Effects-Based Operations: Obstacles And Opportunities

by CPT Choy Dawen

At first sight, Effects-Based Operations (EBO) is such an obvious concept that it seems a strange candidate for the latest fad in military thinking, coming after previous popular notions as military innovation, precision strike and information technology. After all, who can argue against crafting military operations to achieve specific, precise objectives? Clearly, no one advocates mindless destruction and attrition; and any military officer schooled in command and staff colleges within the past few decades could not have failed to learn from Clausewitz that war must ultimately serve higher political objectives. EBO thus seems a rather fancy acronym for what most people would simply call rational behaviour, of acting in the most efficient way to achieve one's interests and objectives.

Yet the current popularity of EBO amongst military thinkers might be a sign of growing dissatisfaction with current operations planning methods, which have become so regimented and mechanistic that it borders on the tedious. Courses of action are translated into dry numbers and tested through detailed OA (operations analysis) simulations; target sets are methodically listed in vast Excel spreadsheets and tackled line-by-line; while 72-hour air-tasking cycles are run with clockwork precision day after day, week after week. War, at least as seen from a command headquarters, has literally become a numbers game. While this transformation of war into a semi-exact science has allowed the military to conduct large-scale operations more effectively than ever before - indeed, you cannot run a million-man army without detailed planning and meticulous logistics - it has also taken away much of the room for strategising and artistic expression by talented generals. Gone are the days of the daring Blitzkrieg raid across the Ardennes , or the risky amphibious landing at Inchon that turned the tide of the Korean War. Instead, the most "artful" element of the 1991 Gulf War was a wide western hook; 12 years later, during *Operation Iraqi Freedom (*OIF*)*, the US did not even bother with any fanciful strategy and opted for a direct blitz towards Baghdad. 1

EBO's biggest attraction, therefore, is that it reminds planners not to get too caught up with equations and spread-sheets, but instead to take a step back and reconsider the strategy-to-task linkages of what they are doing, as well as to dig deeper to find important weaknesses that can be exploited. Rather than attack an adversary's navy, which might have little bearing in a short war, perhaps it would be more effective to immediately go after the political leaders. Rather than hit every power station in the adversary's network, which might take tens of sorties, perhaps disabling a few key distribution nodes would suffice to bring down the grid. Leverage is thus the central idea of EBO - that more can be accomplished with less effort. 2 It is an idea especially attractive to small militaries such as the SAF, which do not have the kind of resource luxury that allows the US to fight and win wars of destruction/attrition.

Yet, intellectually compelling as EBO sounds, in practice there are crucial difficulties integrating its principles into operations planning. This article - while acknowledging the opportunities offered by EBO - attempts to survey the less-often discussed obstacles that militaries should be wary of. Because EBO has been employed in wars even in the past, I will start by examining historical antecedents to see whether EBO proved to be effective; and if not, the reasons for failure. A more theoretical discussion will then follow, where we will see that our currently poor understanding of complex systems will hamper accurate cause-and-effect analysis so crucial to EBO. I will also identify the trade-offs that EBO makes with respect to Destruction-Based Operations (DBO), primarily in the areas of risk (EBO effects are more contingent and susceptible to errors in intelligence or assessment) and planning effort (current

planning staff is simply in-sufficient to cope with the higher workload required by EBO). Finally, I will discuss whether precision weapons might in fact threaten the viability of EBO (because they make destruction so easy), before summarising the reasons why militaries have therefore in recent times gravitated towards DBO models.

Despite this gloomy assessment, however, I believe that significant benefits can still be extracted from judicious application of EBO principles, especially at the operational and tactical levels where the vagaries of cause-and-effect assessment are less prominent. This article will then conclude by offering some suggestions for exploratory steps in EBO that militaries can take.

A Historical Survey

EBO is not an entirely new concept. Early airpower theorists, such as Guilio Douhet, Hugh Trenchard, and Billy Mitchell, were already advocating strategic bombing concepts prior to WWII that resemble modern EBO thinking. Many of them believed, for example, that civilian morale was so fragile that punishing bombardments of cities would coerce the adversary's population into capitulating. It was this belief which drove the British to firebomb the cities of Germany during WWII, thinking that quicker victory could be achieved. 3

However, there is much evidence to suggest that strategic bombing never really worked. Interviews conducted after WWII indicate that the bombing campaigns against cities strengthened, rather than weakened, the will and morale of civilian populations. 4 Similarly, Allied planners at first thought that weakening the German industrial base would dramatically undermine the German war effort, thus the Combined Bomber Offensive plan (March 1943) emphasised striking aircraft and submarine production yards, ball-bearing factories, and petroleum production facilities. But, in fact, the German economy actually *grew* for several years, in spite of the attacks, by dispersing factory lines and shifting patterns of production away towards scarce items. 5 These poor results suggest that we do not really know what outcomes will arise from the actions we take.

In more modern times, the most positive demonstration of EBO was the 1999 Kosovo conflict, which many believe was won through thoughtful effects-based strikes aimed at forcing Milosevic to capitulate. 6 The cohesion of NATO members, the strikes on dual-use infrastructure which were devastating to the Serbian economy, and the threat of future invasion/unconstrained bombing were all cited as factors leading to Milosevic's surrender. However, some post-conflict interviews also suggest that Milosevic may have given up simply because he had already achieved most of his ethnic-cleansing objectives. 7 So did EBO work, or was NATO just lucky? The Kosovo conflict thus demonstrates one of the key problems with employing EBO in war - that often, one cannot discern the necessary and sufficient causes of an outcome, even with the benefit of hindsight. This is especially the case when dealing with the psychological factors behind the leaders' decisions.

As for OIF, the conflict which brought EBO theories to prominence, there is also little evidence at present that EBO was employed or worked. The strategy of decapitation (striking communications links or command nodes), which received much attention during the war, did not seem effective as US forces ultimately still had to destroy all the Republican Guard divisions guarding Baghdad and physically occupy the city itself before the war came to an end - even though it is almost certain that Saddam Hussein was on the run since the start of hostilities and could hardly command and control his troops. In addition, the massive scale of destruction -

with some 15,000 precision weapons dropped and over 13,000 strike sorties flown 8 , against a Third World army weakened by 12 years of economic sanctions - also seems at odds with EBO principles of leverage and economy of effort. When a more comprehensive analysis of OIF is conducted in the future, it may still turn out that some EBO principles were applied, but the evidence available at present shows a level of destruction that reinforces attrition-based warfare more than EBO.

Implementing EBO: The Challenges

What explains the dismal record of EBO in the previous historical examples? What are some of the challenges that military planners must overcome in order to introduce effects-based thinking into their operations?

Understanding Complexity

The first challenge at hand is that we have a generally poor understanding of complex systems - which contain large numbers of interacting elements - such as global weather patterns, human crowd dynamics, and highway traffic. In such systems, complexity arises either because the interactions themselves are not straightforward, and/or that the interactions are so numerous that simple cause-and-effect analysis becomes quite impossible. Thus, an adversary's leadership structure is a complex system, because even the individual behaviour of each person is difficult to predict, let alone when collective decisions are to be made. Similarly, the adversary's military is also a complex system due to the many interacting elements involved (people, organisations, platforms and infrastructure). Unfortunately, since the behaviour and interaction of elements are so interwoven, several difficulties arise when we attempt to understand and manipulate complex systems.

One such difficulty lies in predicting the outcomes of an action on the system. In complex systems, it is difficult to draw accurate cause-and-effect linkages because higher-order disruptions and adaptive behaviour can often complicate analysis by enhancing, or ameliorating, the direct effect. If the power grid is destroyed, will population morale be affected? Perhaps there might even be no effect at all, which is very plausible, especially in Third World countries where power systems might be so notoriously unreliable that people have already learnt how to adapt. From the historical survey above, it should be clear that our knowledge today of military/political cause-and-effect linkages is nascent at best, and it will likely take many more years of research and analysis before we can confidently predict the outcome(s) of our actions. After all, it took meteorologists decades of research to even make moderately accurate forecasts of weather today.

To make matters worse, the second difficulty of dealing with complex systems is that you cannot simplify them for analysis. It sounds intuitive that even a complex system should have some elements or interactions which are more important than others. The notion of centres-of-gravity, for example, is based on this assumption - that there is a small set of critical nodes which if destroyed would cripple the system. However, our experience hitherto with complex systems in other fields is that they cannot be simplified, but instead must be analysed holistically using brute-force methods such as agent-based modelling or Monte Carlo simulations. 9 Any attempt to simplify the system would result in a less-than-perfect description that generates wrong predictions or fails to account for important effects. 10

What Does This All Mean For The Application Of EBO Principles To Military Operations?

First, we need to recognise that many "theories" of cause-and-effect today are dubious at best. There is little evidence, for example, that decapitation causes much paralysis in enemy forces. Alternate links (courier, face-to-face meetings) can be set up in real-time, while authority can be pre-delegated to lower-echelon commanders if top leaders are killed or unreachable. 11 Similarly, we do not know any consistently reliable means of causing enemy capitulation (other than decisive defeat of military forces); previously popular theories such as attacking civilian populace, disabling enemy industry or killing political leaders have all been shown *not* to work. Sadly, EBO proponents often speak as if we already have a good grasp of cause-and-effect linkages in military/political systems, rather than acknowledge the reality of our poor understanding.

In addition, we may need to fundamentally change our methods of analysis to deal with the unique nature of complex systems. Because complex systems resist simplification, methods such as agent-based modelling may have to replace existing concepts and tools based on simplicity - classical notions such as critical nodes and centres-of-gravity 12 will have to be thrown out. Indeed, throughout the history of strategic bombing, airpower theorists have been looking for centres-of-gravity, be they ball-bearing factories, population centres, fuel/lubricant supplies or military/political leaders, and have never succeeded. 13

Their failure strongly suggests that we might have been working with a misguided concept in the first place. 14

No Free Lunch

But even if we do achieve a better understanding of complex systems in the future, there will still be some fundamental trade-offs that militaries have to make when adopting EBO over traditional attrition-based warfare.

The first trade-off is the inherent risk and uncertainty concomitant with an effects-based strategy. As EBO aims to achieve leverage, it is almost by definition that some targets will be spared in the belief that cascading effects would either render them inoperative or irrelevant. An oft-quoted example occurred during the opening night of the 1991 Gulf War, when strike planners figured that hitting just a few underground bunkers in the Iraqi air defence sector operations centres would be sufficient to force operators to vacate the facilities and cease operations. 15 But what if the analysis was wrong? What if the buildings struck were non-critical, and the operations centre remained operational? EBO therefore demands, as payment for potentially significant benefits, risk-taking from planners and commanders - an attribute that the normally risk-adverse military 16 would find hard to cultivate overnight.

The risk-taking is exacerbated because the effects of one's actions, especially higher-order effects, take some time to manifest. Do you then proceed with the second phase of operations, assuming the first has succeeded and achieved its desired effects? Or should you wait for more reliable assessment and confirmation, but risk losing the momentum and giving time for the adversary to adapt? It took guts, that opening night in 1991, to send large waves of strike packages after the initial opening blow, on the assumption that the EBO-strike on the air defence operations centre was effective. 17

Another necessary, although often glossed over, trade-off is the massive demand on intelligence and planning capabilities to substitute for economy of physical effort. Attacking a complex system through EBO requires laborious analysis of cause-and-effect linkages, supported by timely and accurate intelligence - all of which will fluctuate often during the course of war, thus requiring frequent updates to assessments and plans. In contrast, a destruction-based agenda is simpler to execute because it works by sheer extinction of elements within the complex system, without needing to care very much about the multitude of interactions. It may take longer, but it does not require as much mental work.

We should not underestimate the much higher workload imposed on intelligence assets and operations planners. For example, prior to a recent air force command post exercise, I was part of the core planning staff which spent two months devising an effects-based operations plan. However, once the exercise commenced, we simply could not cope with the frequency and volume of changes - not only to enemy disposition, intent and actions, but also to own forces' capabilities and higher command's intentions. In the end, although some elements of effects-based thinking were retained, we had to revert to a largely destruction-based agenda because we simply did not have the bandwidth to continually change our ops plans to reflect new information and new contexts. We must thus recognise that any savings in physical destruction come at the expense of increased mental effort; there is no free lunch. 18

Advent Of Precision Weaponry

The final challenge to EBO comes from an unexpected quarter. At first glance, precision weapons seem to be a key enabler of effects-based operations by providing the ability to hit critical system nodes accurately and rapidly. For example, during WWII it would take thousands of bombs just to destroy a single factory - which makes it hard to tell whether the inability to disrupt Germany 's industrial base was due to faulty EBO thinking, or simply because the bombing was so ineffective. Similarly, during the early phases of the Vietnam War, when precision munitions were not available, the US Air Force was forbidden to attack the power-generating plant at Lang Chi Reservoir due to its proximity to a major dam. By 1972, however, when laser-guided bombs became available, the plant was destroyed leaving the dam untouched. 19 Without the ability to destroy targets accurately and expeditiously, clever target selection via effects-based thinking would come to naught.

But because precision weapons also allow militaries to prosecute destruction-based campaigns more quickly and more effectively than ever before, the case for EBO (whose primary benefit is leverage) becomes much weaker. In what must be the most classic demonstration of the effectiveness of precision munitions, during the Vietnam War more than 800 sorties employing dumb bombs were expended to strike the Thanh Hao bridge without much success. A few years later, in 1972, just four F-4Es were needed to destroy the bridge using first-generation laser-guided bombs. 20 And precision technology continues to improve - three decades later, a single F-15E employing Joint Direct Attack Munitions managed to hit five separate targets within a single pass. 21 When such dramatic increases in strike capability are achievable, EBO suddenly looks a lot less attractive than before. Why spend so much time prioritising a target list when you can simply attack everything on the list within a few days? Why risk the sector operations centre remaining functional by sparing some bunkers, when you can now simply destroy *every* one of them?

As an individual factor, precision weapons alone would not weigh very much against EBO. After all, even with better strike capabilities, there is always a case for strike prioritisation to achieve maximum leverage. However, when combined with the first two challenges - poor cause-and-effects understanding, and the trade-offs inherent in EBO - it is no longer so clear that a simple-minded destruction-based strategy is that much worse off.

Destruction-Based Operations: Still A Strong Contender

Given the above challenges to EBO, we can now better understand why DBO models are still very much in use today, despite continual attempts to introduce effects-based thinking into operational planning. Indeed, DBO has strong intellectual merits as well as practical advantages in implementation.

The theoretical foundation of DBO rests on the fact that one simply cannot avoid destruction of military forces *in war*. The onset of hostilities invariably means that other non-violent forms of conflict resolution - be they diplomacy, economic sanctions, or third-party mediation - have already been exhausted, or that political leaders believe military action would be most effective in achieving their objectives. In that case, one cannot escape the logical conclusion that to decisively end a war, it will be necessary to remove the adversary's military means. Thus, during *Operation Desert Storm*, it was necessary not only to expel Iraqi forces from Kuwaiti territory, but also to inflict grievous damage on the Iraqi military such that it could no longer pose a significant threat to its neighbours after the conflict. Otherwise, if the adversary's military apparatus remains intact, there is no guarantee that war would not restart. 22

Practically, DBO also avoids many of the challenges mentioned previously. It side-steps our poor understanding of complex systems through brute-force elimination of elements and interactions within that system - also a valid avenue of attack! A destruction-based strategy is also inherently less risky since there is no reason to spare targets; everything is marked for destruction sequentially and methodically. Furthermore, since the basic DBO strategy is the destruction of enemy forces wherever they are, planning effort is kept to mostly asset/weapon selection and manoeuvre planning, much of which can be done in advance during peacetime or periods of tension without grave danger of dramatic changes during war (unlike EBO strategies, which can change fundamentally at short notice). 23 Lastly, with precision weapons promising to make assured destruction a quick affair, the advantages of leverage and speed offered by EBO are severely eroded.

DBO is even practical for small air forces, which normally do not have many strike assets to play with. Although EBO seems attractive because it offers them a high-leverage alternative to the attrition style of warfare practised by large nations such as the US, with precision munitions even small air forces today possess significant striking capability. 24 A hundred strike aircraft flying three sorties a day can potentially destroy up to 600 targets daily if each carried two 2,000 pound precision-guided munitions (sufficient to destroy most targets with a single hit). This level of destructive capability is enough to service even thousands of targets within a mere few weeks.

Hopefully, this section has shed light on why DBO should not be too easily dismissed, as it also has compelling intellectual and practical merits to offer. Because DBO has been the model of operations for a long time, we have become very good at destroying things. Even if EBO can

deliver its benefits as promised, DBO is likely to remain dominant in the short to medium term, and even continue to remain viable for specific scenarios in the long-term.

Towards An EBO Framework

As always, it is much easier to criticise than to construct. Research into practical EBO models of operations is still in its infancy, and most articles on EBO can still only offer theories, definitions and prospects at the moment. As such, this article will not attempt to derive a complete framework for applying EBO to military operations, but instead offer some lessons learnt from the sections above to guide the future creation of an EBO doctrine.

• **Demand high leverage from EBO.** Considering the risks and efforts involved, and the relative ease of sheer destruction using precision weapons, the payoff from EBO must therefore be large. Unless high leverage is required and expected, it might be easier and simpler to stick with DBO such as when the enemy target list is very small to begin with, such as when the US invaded Grenada.

• **Focus on Operational and Tactical effects first.**

At present, applying EBO for strategic effects is problematic because our understanding of our own and the enemy's strategic complex systems is so poor. However, at the operational and tactical levels, EBO principles are much easier to apply. For example, when attacking an airfield, different levels of crippling can be achieved by hitting different components, ranging from closing runways to disrupt operations for a few hours, to eliminating ammunition dumps to cause turnaround problems for a few days. Similarly, operational objectives can be streamlined using EBO - such as by recognising that sea control may not be as important during a short war, which then frees up assets to perform other missions.

• **Destruction is also an effect.**

Although some EBO proponents sometimes try to emphasise differences by stressing non-violent actions or avoidance of strikes, we should recognise that destruction is also a valid effect that can be employed under EBO. Information warfare and diplomacy can be well complemented by judicious strikes on valuable enemy assets, as part of a total EBO strategy.

Conclusion

Throughout this article, we have seen a rather negative assessment of EBO's prospects. Does this mean we should give up thinking about effects-based operations and go back to attrition-based warfare?

Perhaps not. While the practical obstacles against implementing EBO remain formidable, the potential payoffs from EBO are so attractive that we should continue to devote resources towards studying complex systems, understand the risks involved with EBO strategies, and put in place the appropriate staff structures needed to perform higher-level operations planning.

Furthermore, although many EBO articles seem to paint a tension between *attrition* versus *effects*, as if we somehow had to choose one over the other, the hope of this article is to demonstrate that destruction has a logical foundation too. Indeed it seems more appropriate to

consider EBO as simply an expansion of, not an alternative to, DBO, with different degrees of enemy destruction chosen depending on the context and the objectives desired. By adopting such an integrative approach to effects-based operations, we can capitalise on the destructive potential offered by modern precision-munitions, while cultivating the intellectual foundations necessary to exploit EBO once the concept matures.

Endnotes

1 There is some truth in the argument that this problem of methodical, predictable warfare is largely an American one, which has leveraged its technological superiority and overwhelming resource advantage to wage a style of warfare that emphasises sheer quantity and quality of firepower, rather than adopting daring, yet risky, strategies. Still, with the growing sophistication of ops analysis tools and the promise of reduced uncertainty that they bring, militaries worldwide have generally embraced more "scientific" methods of war planning, so much so that planning processes now leave much less room for strategy and guile.

2 Simple as it sounds, this defining principle is extremely important as it can be a good test of how effective your articulation of EBO is. No matter what definition of EBO you use, if it fails the test of leverage it is not worthwhile pursuing since you end up having to destroy just about everything anyway.

3 Robert Pape, *Bombing to Win* (Cornell: Cornell University Press, 1996), pp260-262.

4 Robert Pape, *Bombing to Win*, p272.

5 Alfred C. Mierzejewski, *The Collapse of the German War economy, 1944-1945: Allied Air Power and the German National Railway* (University of North Carolina Press, 1988), pp1-20, as quoted in Kevin B. Glenn, "The Challenge of Assessing Effects-based Operations in Air Warfare", *Air & Space Power Chronicles* (24 Apr 2002). See also Robert Pape, *Bombing to Win*, pp272-278.

6 Stephen T. Hosmer, *Why Milosevic Decided to Settle When He Did* (Rand Publications, 2001) and US Department of Defense, *Report to Congress: Kosovo/Operation Allied Force After-Action Report* (7 Feb 2000).

7 Frederic L Borch, "Targeting after Kosovo: Has the law changed for Strike Planners", *Naval War College Review*, Vol. 56, Issue 2 (Spring 2003), p64.

8 "Coalition Forces have fired 15,000 Guided Munitions during Iraqi Freedom", *Defense Daily*, Vol. 218 Issue 9 (11 Apr 2003), p1.

9 The world's fastest super-computer, currently NEC's Earth Simulator, was designed for climatic research.

10 For example, we commonly use a single measure, temperature, to measure the amount of energy/heat in a container of water. Although it is a very beautiful simplification that easily allows you to tell hotness/coldness, or the state of matter, it cannot account for the common phenomenon of evaporation. To explain evaporation, you have to perform the complex task of analysing each molecule of water individually, and then realise that they have a wide range of

energies which allows some of the faster-moving molecules to break free of the liquid and escape as gas. It is *not* a trivial undertaking.

11 Robert Pape, *Bombing to Win*, p323.

12 Paul K. Davis, *Effects-based Operations: A Grand Challenge for the Analytical Community* (Rand Publications, 2001), pp12-13.

13 Even in physics, other than for textbook learning and simple applications, the centre of gravity does not convey sufficient information for more complicated uses, such as designing the suspension system of a car; for that purpose, knowing the actual weight distribution is necessary.

14 It is important to realise that the difficulties mentioned in this section are deeply fundamental to complex systems, not a problem of insufficient information. People often complain that EBO is difficult to implement because they lack sufficient intelligence about enemy capabilities, intents and actions (how can we find critical nodes in the power system if we don't have good technical knowledge about its design?). However, even with perfect information, we may still not be able to find critical nodes - especially if they don't exist in a complex system! Recently, the Naval War College and Gartner Inc. conducted a " Digital Pearl Harbour " exercise to evaluate the vulnerability of US computer networks by asking specialists to try and attack the system. Despite having the expertise of insiders, many of whom had designed the computer systems in the first place, they were unable to cause a catastrophic shutdown of the network. Clearly, we need to get away from blaming "poor intelligence", and instead undertake concrete actions towards better understanding of complex systems.

15 Allen W Batschelet, "Effects-based Operations for Joint Warfighters", *Field Artillery*, Issue 3 (May/Jun 2003), p7.

16 Militaries are notorious for layer upon layer of contingency plans, for backups to backups to backups. While sometimes derided, such risk-aversion and rigorous contingency planning is actually a laudable characteristic, which caters to the ever-present uncertainty of military operations.

17 The risk-taking element is more pronounced at the operational and tactical levels, where the contrast between attrition and EBO is more stark. At the strategic level, both DBO and EBO suffer from considerable uncertainty about whether actions (destruction or otherwise) would result in the desired outcome. However, arguably, DBO may still be less risky since destruction of enemy forces at least guarantees they cannot recover and retaliate.

18 Of course, such a trade-off might be worthwhile if you lack physical resources but are well trained and clever. Terrorists, for example, exploit such asymmetries all the time, utilising EBO ideas to conduct high-leverage terror operations against much better equipped and funded adversaries. A fairly cheap, yet precise, strike like the World Trade Centre attack was able to throw the world's largest superpower into disarray for a while, which demonstrates how much potential leverage EBO can give if properly executed.

19 Kenneth P. Werrell, "Did USAF technology fail in Vietnam ? Three Case Studies", *Airpower Journal*, Vol. 12 Issue 1 (Spring 1998), p87.

20 Merrill A. McPeak, “Precision Strike: The Impact on the Battlespace”, *Military Technology*, Vol. 23 Issue 5 (May 1999), p20.

21 “F-15E Successfully Launches Five Boeing GBU-31 JDAMs on Single Sortie”, Boeing Co. News Release (14 May 2002).

22 Paul K. Davis, *Effects-based Operations*, p12.

23 The best example of EBO strategies being subject to fundamental change at short notice was the opening decapitation strike of *Operation Iraqi Freedom*. It seems apparent that a more massive “shock-and-awe” opening blow was initially planned, but superseded by the unexpected opportunity to kill Saddam Hussein with an early surgical strike.

24 Shaun Clarke, *Strategy, Air Strike and Small Nations*, Royal Australian Air Force: Air Power Studies Centre (1999).

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