are just as important since they affect the balance of the trinity. A final fundamental element is the decision process with the aim to maintain a balance between the elements of trinity to prevent a collapse. Therefore capturing the linkages and decision-making processes is essential. *Influence Net* (IN) is a presentation of a system that captures areas believed to be fundamental to that system. It contains a chain of influences where changes in one part of the system affect other areas. Each influence chain is comprised of a relationship between cause and effect, which increase or decrease the probability that the desired end-effect will occur. The complex dependencies between the government, the military and the people are analogous to the causal relationships in an IN. What is required now is a decision-making process for affecting change in the model. *Decision-making* consists of two components. The first is a process for decision-making and the second is the mechanism for making decision. One widely known decision making process is the OODA (observe, orient, decide, act) loop. Observe is gathering raw data or intelligence of concern to decisions to be made. Orient is distilling that raw data into information on which to base decisions. Decide is developing Courses of Action (COA) and choosing a preferred approach. Act is the execution of the chosen alternative.

For the decision making mechanism the rational actor philosophy is a good approach (alternatives are known, consequences are known, an ordered set of preference exists and decision rule is utility maximisation) and the Nation-State is viewed as a single, unitary body.

Nation-State model

To complete the model a few additional items are required like quantifying the benefit of going to war, the potential costs and the impact of external influences on the Nation-State. *Pillars of Power*. A Nation-State's impetus for going to war is to gain power or value and its reason to concede is to reduce the possibility of losing power or value. There are two additional elements to the trinity, which are economic and survival. These five elements, the government, the people, the military, the economy and the survival can be seen as the pillars of power. Each of the elements is highly dependent on every other element. To mention is that we need to name important internal influences like cultural unity, type of government and the power of the allies. *External Influences* represent actions against the Nation-State by its opponent. According to military theorists Centres of Gravity (COG) should be the focus of attack. COG is where a Nation-State derives its power and freedom to operate. The five-ring model with concentric rings starting with Leadership, Organic Essentials, Infrastructure, Population and ending with Fighting Mechanism is a suitable tool for us to outline potential courses of action (COA). Inner rings are strategically more significant in assessing courses of actions or external influence to affect the trinity and the total power of the opponent to continue the war or not.

Nation State Model Output

Important aspect of the model is that the complexities of a Nation-State can be captured and insight on courses of action against the enemy can be evaluated.

7.3 Byrnes, John

Byrnes, John, *Background Paper On System Dynamics as a Tool for Effects Based Operations (EBO) Analysis*, www.mors.org/meetings/ebo/ebo_reads/Byrne.pdf

Effects-Based Operations (EBO) analysis requires simulation to capture the cause-effect relationships in logical interdependencies. This is particularly true when:

- the problem is less linear and more dynamic,
- the problem contains feedback and/or delays,
- the question mixes dissimilar systems,
- particular sub-systems or technologies are of central interest, or
- the problem contains human factors.

Introduction: Effects-Based Operations (EBO)

In analysing EBO the first key point is to define and understand the exact desired effect in an iterative process. The second step is to develop a solution hypothesis with the associated primary parameters to portray the cause effect relationship in a "if this then that" discussion. If the effect is defined at a very high level, it may need to be broken into a logical set of sub-effects.

Introduction: System Dynamics (SD)

SD is a discipline to develop realistic conceptual models of systems. It is coupled with simulation tools to aid in this development and the subsequent testing of the candidate solutions. Due to its attributes SD enables EBO studies:

- Feedback loops and time delays that can expose surprises such as dynamic behaviour, indirect effects or unintended consequences,
- Time-delays that simulate real world event sequences,
- Vertical integration that allows Digital System Models (DSM) to be realistically represented by their supporting sub-systems or technologies of interest to the customers stakeholder,
- Horizontal integration that allows symbiotic coupling of disparate systems to enable a systems-of-systems approach for an overall mission or campaign representation,
- Methods to handle non-quantitative, people oriented variables such as perceived success/failure, word of mouth influence etc.,
- Probabilistic functions to representation random chance variation.

Examples of SD Use in Military EBO Model Development

SEE paper or rather the Internet, figures are not clearly visible!

7.4 Davis, Paul, K.

Davis, Paul K., *Effects Based Operations (EBO): A Grand Challenge for the Analytical Community*, RAND Publication,
www.rand.org/publications/MR/MR1477/

Chapter 1 – Introduction

EBO can be understood as a revolt of the war fighters:

- *Against poor force-employment strategies in wartime* – In the Gulf War joint fires were applied with decisive effectiveness as the result of thinking about affecting systems, not just servicing targets. EBO tenets have much in common with modern manoeuvre theory and concepts such as achieving decision superiority and achieving capabilities for rapid, decisive operations (RDO).
- *Against standard models and analysis* – War fighters have often felt that they were being asked to comment on inappropriately structured conceptions of warfare. They considered constructive models to be too limiting. The Revolution in Military Affairs (RMA) and military transformation have put a premium on rethinking the art and science of war. Most modelling and analysis still encourages a mechanistic view of warfare that emphasises firepower and attrition while ignoring critical aspects of strategy, like manoeuvre of forces and fires, command and control or soft factors such as will, cohesion and cognition. Traditional models are simply inadequate.

Chapter 2 – Definitions, Dimensions and Distinctions

Definition of EBO is that “EBOs are the operations, conceived and planned in a systems framework that considers the full range of direct, indirect or cascading effects, which may be – with different degrees of probability – be achieved by the application of military, diplomatic psychological and economic instruments”.

According to normal English usage, one might reasonably ask what is new with EBO. Aspects of EBO should be used to expand the scope of operations and supporting analysis. It is claimed EBO is not about destruction or attrition of enemy forces, occupation of territory or other classical considerations. It is like collapsing the will and cohesion of the enemy, defeating his strategy, rather than his armies. It is convincing the enemy's leader to make decisions favourable to our goals. EBO emphasises speed, agility, parallel operations, decisiveness, creating shock and awe and attacking the enemy's mind-set and conceptual Courses of Action (COA). Critics argue that:

- Operations intended to break the will and morale of populations have often done precisely the opposite,
- Nations, whose initial strategies have been defeated have adopted, regrouped and gone on to victory,
- To deter and compel have traditionally been difficult to accomplish because psychological factors are difficult to understand or control,
- The classical concept of attacking Centres of Gravity (COG) has not always a content.

Furthermore, attrition, destruction and the occupation of the territory have been essential factors in some of the greatest victories. Proponents of EBO are well aware that past wars have typically emphasised death and destruction, but modern information technology and precision fires have dramatically made destruction unnecessary, although some operations may still be up-close and personal. EBO should be considered an expansion of operations that involve attrition, destruction and occupation. Some traditional aspects of war will still be necessary. The valid essence of EBO is its emphasis on taking a systemic view when assessing how best to accomplish objectives. Modern technology and networked operational concepts would be useful in these situations. EBO may be considered to have two aspects, physical and behavioural. Physical effects may include disruption, damage and the killing of soldiers. Behavioural effects may be to demoralise and reduce the fighting capability of military forces, to slow actions, to confuse and deceive local and higher-level commanders or to influence decisions by convincing, deterring or compelling. Other distinctions could be used from which the most obvious distinction relates to networking. The second group distinguishes between open and closed target systems, according to the degree to which they are adaptive. The next distinction is time scale, when effects occur and how long they persist. Also levels of conflict is a good group to distinguish. The last group is the distinction among the types of effects usually referred to Air Force studies. Here some desired effects:

- Destroy a functionality of a complex facility,
- Reduce the functionality of a C² or C⁴ISR distributed network or the crucial elements of an Integrated Air Defence System (IADS),
- Limit the functionality of a combat system by attacking one or more of its critical components,
- Limit combat mission capability by degrading support operations,
- Degrade the effectiveness of enemy operations by demoralising or tiring enemy personnel,
- Degrade the effectiveness of enemy operations by confusing and diverting enemy commanders,

- Influence the decisions of the enemy leader by making visible preparations for a large-scale ground offensive,
- Influence the decisions of the enemy leader by providing him with a convenient way to protect some of his assets,
- Influence the attitudes of the enemy population to encourage a revolution or other change of power.

Chapter 3 – Challenges in Addressing EBO

Proponents of EBO establish high goals in the cognitive domain, seeking to influence the decisions of enemy political leaders, military commanders or population. The higher the ambitions of EBO thinkers go, it requires strategic intelligence, which is notoriously unreliable. In history it has been difficult to understand or affect an adversary leader. A further, though fundamental problem of EBO is that in many conflicts there may be no vulnerable COG to attack. Wars, many contingency operations short of war occur in a Complex Adaptive System (CAS), which features that in some domains the variables behave in effectively unpredictable ways. This kind of system is dynamic and many of its changes are observable only indirectly and after delays. Developments in a CAS are often mysterious and what develops is affected not only by a particular action taken by a participant but also by numerous other factors as well. These developments have no respect for hierarchy. Small events at a microscopic level may have major consequences at a macroscopic level with the reverse also being true.

Chapter 4 – Suggested Principles for Analysis in Context of EBO

The suggested principles to guide the overall effort of adapting analysis and supporting models and simulation to EBO are the following:

- Analysis in support of defence planning focusing on *mission-system capability*,
- Analysis should confront uncertainty, probability and randomness, the domain of *exploratory analysis* and a family of models and games,
- Effort should go into *qualitative modelling* including cognitive modelling in an uncertainty-sensitive framework,
- *Empirical information* should be vigorously pursued,
- Modelling should be built around decision-making and C^2 , emphasising *agent-based modelling*.

Mission System Analysis (MSA) – is undertaken to guide mission-system planning to develop mission-system capabilities by thinking around output. EBO requires soft issues like qualitative modelling, including cognitive modelling. The purpose of MSA is to give meaning to the goal of achieving flexible, adaptive and robust capabilities for the mission. Understanding the potential benefits of a new capability is one thing, deciding how much of the capability is needed is another. The system of MSA characterises critical components of the overall capability, components whose failure will cause the system to fail.

Exploratory Analysis (EA) – is a key element of MSA. Its purpose is to confront uncertainty, a fundamental and often massive phenomenon associated with EBO. EA requires relatively simple models with only a modest number of variables. But simple models are at best simple at worst simplistic.

MSA should therefore draw on family of models, games and empirical work to achieve a balance among breadth and depth, to assure that the phenomena at issue are understood and connected with the real world. EA cannot eliminate uncertainty, though. An objective in planning should not be seen as assuring success, but rather as assuring a high likelihood of success as possible. Given the circumstances, EA is under massive uncertainty open ended and inherently complex.

Qualitative Modelling (QM) – is modelling soft factors. When we ignore a factor because we don't know its value accurately, we are assuming that the factor has zero effect. Such factors can be cohesion, morale and training. Possibilities for reflecting soft factors are (1) multipliers of capability, (2) delay terms, (3) spin-up factors, (4) frictional coefficients, (5) credibility coefficients and (6) suppression factors. Explanations SEE on pages 39-42! Soft factors appear sometimes as numbers based on nothing. The solution is to sharpen the definitions and distinctions and to recognise that the factors will vary with time. Cognitive modelling is a special type of modelling, which appear usable since a major objective of EBO is to influence the decisions of national leaders and the behaviour of their societies.

Empirical Information (EI) – is the principle of EBO related analysis, rather the reliance on concepts, notions and war games. Human war games are built around players and tend to be organised around strategy and C^2 . They are often more insightful and innovative than combat models and are much better for preparing for adaptiveness.

Chapter 5 – Examples of How EBO Can Be Represented Analytically

Much discussion of EBO is rather philosophical or anecdotal than analytic. A further serious problem most of the analyses is that they ignore qualitative or soft factors. SEE the halt problem with break points on pages 49-67! It is also important that despite the central role they play in combat models, break points have not been discussed much. The actual reason for a side to terminate battle were seldom the extent of attrition or losses suffered. The dominant factor was manoeuvre, by outflanking and tightening the enemy's lines in the process to strike a retreat or give up territory. Attrition is important but it is the virtual attrition that drives decisions. Methods of exploratory analysis should be used widely in defence planning for evaluating the potential value of new forces and operational concepts to account reasonably for the many ways in which new capabilities could have effects.

Chapter 6 – Conclusions

Current methods of analysis and modelling are inadequate for representing EBO. Addressing the challenge will require changes of mindset, new theories and methods and a new empirical database:

- Analysis in support of defence planning should embrace the paradigm of focusing on mission-system capability,
- Analysis should fully confront uncertainty, probability and randomness,
- Dealing with uncertainty will require exploratory analysis and a family-of-models-and games approach,
- A key element of analytical work should be qualitative modelling including cognitive modelling,

- Much of EBO is tied to affecting decisions and behaviours, which implies emphasis on the concepts and technology of agent-based modelling and system engineering,
- Analysis should pursue a new base of empirical information.

7.5 Evans, A./Graham, S./Jones, E. K./Pioch, N/Prendergast, M./White, C. M.

Evans, A./Graham, S./Jones, E. K./Pioch, N/Prendergast, M./White, C. M., *Strategy Development for Effects-Based Planning*, ALPHATEC Inc., www.mors.org/meetings/ebo/ebo_reads/White_Strategy.pdf

Introduction

Effects-based approaches to planning, executing and assessing air operations begin with the recognition that opponents are intelligent, devious and proactive. In planning to achieve a given effect it is crucial to model the likely response, taking into account the doctrines, historical patterns of behaviour and current capabilities of the enemy. This approach employs adversary models to guide refinement of a strategic-theatre-level mission into operational level tasks, and tactical-level target sets and desired effects, together with Measures of Merit (MOM) and collection requirements. Models, like Dynamic Bayesian Networks (DBN) are provided at the strategic-theatre and operational levels of war. They can be used to compute estimates of the enemy's response to our actions, enabling identification of critical vulnerabilities.

Background

Before the XXth century, most military battles involved adversaries trying to destroy each other on the battlefield and/or the seas. Employing the twin strategies of annihilation and attrition, battles were usually both bloody and protracted. All military strategies prior to WWI were based upon the doctrines of attrition and annihilation, which were the predominant strategies of the time. But slowly during the brutal trench-war of WWI the emphasis of annihilation and attrition began to change. With the advent of the air plane military leaders quickly came to understand some of the effects that attacking strategic targets could have against enemy troops. Target selection was determined through a combination of reasoning, intuition and experience, which practice continued into WWII. Although allied planners had access to detailed analytical models, which unfortunately were cumbersome to use as the digital computer had not yet been invented. Targets were generally serviced sequentially to compensate for bombing inaccuracies. Although WWII planners did target for effect rather than destruction, they primarily considered only one Centre of Gravity (COG), the fielded forces. In Vietnam Operation Linebacker demonstrated the effect of target selection on the leadership COG. Operations Desert Storm was a large-scale application of EB targeting against multiple enemy COGs. Air Force planners decided to continue or stop attacks against a target set based upon the effect they were producing and not on the actual state of destruction. This targeting approach proved very efficient and resulted in an immensely successful parallel attack against multiple COGs of the adversary. The problem is that current C2 systems provide almost no visibility into the effect that targets have upon enemy systems.

System Architecture

The system architecture developed here has two major sub-systems, the (1) plan authoring sub-system, which provides tools for constructing hierarchies of tasks and desired effects and (2) the COG modelling and analysis subsystem. *Plan authoring* – provides a baseline plan authoring tool for developing a hierarchy of tasks and desired effects augmented by map-based and timeline displays. SEE text and figure on pages 7-8! *COG Analysis and Model Authoring* - EBO requires ready access to adversary models at both the strategic and operational levels of war. COG models focus on the characteristics and capabilities that enable the enemy to oppose our will, the systems that support these capabilities, and the critical vulnerabilities of these systems. Models of COGs at both strategic and operational levels can be employed in two different ways:

- Prior to plan execution to provide predictions and causal accounts, which is called predictive effects-based planning and
- During plan execution when observations and indicators become available over time, which is called effects-based re-planning.

Bayesian COG Modelling and Analysis

DBN can be used for COG modelling and analysis at either the strategic or the operational level of war. SEE figure on page 11! DBN models can compute direct, indirect and synergistic effects of friendly actions. Bayesian COG analysis begins at the strategic level of war. Users select generic COG models, parameterise them and conduct experiments to determine appropriate strategic level tasks that attack critical vulnerabilities. Unfortunately models at the strategic level of war do not provide hard and fast predictive guarantee. COGs are intended to encode relevant enemy systems and their critical vulnerabilities to guide planning and downstream campaign assessment. Strategic-level DBN models serve two purposes, (1) they provide machine accessible audit trail and (2) they can help provide an early warning of plan or model deficiencies.

Operational COG Modelling and Analysis

At the operational level of war, models of target systems form the core of a continuous planning capability that predicts the effects of actions taken against target sets and even individual targets of critical importance. This model considers the following sub-processes or inner-loops, (1) Model Development, (2) Model Refinement, (3) Plan Authoring, (4) Target System Analysis.

Shared Representation for Planning and COG Analysis

Strategic COG Analysis can lead to a refinement of a plan, either by expanding it with results from the operational COG analysis or pointing out its flaws. It can also explain the why and point out which variables are indicators.

7.6 Gallagher, Mark A., Snodgrass, Anthony W., Ehlers, Greg

Gallagher, Mark A. (Lt. Col.)/Snodgrass, Anthony W. (Capt.)/Ehlers, Greg (Capt.), *Input-Output Modelling for Effects Based Operations*, Draft, www.mors.org/meetings/ebo/ebo_reads/Gallagher_Snodgrass_Ehlers.pdf

Technological advances in munitions, weapons delivery systems and C² have advanced a new methodology in military strategy called Effects Based Operations (EBO). The reality emphasises the ability to strike critical targets in a matter of days with adapting and re-planning in a matter of hours. This forces the analyst to be prepared with models that represent the enemy as a system. As part of the Revolution in Military Affairs (RMA), Rapid Decisive Operations (RDO), Parallel Warfare (PW) and EBO evolved. PW is in essence the application of force across multiple enemy systems simultaneously to obtain desired effects in an overall strategy at all levels of war. EBO is applied to bring about a prompt and decisive conclusion to the conflict. EBO calls for an organisational change from a ground-centric view of military operations to one of strategy-centric operations constrained by the following observation:

- The evolving security environment requires greater responsiveness, long range, effective punch and high level leverage,
- Focusing on effects enables us to consider different and perhaps more effective ways to accomplish the same goal with fewer resources.

The Input-Output Model

There are three assumptions that give the input-output model of Leontief relevance in modelling the enemy:

- Fixed coefficients of production which assumes that there is some minimum level input required in order to get one unit of output,
- Constant returns to scale implies that if you change the amount of input resources required, the output will change accordingly as a result and
- Homogeneity of input resources assumes that the level of aggregation affects the level of homogeneity of inputs (adding new rows and columns).

SEE tables within the text!

7.7 Hutchins, S. G./Kemple, W. G./Adamo, R./Boger, D.

Hutchins, S. G./Kemple, W. G./Adamo, R./Boger, D.: *Knowledge Management and Collaboration in an Effects-Based Operations Environment*, Graduate School of Operations and Information Sciences, Naval Postgraduate School, 01 May 2002, www.dodccrp.org/Activities/Symposia/2002CCRTS/Proceedings/Tracks/pdf/110.PDF

New war fighting concepts are currently under development to improve the ability to rapidly and decisively conduct particularly challenging and important operational missions as they transition to the fighting force described in JV 2020.

1. Introduction

This paper describes one aspect that is part of these new concepts: knowledge management and collaboration to support the Effects-Based Planning and Assessment (EBP&A) process.

2. Collaboration

Collaboration offers great potential to better enable war-fighters to plan, execute and assess activities across the spectrum of joint functional areas. It offers the added capabilities of providing the ability to share information and resources and to co-ordinate among individuals across geographic and temporal boundaries. SEE taxonomy and table on page 3!

3. Effects-Based Operations

Effects-Based Operations (EBO) is defined as a process for obtaining a desired strategic outcome or effect on the enemy through the synergistic and cumulative application of the full range of national (military and non-military) capabilities at all levels of conflict. An effect is the psychological, functional or psychological outcome, event or consequence that results from specific military and non-military actions. EBO is based on a better understanding of the adversary with the increased involvement of other national agencies and leads us to better reasoned options to engage potential adversaries. It is conceptualised as a continuous iterative planning and execution cycle, with five phases:

- Developing a comprehensive knowledge into the nature of the adversary, the environment and our own capabilities,
- Articulating the desired effects necessary via an Effects Tasking Order (ETO) to break the adversary's cohesion and cause him to change his behaviour,
- Determining and applying elements of national power (diplomatic, informational, military and economic – DIME) most effective in achieving the desired effects,
- Conducting an integrated and continuous assessment process to measure and assess the impact of effects created,
- Making decisions to adapt and adjust the current course of action to reach the desired end-state more effectively.

The difference between EBO and traditional Objective-Based Planning (OBP) is that the first include a broader and deeper insight into the adversary through the fusion of information from a broad spectrum of sources, which is developed through conducting a complex System of Systems Analysis (SOSA) of the adversary. An analysis, done by a team of cultural, behavioural, technical, economic, political and military experts. Effects-Based Planning (EBP) considers the full range of potential results of our action. Key aspects to EBO are:

- The quick recognition of any unexpected effects combined with the flexibility and agility to adapt to the implications of those effects,
- The ability to examine the causal linkages and effects through which actions lead to objectives,
- The Joint Task Force (JTF) commander's broadened focus to more precisely select the right set of actions to minimise undesired collateral effects.

4. Operational Net Assessment

The challenge inherent in the EBO process is to accurately identify the causal linkages that determine whether or not the action taken will achieve the desired effect. This is addressed through the Operational Net Assessment (ONA). ONA provides a common knowledge base to all customers from the national strategic level to tactical level.

It views the potential adversary as an interdependent system of systems, which contribute to societal coherence, will and capability. ONA provides a continuous stream of knowledge from adversary vulnerabilities to effects to tasks.

5. Limited Objective Experiment on Effects Tasking Order-to-Actions

SEE table on page 4!

6. Results

Not really relevant yet, but interesting.

7. Discussion

Collaboration offers great potential to better enable war-fighters to plan, monitor, execute and assess activities across joint functional areas during EBO. It offers a more comprehensive nature to the analysis of the adversary and although the complexity increased, also an increased speed of the planning process is possible.

7.8 Lee, David B./Kupersmith, Douglas “Kupe”

Lee, David B./Kupersmith, Douglas “Kupe”, *Effects Based Operations: Objectives to Metrics Methodology – An Example*, Military Operations Research Society Analyzing Effects-Based Operations Workshop, Vienna, Virginia, January 2002, www.mors.org/meetings/ebo/ebo_reads/LeeKupersmith.pdf

Introduction

Effects-Based Operations (EBO) have become increasingly accepted in air campaign planning. While not clearly defined, EBO is an attempt to understand the complex interactions between the different systems presented to combat decision-makers. EBO attempts to bring a wholly new genre for rating objectives accomplishment and when properly implemented it suggests a better means for observing and understanding second and perhaps even third order effects of military activities ranging from traditional destruction to information operations. This paper explains how a decision maker links his objectives (expressed as an effect) to specific tasks capable of achieving the stated objectives (effects).

Approach: Concept and Methodology

The process begins with developing a plan described as Observe-Orient-Decide-Act (OODA) loop. The last part of the loop, *attack* applies the means identified in the *decide* step to achieve the desired effects.

Concepts of Can't and Won't

Departing from the assumption that the capability of the enemy to perform its objectives has significant impact on his will to implement those objectives, there are two broad conditions under which these desired effects can be achieved:

- The enemy *cannot* achieve the own desired objectives – cannot determines those pertinent factors that contribute to a particular capability,
- The enemy *will not* perform activities in support of their objectives – this infers the opponents will such as the case of enemy leaders deciding, it is not in their best interest to contest friendly operations (a misinterpretation of opponent value in a system is the biggest problem here).

Methodology

The Objectives to Metrics Methodology (OMM) is a five step process designed to link a desired effect to a measurable set of metrics, which starts with:

- The identification of the objective.
- Definition of the effects.
- Framing the effects.
- Assignment of target sets to the effects.
- Establishment of Measures of Merit (MOM).

Description of the process

Objectives are identified from the commander's intent, which is generally used to describe the end state of the operations and concise the purpose of the operations. Further this paper focuses on the intent *Gain Air Superiority*. After the objectives are derived effects are defined in order to meet the objectives. The OMM approach uses definitions with doctrinal roots because they provide a formally defined, common frame of reference. A definition of an effect is reformed into a question to facilitate establishing measurable metrics against a particular objective to help determine if the effects are being accomplished or not. With the question has been framed, planners can focus on real world tasks which can be applied against this question. In this process it is important that the planner can examine also asymmetric types of attack to establish the quantity of resources required to achieve the air superiority effect. Once quantifiable measures have been applied to the effect, tasks are assigned to various ways to achieve the effect. This means decomposing each of the "can not" and "will not" ideas into details from which vulnerabilities and interactions can be identified and prioritised for attack. Once defined we can then devise methods of mitigating or eliminating each of the elements tied to achieving the effect of air superiority. The methods depend on the resources and the political and military constraints. Metrics are used to measure progress in achieving an effect. Metrics are required to account the impact of the planning decisions (i. e. duration of an effect). Measures provide the decision maker a balancing mechanism for resources across the spectrum of planned effects. Once the effects are defined it is good to build a framework consisting of the elements comprising each effect. Tree structure lays out hierarchical relationships of some key factors contributing to the effect and helps:

- Visualise the interrelationships of the various factors that contribute to the effect,
- Identify a set of crucial targets in achieving a portion of the effect,
- Determine potential vulnerabilities to attaining the desired effect.

Given the basic framework the planner should examine the branches of the tree for relevancy. The purpose of this is to focus limited resources against key portions of the framework.

Second order effects are consequences of tasks on other effects beyond the original effect intended. OMM helps examine multiple effect frameworks to find potential second order effect opportunities or to avoid negative unintended effects.

SEE figures within and at the end of the article!

7.9 McCrabb, Maris

McCrabb, Maris, *Effects-based Coalition Operations: Belief, Framing and Mechanism*, DMM Ventures Inc., www.aiai.edu.ac.uk/project/coalition/ksco/ksco-2002/pdf-parts/S-ksco-2002-paper-02-mccrabb.pdf

Section 1 – Introduction

The essence of military command is allocating scarce resources to attain desired goals. Strategy is the linking of actions (the use of resources) and outcomes. Older strategies focused on the actions taken, while current approaches tend to focus solely on outcomes with little concern on how outcomes arise from the actions. Effects-based Operations (EBO) focus on causal explanations which have two critical elements, (1) how can a decision maker understand the causal mechanisms and (2) what impact does an EBO method have on decision making.

Section 2 – Effects-based Operations (EBO)

Description – EBO is an approach to planning, executing and assessing military operations that focuses on the results of military actions done by military units. It is thinking strategically. It accounts for lethal and non-lethal application of force, delivered kinetically or via non-kinetic models. It incorporates and expands upon traditional approaches (TB, STT) with the challenge of predicting and assessing how physical actions result in behavioural outcomes. The goal of an EB approach is to trace and understand how actions affect the enemy commander's behaviour. In this context functions are defined as broad, fundamental and continuing activities. Activities (processes) define how the work or task is done. *Effects-based Planning* – starts with the commander's intent. This provision begins the process of mission analysis where objectives, desired effects, tasks, constraints, restraints and other elements of information start. SEE figure on page 135! The process starts with Course of Action (COA) development, followed by a Centre of Gravity (COG)/Target System Analysis (TSA) and ending with the Dynamic Air/Space Execution Order (DAEO). SEE figure on page 136. *Effects-based execution* – is DAEO execution. Key ingredient in the success of the DAEO process is the collaboration between the operational level tasking organisation and the tactical level execution organisations. It is embodied in the concept of centralised C² and decentralised execution. *Effects-based assessment* – is COA assessment, which begins already in the planning phase and checked in war-games to offer options. The reason for this step is to provide useful information for decision making. Combat assessment focuses on effects and actions at the direct, physical level effect. Campaign assessment builds upon it, with including the indirect, complex and cumulative behavioural effects. An EB campaign assessment is a horizontal process, which starts with indicators seen as the evidence of effect, mechanism or action.

Section 3 – Decision making models

There is a need to develop a collegial decision making model that supports EBO since most decision making takes places among several individuals. *Rational actor model* – is one of the oldest portrayals of human behaviour. Rational decision making is a procedural approach that is consequential and preferential. The key word here is belief with a critical role of framing, which describes the structure of argument.

In a collegial decision making environments arguments are most likely to result in the shared understanding of the group. But a rational choice decision making model in a collegial environment works only to the degree the individuals in a group have shared belief as common preferences. Other elements are that (1) alternatives are examined, (2) decision-makers have preferred information about alternatives, and (3) there is some objective function used to define the selected criteria. In this model decision-making is almost mechanical. *Satisficing* – has as basic premise that decision makers search only for such information and examine only such alternatives and employ only such decision criteria to produce a result, that is good enough in some behavioural sense. Limited rationality explicitly attempts to model the costs of deciding. It recognises that memory and comprehension are limited and communication is not seamless. It is based on re-using previously discovered or developed information. Decision-makers match conditions they face with conditions they faced before. This bounded rationality model deals with uncertainty and costs of decisions. *OODA* – this model's strength is the emphasis on orientation. By stressing the need to orient it makes the contextual underpinning of images, which are based on experience, culture and belief explicitly. It also emphasises analysis and synthesis as a useful, structured approach to problem solving. With technology making warfare a very complex enterprise it is excessively much to expect any single person to grasp it all. The model also includes implicit guidance and control loops as well as explicit feedback loops among every element.

A major limitation of the models above is they unitary actor perspective. In most cases decisions result from group action and not from the action of a single decision-maker.

- *Groupthink model* – describes group-behaviour with examples like lack of norm or cohesiveness, manipulation by members and panic. The more cohesive the group, the more likely it rejects views seen as non-conforming to its norms. These norms arise from the tendency to evolve ways of preserving friendly inter-group relations.
- *Collegial models* – the key elements required for a collegial decision making model are that (1) the term collegial represents the idea that the group shares a goal, (2) the model must take into account the decision making process. Decision-making models must incorporate and describe the belief structures and models of causality that reside within each member of the group. It is the point of tangency between the group members. Lacking tangency means a thin degree of sharing.

Section 4 – A Collegial Decision-making model

Any description of leadership requires pointing out two crucial capabilities, (1) it must be aware of its circumstances of situation and (2) it must make decisions.

Situation Awareness – is defined as the perception of the elements in the environment within a volume of time and space, the completeness of their meaning and the projection of their status in the near future. It postulates three definitions (1) level of perception, (2) level of comprehension and (3) level of projection.

Levels (2) and (3) are crucial to decision making because they provide knowledge and understanding of the environment through a cognitive hierarchy. *Framing* – recognition priming is a means of framing context for decision-making.

The importance of framing is the key insight of prospect theory, which presents a richer view of decision-makers and hence relies upon much more information about them. Information about the adversary's decision-making apparatus comes from:

- COG/TSA, which is an understanding of the elements from which the adversary derives its freedom of action, physical strength and will to fight and
- COA, which is based on postulating a series of enemy actions, from which planners predict a set of behaviours. *Model* – SEE page 142! The focus is on the actors and their interrelations.

Belief structures – constitute the values assigned to individual variables while the causal models constitute the relationships between the variables. Beliefs have relationships or strategic culture, which is the socially transmitted habits of mind, traditions and preferred methods of operation that are more or less specific to a particular geographically based community. Strategic culture incorporates expressions of strategically adaptive reasoning behaviour. Preference and adaptive reasoning are the critical elements in framing. It is how the actor mediates the raw data arriving from situation awareness. *Causal models* – are used to make some predictions about how actions that might be taken in the group's name are likely to produce some outcome. Causal models are probabilistic. Besides showing dependencies they play also an important role for group decision-making and used in war-game potential COA. *Shared understanding* – The move from awareness to understanding requires understanding the strategic culture of the coalition partner. The most important elements in the strategic culture is the predisposition to causal mechanisms, risk proclivity and belief structures. *Implications for EBO* – the goal in warfare is to affect some sort of change in the opponent's behaviour through brute force (like annihilation or attrition) or coercion. At root the military aim is to set conditions where other instruments of national power can take over and attain the strategic aim. War is really politics by other means.

Section 5 – Implications for Knowledge Systems

Targeting (COGA/TSA) – Strategy and COA Development – War-gaming (most computerised war-gaming tools are not adequate to satisfy EBO requirements. SEE text!

Section 6 – Conclusion

This article presents some preliminary thoughts on how EBO impacts classic decision making and how collegial decision making, such as that characterise coalitions, places further demands on supporting knowledge systems.

7.10 McCrabb, Maris “Buster” Dr./Caroli, Joseph A.

McCrabb, Maris “Buster” Dr./Caroli, Joseph A., *Behavioral Modelling and Wargaming for Effects-Based Operations*,
www.mors.org/meetings/ebo/ebo_reads/McRabb_Caroli.pdf

Effects-Based Operations (EBO) is a new paradigm for planning, executing and assessing military operations. This paper wants to present some research into behavioural modelling and war-gaming.

The reasons are threefold:

- The ultimate test for EBO is its ability to predict how friendly actions attain some set of desired behaviours of the opponent,
- Due to the nature of soft evidence, commanders must be provided with some understanding of how their Courses of Action (COA) might play out,
- To understand the boundaries between multiple disciplines such as operations research, computer science and cognitive science, since EBO is a cross-domain methodology.

Concept of Operations

EBO is defined as a process for obtaining a desired strategic outcome or effect on the enemy through the synergistic, multiplicative and cumulative application of the full range of military and non-military capabilities at the tactical, operational and strategic levels (JFCOM/J9, 2001:ii). It is a methodology for planning, executing and assessing operations designed to attain the effects required to achieve desired national security outcomes (AU/CADRES, 2001:19). An effect is a result or outcome of some action. It is characterised by object – mechanism – indicator. The vision of EBO is to provide means to plan, execute and assess military operations in light of the effects they achieve rather than focused on the inputs. It applies across the spectrum of missions and accommodates lethal and non-lethal, kinetic or non-kinetic applications of power. EBO means that relatively few assets are called upon to attain quickly and decisively strategic and operational effects. It enhances to build, execute and assess operations dynamically in an environment, which is characterised by non-linear, asynchronous and interactive activities on both sides of the conflict.

Planning model consists of three macro models comprise the planning toll: Centre of Gravity (COG) and target system analysis (TSA), Courses of Action (COA) development model and war-gaming. Barlow's model explains that each of the seven COGs is linked reciprocally of unequal importance and disturbances to one can be compensated by the others. Warden's five-ring model provides ever-finer gradations while maintaining coherence. This approach has two benefits either allowing to make the connections between the elements of the model explicit or desegregating from target systems down to targets and desired mean point of impact (DMPI). In this model COA is defined as a plan that would accomplish or is related to the accomplishment of a mission. It is the scheme adopted to accomplish a task or a mission by answering the *what, why, who, where, when* and *how* to specify tasks of subordinate units.

Assessment model consists of plan assessment, combat assessment and campaign assessment. It takes the specifications of indicators linked to the elements of the plan and arranges them such that evidence fed back into the model updates the output of the model.

Warfare rarely is only about breaking things or killing people. It is to affect some sort of change in the opponent's behaviour generally by brute force means, like attrition or coercion. The military aim is to set the conditions where other instruments of national power can take over and attain the strategic aim.

Therefore commanders must have some understanding of the behavioural effects their actions accomplish. In this model the leadership is autocratic, oligarchic and of limited access (typical for coalition environments like NATO). Autocratic because it holds all significant decision making power, oligarchic because it is comprised of just a few individuals and limited access because those outside the oligarchy can gain influence over those within the oligarchy. This kind of leadership has two critical capabilities. It must be aware of its circumstances and it must make decisions. Situation awareness postulates perception, comprehension and projection.

War-gaming Technical Challenges

Current war-games do support and analyse higher level objectives such as establish air supremacy, defeat war fighting forces or disrupt enemy leadership but they are not adequate to satisfy EBO war-gaming requirements.

7.11 Saunders-Newton, D./Frank, Aaron B.

Saunders-Newton, Desmond/Frank, Aaron B., *Effects-Based Operations: Building the Analytic Tools*, Defense Horizons, October 2002, www.ndu.edu/inss/DefHor/DH19/DH_19

Overview

Effects-Based Operations (EBO) is a new concept of military planning and operations that is agile and adaptable to the conflict at hand. The aim is to develop capabilities that can rapidly break an adversary's will to fight and undermine the utility of asymmetric capabilities. The EBO concept requires deep knowledge not only of enemy but also of friendly capabilities and structures. Earlier success in battle was understood to dominate the enemy in an extended attrition campaign, with success measured by territory defended or gained. The new concept of EBO is an effort to leverage advantages in computation, information and analysis to achieve political-military outcomes. Making EBO a reality will depend on developing and using appropriate analytic frameworks of political and military problems. EBO seeks to control the duration and scale of a conflict, allowing the state to achieve strategic objectives at an acceptable cost under the dual objectives of operational efficiency and political effectiveness. The result is an operational paradigm that couples the use of force with purposeful political behaviour and allows operators to take the most efficient or effective path to achieve the most desirable political outcome to establish the linkage between ends and norms. EBO constitutes a shift-away from traditional force-on-force analysis, in which the central concerns have been the ability to mass forces and deny the adversary the ability to do the same. EBO is a natural and logical adjustment to changes in the security environment and the diminishing barriers between military and political activities and outcomes.

Why Effects-Based Operations?

Strategic planning has always linked military operations to a desired political outcome. EBO constitutes an important development in the planning and conduct of military operations because it makes a direct linkage between military operations and desired political effects.

Attrition based strategies rest upon the exhaustion of the adversary. Analytical support typically assumes a linear relationship. The result is a process that is fundamentally systematic, quantitative and relatively objective.

Implementing Effects-Based Operations

The United States Joint Forces Command (USJFCOM) defines EBO as a process for obtaining a desired strategic outcome or effect on the enemy, through the synergistic, multiplicative and cumulative application of the full range of military and non-military capabilities at the tactical, operational and strategic levels. The political objectives provide the basis for creating an operational measure of effectiveness of an EBO. EBO ensures that tactical and operational actions are explicitly part of a strategic plan, developed to achieve specific political results. By coupling strategic outcomes with military operations, EBO is as much about a change in emphasis and concepts as it is about force structure and operations. Operationalising EBO may demand dramatic new military capabilities and forms of organisation. It requires that military organisations increase their flexibility and formulate novel approaches to achieve a particular political effect. It encourages services to work toward interoperability and flexibility in their mission packages and organisational structures. Military tools and organisations must be adaptive enough to ensure that organisational and technological constraints are kept to a minimum.

Analysis – The Linchpin of EBO

Because EBO emphasises outcomes and seeks to minimise the costs of a conflict, it is much more information intensive than attrition based military operations. It demands that the information, estimates and assessments allow an understanding of the environment of operations. SEE pages 5-6!

Eight Information Sets

The combinations of the following eight information sets are of importance and necessary for EBO:

- *Technical* – contains the physical characteristics of friendly and adversary militaries and describes physical features,
- *Geographic* – relates to objects like sensors, weapons and people to positions within physical space,
- *Infrastructure* – combines technical and geographic information about the relationship among objects and actors based on technical capabilities,
- *Organisational* – overlays manmade, hierarchical and formalised organisations on the infrastructure data set,
- *Socio-political* – describes the social and political conditions from which organisations develop and serve,
- *Psychological* – explains the nonmaterial factors in decision-making and conduct,
- *Contest* – parses the previous data sets and forms the body of theories to select appropriate models to evaluate situations,
- *Dynamics* – allows the understanding of how systems change across time in response to external stimuli. It is a set of theories, hypothesises and assumptions that explains causal relationships between action and outcome.

Analytic Outputs: Qualitative vs. Quantitative

The outputs can be quantitative versus qualitative. Quantitative methods have roots in the physical sciences and have been adapted by the social sciences, but they have been hard pressed to deal with complex situations and soft factors. Qualitative models have analytic outputs, which are generally much more difficult to verify and are highly subjective. But they can provide meaningful insights into complex situations by defining the nature of problems and identify tradeoffs between competing objectives. They do little to identify optimal or efficient solutions to problems. They produce narrative outputs and are open to a wide array of interpretations. Although they provide a more robust framework, these insights are often difficult to communicate. EBO can only succeed if the information available allows the conceptualisation of complex systems. Without the ability to provide analytic support, EBO will remain an interesting but ultimately unrealisable concept.

Beyond Joint: Interagency Dimensions

To be successful with EBO the Department of Defence (DOD) must establish an interagency EBO support centre. The collection and management of all necessary sources of information lie beyond the resources, mission or capabilities of any single department. Organisations therefore must collaborate in relating all dimensions of a crisis to one other. An interagency analytic effort offers the best opportunity to tap into the broadest set of skills and organisational resources, but it presents four challenges:

- Discrepancies in the resources available have traditionally limited the level of support,
- Interagency analytic centres need to be in place before a crisis erupts,
- An interagency leadership is needed because organisations have distinct cultures and subcultures and
- It is important to synchronising interagency analytic support to EBO with each organisation's support elements.

DOD must recognise to conduct military operations for political effects, not just military effectiveness, it should be capable of co-ordinating its operations with all relevant governmental agencies to ensure that military operations are synchronised with other forms of national power.

Incorporations of the “New” Social Sciences

Traditional Operations Research (OR) were not formulated to present explicitly all of the attributes associated with EBO. Traditional models are useful for evaluating combat power and war fighting potential, but they are not designed to model the political consequences of military operations. An effects-based approach should include objectives rendering socio-physical systems and their dynamics, as well as important behavioural and psychological aspects of individuals.

Building an EBO Analytic Community

It is necessary to consider how to include computational social science in military OR and analytic communities. This integration will likely be challenged by various concepts, which include:

- *Optimisation*, the process of determining the most efficient design or functional solution to a particular problem,

- *Reductionism*, to represent a complex system by simple system or independent subsystems,
- *Prediction*, the ability to determine or reason the future state of a system, and
- *Non-deductive reasoning*, the ability to employ models for heuristic or experimental purposes.

The ability to integrate these new perspectives into frameworks and methods inclusive of social sciences will be necessary if EBO is to be effectively supported.

Additional Effects-Based Challenges

Three distinct challenges remain to make EBO a reality:

- *Data and information* that drive the analytic models must be readily available or rapidly and reliably acquired,
- *Potential* for operations to take on a life of their own,
- *Time*, because there are no long periods of time to study an adversary in a fluid security environment.

Conclusions

EBO has the potential to transform military planning and operations by establishing linkages between actions and intended effects.

7.12 van Zijderveld, Erik J. A. Dr. Ir.

van Zijderveld, Erik J.A. Dr. Ir., *Measures of Merit for Analysis of Small Scale Contingencies example*, TNO-FEL, The Hague, 2002

Small Scale Contingency Operations (SSCO) like humanitarian operations, are related only to a limited extent to the military component. The success of such an operation is expressed primarily in terms of economic, diplomatic or other non-military achievements.

Paper

The Measures of Merit (MOM) structure is intended for a specific type of analysis, namely prior to actual operations. It is intended for analysis of future asset purchase projects and of future force structures. The scenario outline focuses on the intended purchase of a new helicopter. The international community has decided that intervention is required and sends an international force with the mandate to restore peace and political stability. Based on the scenario outline the analyst has to found criteria to evaluate the suitability for each helicopter type. But to do this, it is impossible to directly establish the effect of a certain type of a helicopter on the mandate. To analyse the contribution of the helicopter to the mandate, a breakdown of the MOM into several levels is needed, with each level being more detailed and precise. To do this, the following levels are of relevance:

- *Measures of Policy Effectiveness* (MOPE) measure how well the overall objectives of the mandating authority are achieved,
- *Measures of Force Effectiveness* (MOFE) measure the degree to which a force meets its objectives,

- *Measures of Effectiveness* (MOE) measure how well systems of force elements accomplish their assigned tasks within an operational context,
- *Measures of Performance* (MOP) measure how well a system or force element together with the dimensional parameters accomplishes a defined task,
- *Dimensional Parameters* (DP) are the properties or characteristics inherent in the physical systems or force elements.

All levels in this hierarchy are to be linked together, eventually all contributing to the mandate which should be satisfied by all defined MOPE. SEE figure 3! This interdependence between the segments means that for example at a level of policy evaluation military and economic successes are mutually interrelated and dependent. This intertwining of several involved segments highly complicates establishing the effects of military activities on the policy and the mandate.

Constructing Measures of Merit

To construct MOM relevant to analyse the performance of the helicopters in the scenario, a consistent and relevant set of MOM must be constructed. First the analyst works down the hierarchy from the mandate to the dimensional parameters, then he/she works up starting from the dimensional parameters and ending with the mandate. The guideline for working down and up the hierarchy are tasks, which can be derived from the mandate and broken down into further subtasks. When working down first, the analyst start at the mandate and defines MOPE, which express to what extent the mandate is met. Then the analyst breaks down the mandate into a number of main tasks needed to reach the mandate's goal. For each of these main tasks the analyst defines one or more MOFE, which express the success at that main task. An important aspect of this approach is that MOE tend to be highly dependent on a specific scenario, while MOP and DP are rather quite independent of the actual scenario. By doing so the analyst has received a more complete picture of the relevant DP and MOP for the helicopters, he/she just might find some more tasks to which the helicopters can contribute and which he should analyse too for a complete evaluation of both items. For this reason he/she has to work up the hierarchy again.

Conflicts between Measures of Merit

Although the described process is suitable for finding relevant MOM but the analyst may have discovered conflicts between MOM which highly complicate the contribution of the helicopters to the mandate. The unexpected consequences are called conflicts between MOM.

Unclear relationships

It is quite impossible to determine the effects of one particular MOFE on higher MOM, because an analyst can hardly determine vertical relationships between higher level MOM. Apart from unclear vertical relationships, numerous horizontal relationships exist between MOM, which are also hard to describe. A main reason for this phenomenon is that mechanisms behind MOM are generally blurred, therefore the determination of correct effects on and values of many relevant MOM is really hard.

Creep, estimates, metrics versus objectives and standard MOM for SSCO are explained in the article.

7.13 Voskuilen, M./Barbier, B./Toevank, F-J./Smeek, B.

Voskuilen, M./Barbier, B./Toevank, F-J./Smeenk, B., *Scenario Development for Crisis Response Operations, How to include the mental component?*, TNO-FEL, The Hague, 30 August 2002

The influence of the mental component on Crisis Response Operations (CRO) is of great importance and it implies that the armed forces' capabilities to engage the adversary's mental state should be more conspicuous. Methods of scenario development almost focus on the physical component and the engagement of the adversary's mental component is heavily under-exposed.

Introduction

In CRO the success of the mission mostly depends on striking the mental component of the enemy. Firstly because there will be an asymmetry between the rivalling parties, secondly the intervening actor is in most cases a guest in the country and it is desirable to avoid (collateral) damage. TNO has developed a method to describe operational scenarios of CRO. The idea is that in an irregular conflict rather than in a regular one the mental component of military power is the more auspicious target to attack. Confrontation and Collaboration Analysis (CCA) has turned out to be a promising method to cope with the mental component:

- *Scenario requirements* – the scenarios should be generic enough to prevent the possibility of over-focusing too specifically on an operation,
- *Military Power* – military power is the result of a conceptual, a mental and a physical component. SEE figure 1 on page 2!
- *CRO and irregular forces* – during development activities for a CRO the inability to cope with the irregular aspect was recognised. Actions of parties involved are characterised as regular or irregular operations.
- *Method for the mental component* – the military contribution to the process of solving and settling a conflict is only one of the entirety. The primary endeavour is to achieve a de-escalation of the conflict by preventing and controlling the use of physical force. The opponent's mental component has a great influence on the way an operation evolves. Since in most CRO forces are guests in a foreign country they have to deal with restrictions, like no use of brute force. The enemy on the other hand is sometimes not identifiable and sometimes he uses unusual means as a weapon.
- *CCA method* – is derived from game theory and it starts with the idea that defence forces must sustain and win not a battle but what is called a confrontation. With the technique of CCA it is possible to plan and execute a strategy to influence and defeat an adversary. CCA helps to structure the whole. Steps are -> scene setting, bounding the situation -> build-up, actors develop positions and fallbacks -> resolution, meeting and making an agreement -> climax, the moment of truth generates emotion -> conflict, heated exchanges -> implementation, taking action.

CCA in scenario development

- Brainstorm: characteristics of the scenario,
- Brainstorm: characteristics of the parties,
- Brainstorm: characteristics of key figures,
- Formulating the scenario,

- Characterisation of key figures,
- Relationships,
- Choice of events,
- Preparing the confrontations,
- Next event.

Evaluation of the method

CCA helps focus and structure the discussion as a different way of war-gaming. It proved useful in describing an irregular operation. An important notice is that an elaborate preparation before the expert meeting is preferable, thus making the session itself more effective.

Conclusions and way ahead

For instance it is extremely difficult to predict the behaviour of a person living in totally different, non-western culture.

7.14 Wagenhals, Lee W./Levis, Alexander H.

Wagenhals, Lee W./Levis, Alexander H., *Effects based course of action analysis in support of war games,*

www.mors.org/meetings/ebo/ebo-reads/Wagenhals_Lewis.pdf

The problem of planning, executing and modelling Effects-Based Operations (EBO) requires the synthesis of a number of modelling approaches. One particular output is the probability of achieving the desired effect as a function of time.

Introduction

EBO is not a new concept. In the past decade there has been an increased emphasis on modelling tools and techniques to support Effects-Based (EB) planning and execution. The rapid advancement of technology has focused attention on EBO as an essential organising principle for C² of military operations across multiple echelons. The new technology allows precision attacks with pinpoint accuracy, intelligence systems provide accurate location of targets and stealth technology greatly reduces the requirement of defensive support systems to protect striking weapons. All these developments have enabled selective components of adversary systems to be struck with precision, to achieve desired effects with minimum risk and destruction. The complexity of coalition operations and the understanding that an important aspect of warfare is the actions that will take place after the combat operations have ceased, has led to the notion that we should consider alternatives to the concept of maximum destruction attrition warfare. By focusing on the overall effects needed to achieve objectives Courses of Action (COA) can be formulated that use precision intelligence and strike capabilities to inflict the minimum collateral damage, while achieving objectives. To do this one must develop a set of effects, which result in the overall objectives and then determine the best set of actions to take. Such actions include not only traditional military attrition based operation, but a spectrum of actions across the instruments of national power employed to influence and persuade an adversary to change his behaviour. SEE figure 1! Military actions have been categorised into strategic, operational and tactical levels.

The details of the objectives may be different at each level, but all objectives must be consistent with the overall objectives. Many traditional military actions (the Ds – destruction, disruption, denial, degradation etc.) are designed to effect specific systems of the enemy. The combination of these tactical effects is designed to affect the Centres of Gravity (COG). The ultimate reason for the tactical operations is to influence and change the belief, reasoning process and behaviour of the adversary. But these operations are just means to a higher-level end. Tactical actions are undertaken to affect the belief and reasoning processes of the adversary. The EBO concept is based on relating actions in a battle plan to effects that will achieve the objectives in a situation and thus accomplish the goals of the mission. Given the potential complexity of future situations and the many consequences of the responses, an approach is needed that:

- Relates conventional and information operations of multiple coalition partners to events and from events to effects,
- Allows for the critical time-phasing of actions for maximum effect and
- Provides the ability to carry out in near-real-time trade-off analyses of alternative COA as operations unfold.

CAEASRII/EB has been built and tested to focus on the belief and reason aspects of the spectrum of operations.

The rest is description of the methodology and the progress itself. At the end there is a good quotation!

7.15 Whittemore, David M.

Whittemore, David M. (Maj.), *Modelling Strategic Effects in Wargames*, Air Command and Staff College, Air University, Maxwell AFB, Alabama, April 1999, www.research.au.af.mil/papers/student/ay1999/ascs/99-226.pdf

Introduction

Strategic effects are the impacts that the outcomes from wartime operational and tactical events have on the highest level decision-makers. Operational and tactical events create outcomes, which change the strategic environment. These outcomes become strategic effects when they carry important meaning to primary decision-makers, but people view a single outcome differently and consequently react differently. Is it possible to understand the calculus of the person in charge, and can this be incorporated into war-games? According to JCS Pub 1-02 war-games are a simulation of military operations involving two or more opposing forces, using rules and procedures designed to depict an actual or assumed real life situation. They are especially good at simulating physical interactions between military machines. War-games tend to be most realistic when they focus on the physical processes of war rather than the psychological. Tactical war-games focus somewhat less on human factors, operational war-games deal with multiple simultaneous tactical interactions and also introduce a big amount of strategy (psychology) of the opposing force commander, but it is still primarily about the interactions of physical force. Strategic war-games are much more about strategy (psychology) with a decision-making process holding centre-stage.

These kind of war-games have to model and simulate processes that are less well understood like politics and culture of the opposing country with a strong focus on the *why* instead of the *what* of enemy decisions. At the strategic level operational and tactical level outcomes are the inputs and decisions are the output. Strategic effects are the mechanism, which convert inputs into outputs. As it is known wars are not always fought symmetrically, but rather asymmetrically with each side pitting its strength against the other's weakness. A valid strategic war-game model could help identify targets most likely to influence a leader to accommodate by choosing the best COA to limit the basis destructiveness of war.

Theoretical foundation for a Strategic Effects Model

Strategic war-games require both a good understanding of decision-making processes and a means to quantifying them. *Thomas Schelling and Arms of Influence* – has the essence that influence is better than destruction for destruction's sake. He uses the word compellence (others use coercion) to convincing the opponent to accommodate, which means that the best way to win is to threaten. In threatening military force is viewed as a source of pain with a focus to use just enough military power to hurt the opponent and make threats credible (yielding). This use of yielding or being punished is also called the punishment theory, which requires both knowledge of what causes the opponent pain and the force to inflict that punishment in a graduate way. Pain is a key part of strategic effects model. To exploit the capacity for hurting and inflicting damage needs to understand the adversary and its values (like the population). In certain strategic environments punishment theory works well, but there are many strategic environments where it does not work that well since totalitarian states do not care about their peoples. Time can be seen as a pain multiplier and an important psychological component of war. Strategic effects within a compressed time period magnify their psychological impact on decision-makers. *Robert Pape and Bombing to Win* – argues that for compellence/coercive purposes the most important strategic effect mechanism is the opponent's cost-benefit analysis. The opponent is willing to pay a price to get a certain value provided the benefits outweigh the costs. The key mechanism for this is military power. In his denial theory strategic effects deal with the availability of sufficient military resources to achieve the objective. Surrender is associated with costs, then the opponent chooses the option with the least cost. In punishment theory the strategic effect MOM is the degree of threat to population's survival, in denial theory it is the level of attrition achieved against the opponent's military force. Both MOMs are easy quantifiable. *John Warden and Success in Modern War* – views an enemy as a system converting inputs into outputs. Inputs can include many things, but the output is survival. The system will be the state made up of five elements like leadership, organic essentials, transportation, the population and fielded forces. The more important the element the less damage it can sustain before the state stops producing its own survival. Like in the theories above, the state must sue for peace once it recognises a credible threat to one or more of these rings or risk ceasing to exist as a state. Warden's theory allows strategic effects to occur in outcomes dealing with events other than just attrition of population and fielded forces. It begins to capture the synergy inherent within a state and the cascading effects that occur when synergism is removed because all the pieces are interrelated. Strategic effects can be achieved without totally destroying military forces threatening population.

A type of strategic effects are called strategic paralysis, which is the outcome of a series of operational events known as parallel warfare, a large-scale, near-simultaneous destruction of targets. The goal is to overload the enemy's leadership with so many simultaneous problems, that it loses control of events.

Unfortunately, there are three problems with the theories above:

- They all focus on the use of overwhelming military force,
- They do not explain asymmetrical strategic effects (positive outcome in one area with a negative outcome in another) well and
- They do not contribute to an understanding of the underlying cause of the conflict, although wars occur for a reason.

Value-Based Strategic Effect Model (VBSEM)

This model is an attempt to resolve the problems identified in the previous chapter. It measures probable achievement of coercion. It also allows quantifiable variables to employ artificial intelligence routines. For simplicity this chapter will assume that war is between two states. The model uses the concept of value as its basis for quantifying relationships with each side estimating its own value, the opponent's value and value of the object. Key is to understand how each side views these values, which can be classified into six variables, (1) starting a current value, (2) forecast benefit, (3) probability of achieving benefit, (4) attractiveness of benefit, (5) current and forecast cost and (6) probability of achieving forecast continued cost and cost aversion. VBSEM treats benefit (winning) as achieving an increase in value and treats cost (losing) as experiencing a decrease in value. *Value: Starting and Current* – The fundamental concept is that each state has a value. Identifying the values helps understand the relationships, keep score and allows incorporation of economic models. The state has values in the areas of military, political, economic, moral informational and survival, which are summed to make up the total value. Current value is the value at any point in time after the start. A valuable state is powerful, different strengths can say more about a state than just the sum. Strength in one area can be overcome by weakness in other area. Power has also a useful aspect that it can be treated as a zero sum game in certain situations. Important is *moral informational power* (public opinion, attitudes and will), which refers to the cultural support of the war and can have a unique strategic effect on war. After identifying the values of each area the summarisation determines each state's total value. *Forecast Benefit* – Benefit is the amount of increase above the starting value. In war both sides usually hope to increase the current value above the starting value by some target amount, which provides the reason for starting a fight or continuing the fight once started. Current benefit is the positive difference between starting value and current value and it shows whether a state is winning or losing. The magnitude of the difference between current value and starting value helps show the likelihood that winning will turn into won and losing will turn into lost. *Probability of Achieving Benefit* – The benefit of fighting depends on the probability of success, which requires taking into account the magnitude – the amount of change over time – and the direction of change in each state's current values. *Attractiveness of Benefit* – Not all states place the same importance of improving their value. A state at the high-end value has a lot to lose, whereby a state on the other end has little or nothing to lose but everything to gain. *Cost: Forecast and Current* – Cost is current and forecast value below the starting value. Losing value during war means paying cost. Yet losing does not mean lost.

All states accept a certain amount of cost early in the war, especially if the magnitude is small. *Probability of Achieving Forecast Continued Cost* – Probability of achieving forecast continued cost is simply the negative side of probability of achieving forecast benefit. If much value has been lost quickly it suggests a straight decrease in value until no value is left. *Cost Aversion* – The amount of acceptable cost is a function of starting value. The state with a high starting value will be more averse to cost than a low starting value state, because it has literally a lot to lose. However the low-value state is also much closer to losing all its value. *VBSM Conclusion* – A strategic war-game can use the total values of competing states to understand the players, but models are just good ideas until operationalised.

From Model to Wargame

Four computer war-game topics are covered here, (1) players, (2) databases, (3) mechanism and (4) fuzzy logic. For details SEE pages 28-34!

7.16 Conclusions

Military operations of any kind in an effects-based manner require a systemic approach and a nearly full-scale understanding of the environment, the enemy and the own capabilities. Effects are achievable and can serve as a guiding principle through the full spectrum of operations but if we try to measure effects outside the material domain the problem is getting more and more difficult. Physical and functional effects are at least theoretically measurable and the accuracy is rather a question of the applied methodology and metrics. Psychological effects require more time to mature and remain at best an elaborated guess, or nothing more than a balancing act between competing soft factors.

Another problem is that the complexity of higher order effects put high demand on modelling or computing Effects-Based Operations, because it means that we need to find ways to operationalise soft factors like culture, will, morale and belief. The modification in behaviour, the ultimate goal of EBO does not respond in a linear way to the modification of material, which is the destruction of targets or infrastructure.

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8. Conclusions and recommendations drawn from the abstracts

8.1 Introduction

The face of war and the way Western democracies are ready to fight is changing. The collapse of the communistic world opened new forms of security challenges and to some extent the world of today is more dangerous than during the Cold War. To face the challenges of terrorism, various nationalism and alike a new form of response is needed. Effects-Based Operations is one of the flagships of this new era. It possesses those very advantages, which wealthy nations favour when sending troops to fight.

8.2 Conclusions for the study

The literature on Effects-Based Operations is extensive and it depicts many features and characteristics of the phenomenon. We can learn the origins of the concept together with the differences to other war fighting maxims. Also the major advantages are listed quite well. The power of EBO is reflected in the fact that this originally air force centric operational level force employment concept is under extension to serve as a basis for a joint force application. The recently announced concept for Rapid Decisive Operations, a White Paper issued by the USJFCOM J9 Joint Futures Lab capitalises on the ideas of EBO. Recent examples have demonstrated that EBO or parts of it has been applied throughout emerging conflicts with success. Nevertheless there are clear limitations to the concept:

- Currently EBO is used to physical destruction to achieve functional effects with only a hope that these functional effects again cause some higher order psychological effects.
- In many case studies even the stated military-political objectives themselves do not aim at the cognitive domain. They are rather limited to reducing the available infrastructure of the enemy leader or leadership. This limitation unfortunately reduces EBO to an old-wine-in-new-jar phenomenon.
- The current EBO practice is rather a methodology to physically limit the enemy's ability to organise own activities to respond properly. It can be seen as a large-scale chess game in which the moves of the enemy are limited systematically. The level of EBO in which the enemy even does not decide to start to play because he is convinced that he loses is not yet achieved.
- The effects-based movement has caused an inflation of the term effect. An originally operational level force application concept, which depicts the non-linearity of war to get rid of the old fashioned force-on-force attrition, is now being used from the tactical to the political strategic level.

Effects are measurable in a more reliable way regarding the physical domain and with a bit of intuition in the cognitive domain. To find ways to measure effects is the centrepiece of this study. Some general remarks can here help us to go further:

- Analysts are successful to some extent in measuring first order physical effects with the Battle Damage Assessment process and functional effects can also be measured with some systemic performance indicators of the targeted infrastructure.
- Regarding the latter the US Joint Warfare Analysis Center is responsible for providing information to theatre commanders to assess campaign plans. Regarding hard facts and the material domain the JWAC has been successfully supported commanders in various operations.
- The real challenge is to find measures and metrics for the non-material, cognitive domain. Influence Nets, System Dynamics, Net Assessment and Bayesian Nets can probably be helpful for that.

8.3 Recommendations

To be fully of control of EBO, further analysis is needed especially in the field of achieving psychological effects. Apart from shortening the time needed to prevail in a conflict and reduce the overall costs, effects have also a big potential for a more general application. It is very important to go back to the roots and clarify the taxonomy characterising the various levels of interactions. A distinction between goals, objectives, effects and tasks is needed otherwise we will be lost in an effect-jungle.

Effects have also the potential to serve as the basis for planning in scenarios. If this is true, than effects can become the basis for the Long Term Military Planning Process, as well. With this step we can achieve a concordance in Operational Planning, Operational Evaluation and Long Term Military Planning.

Within this coherent effects-based framework forces are employed and also designed, equipped, manned, trained and commanded in an effects-based way. This generalisation leads us from Effects Based Operations to an Effects-Based Force what is capable to achieve full spectrum dominance and successfully accomplishes missions without major adjustments. A potential included in the very heart of EBO.

8.4 Remarks

This paper contains the abstracts of 70 various articles, theses, reports and books dealing with Effects-Based Operations and closely related areas. The intention behind abstracting is to establish an order among the information the author has to digest in the course of the research.

The abstracts help give the readers a first impression on EBO but do not replace the original texts. They reflect the authors interest and understanding and may not satisfy everybody's curiosity. Every misinterpretations or not correct English is the author's own fold and nobody else should be blamed.

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