No. 57

THE ADVENT OF A NEW WAY OF WAR :
THEORY AND PRACTICE OF
EFFECTS BASED
OPERATIONS

Joshua Ho

The Institute of Defence and Strategic Studies (IDSS) was established in July 1996 as an autonomous research institute within the Nanyang Technological University. Its objectives are to:

- Conduct research on security, strategic and international issues.

- Provide general and graduate education in strategic studies, international relations, defence management and defence technology.

- Promote joint and exchange programmes with similar regional and international institutions; organise seminars/conferences on topics salient to the strategic and policy communities of the Asia-Pacific.

Research
Through its Working Paper Series, *IDSS Commentaries* and other publications, the Institute seeks to share its research findings with the strategic studies and defence policy communities. The Institute's researchers are also encouraged to publish their writings in refereed journals. The focus of research is on issues relating to the security and stability of the Asia-Pacific region and their implications for Singapore and other countries in the region. The Institute has also established the S. Rajaratnam Professorship in Strategic Studies (named after Singapore's first Foreign Minister), to bring distinguished scholars to participate in the work of the Institute. Previous holders of the Chair include Professors Stephen Walt (Harvard University), Jack Snyder (Columbia University), Wang Jisi (Chinese Academy of Social Sciences) and Alastair Iain Johnston (Harvard University). A Visiting Research Fellow Programme also enables overseas scholars to carry out related research in the Institute.

Teaching
The Institute provides educational opportunities at an advanced level to professionals from both the private and public sectors in Singapore and overseas through the Master of Science in Strategic Studies and Master of Science in International Relations programmes. These programmes are conducted full-time and part-time by an international faculty from July each year. The Institute also has a Doctorate programme in Strategic Studies/International Relations. In 2004, it will introduce a new Master of Science in International Political Economy programme. In addition to these graduate programmes, the Institute also teaches various modules in courses conducted by the SAFTI Military Institute, SAF Warrant Officers' School, Civil Defence Academy, Singapore Technologies College and the Defence, Home Affairs and Foreign Ministries. The Institute also runs a one-semester course on '*The International Relations of the Asia Pacific*' for undergraduates in NTU.

Networking
The Institute convenes workshops, seminars and colloquia on aspects of international relations and security development which are of contemporary and historical significance. Highlights of the Institute's activities include a regular Colloquium on Strategic Trends in the 21st Century, the annual Asia Pacific Programme for Senior Military Officers and the biennial Asia Pacific Security Conference (held in conjunction with Asian Aerospace). Institute staff participate in Track II security dialogues and scholarly conferences in the Asia-Pacific. The Institute has contacts and collaborations with many think-tanks and research institutes in Asia, Europe and the United States. The Institute has also participated in research projects funded by the Ford Foundation and the Sasakawa Peace Foundation. The Institute serves as the Secretariat for the Council for Security Cooperation in the Asia-Pacific (CSCAP), Singapore. Through these activities, the Institute aims to develop and nurture a network of researchers whose collaborative efforts will yield new insights into security issues of interest to Singapore and the region.

ABSTRACT

The successful conduct of Operation Iraqi Freedom has led to much publicity and claims of the coming of age of a new way of war known as effects based operations (EBO). However, EBO is not a new concept. It has its roots in strategic thinking of ancient thinkers like Sun Tzu and Clausewitz, and more recent thinkers like Liddell Hart and Giulio Douhet. In practice, the principles of EBO have also been crudely applied from the Second World War onwards. Despite its lack of novelty, there has been resurgent emphasis in EBO after Operation Desert Storm in the post-Cold War era. The main objective of this resurgence was to consider how a future Desert Storm might be won in less time and with far fewer troops. Subsequently, the thinking evolved into knowing how and where to apply precise force to achieve a rapid and decisive victory.

Over the last 13 years, the thinking on EBO has evolved, and six theories of what EBO is have emerged. The six theories also indicate the different levels of sophistication for the practice of EBO. The level of practice of EBO depend on the military capabilities that can be brought to bear on operations and includes a full range of capabilities from sensing, the ability to manage knowledge, and the ability to create effects via kinetic and non-kinetic means. The capabilities required to conduct EBO, the extent of their use in military operations conducted since 1990, especially in Operation Iraqi Freedom, and the strengths and limitations of these capabilities are examined to provide evidence of the current state of practice of EBO. The paper asserts that successful conduct of EBO requires not only a diverse set of military capabilities, but also a strong emphasis on professional military education to enable the soldier to better operate in a complex environment.

****

Joshua Ho is a Research Fellow in the Revolution in Military Affairs Programme at the Institute of Defence and Strategic Studies. He obtained a B.A. and M.A. in Engineering from Cambridge University, U.K. on a SAF (Overseas) Scholarship, and holds a MSc (Management)(Distinction) from the Naval Postgraduate School, Monterey, California, where he was awarded the Graduate School of Business and Public Policy's Faculty awards for Excellence in Management and Outstanding International Student. Joshua is a serving Naval Officer with 17 years of service and currently holds the rank of Lieutenant Colonel. He was trained as a Principal Warfare Officer and has served in various shipboard appointments, culminating in the Command of a Missile Gun Boat. He has also served in various staff appointments including stints in the Naval Operations, Plans, and Personnel Departments and was attached to the Future Systems Directorate, MINDEF. He has held concurrent appointments of Honorary Aide de Camp to the President, Secretary to the Naval Staff Meeting, and Secretary to the Policy and Strategy Meeting chaired by the then Second Minister for Defence.

THE ADVENT OF A NEW WAY OF WAR : THEORY AND PRACTICE OF EFFECTS BASED OPERATIONS

From the onset of the salvos on the 21 March 2003, it was evident that Operation Iraqi Freedom was going to be a different kind of war. General Tommy Franks, the Commander US CENTCOM, confirmed this view during a press briefing the following day, when he said that Operation Iraqi Freedom was to be a war 'characterised by shock, by surprise, by flexibility, by the employment of precise munitions on a scale never seen before and by the application of overwhelming force.'[1] As it turned out, Operation Iraqi Freedom did live up to General Tommy Franks' bold claims and was a landmark victory in many respects: the time taken to secure victory was short for a major campaign, precision weapons were used more extensively than in any other conflict and the coalition casualties sustained was relatively low for a major war. Operation Iraqi Freedom also took half as long and required only one-third as many troops to complete the mission in comparison to Operation Desert Storm conducted 12 years ago.[2]

Although the current statistics released have been impressive,[3] some have suggested that the US was able to win because of its overwhelming superiority since Iraq was a 'paper tiger' with a military possessing obsolete equipment and little desire to fight.[4] In addition, the northern and southern no-fly zones imposed after the first Gulf War gave the US a tremendous advantage in keeping the Iraqi air force in check and facilitating the conduct of surveillance prior to the start of the war. Some have even alleged that the actual war began as early as December 2002, when SEAD operations

---

[1] Paul Adams, "'Shock and Awe' – An Inevitable Victory" in Sara Beck & Malcolm Downing (eds.), *The Battle for Iraq: BBC News Correspondents on the War against Saddam and a New World Agenda* (London: BBC Worldwide Limited, 2003), pp. 105 & 106.
[2] Michael P. Noonan, "The Military Lessons of Operation Iraqi Freedom", *FPRI E-Notes*, Foreign Policy Research Institute, 1 May 2003.
[3] There was an increased use of precision weapons with a 70 percent use of precision strikes, which is in contrast to the mere 9 percent used during the first Gulf War. Casualties were historically low and amounted to seven per division per day as compared to 12 per day for Operations Desert Storm, 110 per division per day in the Israeli 1967 Six Day War and over a hundred a day in World War II. See Jennifer Pangyanszki, "A Textbook Case for the War Colleges for the Future", CNN.com, 19 April 2003, and Jim Dunnigan (ed), "Combat Lessons Learned", StrategyWorld.com, 10 June 2003, p.12.
[4] Paul Adams, Op. Cit, p.120.

purportedly began.[5] Despite the advantages conferred to the US, the results of the battles on the ground were far from predetermined. The battles for the Al-Faw Peninsula, the Port of Umm Qasr, cities of Nasiriya and Basra and eventually the move into Baghdad were reported by news teams to be neither bloodless nor walkovers, as there were still incidences of Iraqis resistance.[6] The swift and overwhelming nature of the American victory in the face of uncertain opposition have prompted many to claim the arrival and coming of age of a new way of war known as effects based operations (EBO).

There has been a lot of publicity about EBO as a new way of war after the successful conduct of Operation Iraqi Freedom, but more heat than light has been shed on the topic. EBO does not appear to be a new concept, and although some have linked it to the concept of 'shock and awe', several theories of what EBOs are can be discerned from literature published since the 90s after the successful conduct of Operation Desert Storm. The paper examines the capabilities required to conduct EBO, the extent of their use in military operations conducted since 1990 with particular reference to Operation Iraqi Freedom, and the capabilities and limitations of these capabilities to provide evidence of the current state of practice of this new way of war.

Shaping Behaviour as the Key Principle of Effects Based Operations

EBO seeks to move away from a destruction centric, attrition based and linear approach to warfare. Instead, an effects based approach to operations seeks to separate the means from the ends by identifying the outcomes or strategic objectives desired in a campaign and then deriving the means required to achieve those outcomes. Implicit in EBO is the focus on shaping behaviour of adversaries to such an extent that they will choose to surrender and not fight if possible. The means or "effectors" can comprise both the use of force as well as the application of non-force measures, for example psychological operations. It also includes non-military measures like the use of

---

[5] Anthony Cordesman, "The Lessons of the Iraq War", *Summary Briefing for the Land Warfare Studies Centre – Chief of Army Conference 2003*, 2 October 2003.
[6] Clive Myrie, Adam Nynott, Andrew North, Ben Brown, Gavin Hewitt, and David Willis, "Front-Line Stories" in Sara Beck & Malcolm Downing (eds.), *The Battle for Iraq: BBC News Correspondents on the War against Saddam and a New World Agenda* (London: BBC Worldwide Limited, 2003), pp. 19-38.

diplomatic, economic and political methods. The breakthrough in thinking comes in recognising that destruction is not an end in itself but a means to an end. This new way of thinking also points to how the impact of physical action is felt not only in the physical domain but also in the cognitive or psychological domain of the adversary. A more sophisticated approach recognises that every physical action has immediate effects, also known as primary effects, secondary effects, as well as tertiary and unintended effects, and treats the adversary as a complex adaptive system.[7]

Certainly the concept of EBO is not new. The assessment on behavioural determination of the adversary espoused by EBO are aligned with prominent strategic thinkers in history like Sun Tzu and Carl von Clausewitz. Sun Tzu and von Clausewitz emphasise the importance of the psychological aspects of war, to the extent that action in battle may be to gain psychological advantage alone rather than to achieve a physical objective. Examples of such thinking include:

> *Thus, those skilled in war subdue the enemy's army without battle. They capture the enemy's cities without assaulting them and overthrow his state without protracted operations. Their aim is to take all under heaven intact by strategic considerations.[8]*
>
> *Sun Tzu, circa 400-320 B.C.*

> *Victory normally results from the superiority of one side; from a greater aggregate of physical and psychological strength. This superiority is certainly augmented by victory, otherwise it would not be so coveted or command so high a price. That is an automatic consequence of victory itself. Its effects exert a similar influence, but only up to a point. That point may be reached quickly-at times so quickly that the total consequences of a victorious battle may be limited to an increase in psychological superiority alone.[9]*
>
> *Carl Von Clausewitz, 1780-1831*

---

[7] In simple terms, a complex adaptive system is a system that learns from experience. See Murray Gell-Mann, *The Quark and the Jaguar: Adventures in the Simple and the Complex* (New York: W.H. Freeman and Company, 1994), p. 17.

[8] Tao Hanzhang, *Sun Tzu's Art of War* (New York: Sterling Publishing, 1987), p. 99.

[9] Michael Howard & Peter Paret (edited and translated), *Carl von Clausewitz: On War* (Princeton: Princeton University Press, 1976), p. 566.

More recent thinkers on strategy have also emphasised the need to influence the thinking and behaviour of the adversary. For example, Liddell Hart asserted that the perfection of strategy was to produce a decision without any serious fighting and the aim of strategy was to dislocate the enemy, which would result in either dissolution or easier disruption of the enemy in battle.[10] Douhet believed that a successful air attack on civilian infrastructure deep in enemy territory would create tremendous moral and material effects on the civilian population and break the enemy's national resolve to fight.[11] Both evolved their theories as a way of circumventing the frontline, and avoiding the deadlock experienced on the Western Front in the First World War, which resulted in horrendous numbers of casualties.

The thinking and concept of EBO is not only rooted in historical strategic thought. The United States has also tried to apply the principles of EBO for over 50 years since the Second World War when US Army Air Corps planners wrote the Air War Planning Document 1 in 1941.[12] A renowned example of EBO thinking and application is the US Army Air Force's attempt to destroy the German war economy by a strategic bombing campaign on the critical nodes in German industry, which was in this case, the ball bearing factories at Schweinfurt.[13] It was thought that destruction of the factories would severely damage the German war economy as many of the German tanks and machinery required the ball bearings from Schweinfurt to function. Despite the damage done to the factories at Schweinfurt, the German war machine continued to roll on with ball bearings supplied by the Swiss and the Swedes, and by design improvements to make existing equipment less reliant on ball bearings.

---

[10] Basil H. Liddell Hart, *Strategy* (New York: Praeger, 1972), pp. 338-339.

[11] Giulio Douhet, *The Command of the Air,* translated by Dino Ferrari (New York: Coward-McCann, 1942), p. 20.

[12] Edward Mann, Gary Endersby & Tom Searle, "Dominant Effects: Effects-Based Joint Operations", *Aerospace Power Journal*, Fall 2001, p. 93.

[13] Dennis J. Gleeson, Gwen Linde, Kathleen McGrath, Adrienne J. Murphy, Williamson Murray, Tom O'Leary, and Joel B. Resnick, *New Perspectives on Effects-Based Operations: Annotated Briefing* (Alexandria, Virginia: Institute for Defense Analyses, June 2001), pp. 28-29.

A Resurgence in the Emphasis on Effects

Although the tenets of EBO had been crudely applied in previous wars, the dominant approach to warfare was still focused on the destruction of the adversary's military assets. However, after Desert Storm in 1991, there was a rethink of how the US should go about fighting its future wars in a post Cold War environment of unequivocal American military prominence.[14] In the unilateral geo-strategic environment that followed the collapse of the Berlin Wall, there was pressure to shrink the military budget, reduce the number of capital assets and reduce the number of military personnel in the United States Department of Defense (DoD). In fact, the US DoD authorised budget shrunk from US$282.1 billion in 1992 to US$278.4 billion in 1999, and hit a low of US$254.4 billion in 1996.[15] Not only did the Defence Budget shrink during the 1990s, more critically, the total deployable force strength was also cut by well over 40 percent in the post-cold war period.[16] Given the background, the concept of EBO was initially started to consider how a future Desert Storm could be conducted in less time and with far fewer troops. Subsequently, the thinking evolved into knowing how and where to apply precise force in order to achieve a rapid and decisive victory.[17]

Theories of Effects Based Operations[18]

Most commentators who comment on the employment of EBO in Operation Iraqi Freedom actually refer to the theory of rapid dominance to achieve 'shock and awe'. However, this is just one theory of EBO. Although there is no authoritative definition for

---

[14] Jefferson Morley, "The Origins of 'Shock and Awe'", *Washington Post*, 21 March 2003.

[15] The first sustained long term increase in defence funding since the Cold War was proposed for the period FY 2000-2005 during the Clinton administration. Since then the budget authorised for the DoD increased from US$290.5 billion in 2000 to US$378.6 billion in 2003, which is an increase of 30 percent over 3 years. See The International Institute of Strategic Studies, *The Military Balance: 2003-2003* (London: Oxford University Press, October 2002).

[16] In particular, the Army had reduced it active force structure from 18 to 12 divisions and total active manpower from around 800,000 to 480,000. See Anthony Cordesman, Op Cit., p. 14.

[17] Harlan Ullman, "Shock and Awe Revisited", *RUSI Journal*, June 2003, p.11.

[18] Theories expanded from those initially espoused by Dr Joel Resnick of the Institute for Defense Analysis.

EBO, six different variants of what EBOs are can be garnered from writings post-Operation Desert Storm.

The first theory treats EBO as a planning methodology for the conduct of operations. The planning methodology emphasises the strategy to task links, the integration with other planning processes and the use of both military and non-military means to prosecute the adversary. Operation Iraqi Freedom provided one such example of this planning process where the national strategy was integrated with the operational objectives. The national strategy of conducting regime change, eliminating weapons of mass destruction and capturing the terrorists in Iraq filtered down to Tommy Frank's eight operational objectives, which were to: (1) finish the regime, (2) eliminate weapons of mass destruction, (3) capture or drive out terrorists, (4) gain intelligence on terrorists and weapons of mass destruction, (5) secure oil fields, (6) deliver humanitarian relief, (7) create the conditions for representative government, and (8) insure territorial integrity.[19] In turn Tommy Frank's eight operational objectives were translated to the missions of his component commanders, which were in turn translated into tactical action plans. The strength of the planning process lay in the fact that each mission could be traced back to an operational objective. The US Joint Forces Command uses the term effects based planning to describe EBO as a planning methodology.

The second theory treats EBO as efficient targeting.[20] The efficiency approach seeks to exploit the key weak points of the enemy by analysing its capabilities as a total system.[21] It focuses on the destruction of critical nodes rather than the destruction of the entire infrastructure to achieve the desired effect, and on the conduct of parallel operations[22] which emphasises attacks on all desired targets simultaneously rather than in sequence. The US Joint Forces Command uses the term effects based targeting to

---

[19] Paul Adams, Op Cit., p. 105.
[20] The principal proponent of this theory is Major General David A. Deptula, United States Air Force. He was the principal offensive air campaign planner for the Joint Force Air Component Commander's director of campaign plans in Desert Storm.
[21] Nick Cook, "The Proving Ground for America's New 'Warform'", *Scotland on Sunday*, 23 March 2003.
[22] Parallel operations exploit the three dimensions of time, space and levels of war (tactical, operational, strategic) to achieve simultaneity. See David A. Deptula, *Effects-Based Operations: Change in the Nature of Warfare* (Virginia: Defense and Airpower Series, Aerospace Foundation, 2001), pp. 3-6.

describe efficient targeting.[23]   Two examples, one from Operation Desert Storm and another from Operation Iraqi Freedom will illustrate how this concept is achieved in practice.

In order to render the Iraqi Air Defences ineffective in Desert Storm, the US decided to attack the two major sector operations centres (SOCs) providing the command and control to the air defences. Even though the specifications stipulated that six 2,000 pound laser guided bombs were required to totally destroy the hardened bunkers of the SOCs, the US chose partial destruction of the SOCs by a single 2,000 pound bomb which then 'smoked out' survivors from the building.[24]   This partial destruction approach allowed more aircraft sorties to be generated for strikes against four more SOCs discovered subsequently.   During Operation Iraqi Freedom, a less protected communications switch located 200 metres away was destroyed instead of the command and control bunker that was underneath Baghdad's Rashid Hotel as attacking the Rashid would have resulted in civilian casualties since there were still foreign journalists staying at the hotel. Attacking the communications switch that served the command and control bunker had the same effect of rendering the bunker ineffective, as it could no longer communicate with the troops under its charge.[25]

The third theory treats EBO as the application of all sources of national power, political, military, economic and diplomatic, to address all elements of adversary national power.[26]   It claims that the reliance on a single source of national power will inevitably reduce the overall effectiveness of a campaign and make it relatively easy for an

---

[23] The US Joint Forces Command has defined effects based targeting as the focus of the targeting process to produce courses of action that will change the enemy's behaviours and compel him to comply with our will. (Available at http://www.jfcom.mil/about/glossary.htm).

[24] The solution arose when a US air campaign planner pointed out that while the planning group might survive a single 2,000 pound bomb exploding at the other end of the building, the survivors would certainly abandon the facility to seek shelter elsewhere. (Ibid., p. 12).

[25] Paul Adams, Op. Cit, p.107.

[26] Dennis J. Gleeson, Gwen Linde, Kathleen McGrath, Adrienne J. Murphy, Williamson Murray, Tom O'Leary, and Joel B. Resnick, Op Cit., pp. 11-15. The term D.I.M.E. (Diplomatic, Information, Military and Economic) is also used by the United States Joint Forces Command to describe the full range of actions that can be used to achieve specific effects on an adversary. (Available at http://www.jfcom.mil/about/glossary.htm). See also Australian Army Future Land Warfare Branch, "Military Operations in the Littoral Environment", *Australian Army Vanguard Concept No. 1*, February 2003, p.vi. (Available at http://www.defence.gov.au/army/Vanguard/Index.htm).

adversary to adapt to this single form of attack. The US Joint Forces Command's definition of EBO is analogous to the effectiveness approach.[27] Two examples, a negative one from Operation Allied Force and a positive one from Operation Iraqi Freedom, will illustrate how this theory is achieved in practice.

The air campaign conducted as part of Operation Allied Force against Serbia was planned to affect a Serbian military withdrawal from Kosovo. Although, all non-traditional techniques were employed, including the modelling of social networks to persuade those close to Milosevic to influence him to withdraw his troops from Kosovo[28], NATO's decision to forgo the threat of a ground invasion[29] meant that the air campaign in Serbia did little to persuade Milosevic to change his policy towards Kosovo. It was the Kosovo Liberation Army ground offensive supported by the United States, which proved to be the deciding factor in Milosevic's withdrawal. However, the extensive damage to infrastructure resulting from the air campaign had the unintended consequence of eroding Milosevic's political support and led to his eventual fall from power. Operation Iraqi Freedom also provided a limited example of the use of this concept, at least until the end of the hot war phase. Alternative measures such as economic sanctions against Iraq's oil exports after Desert Storm and diplomatic negotiations at the UN Security Council were attempted before resorting to the use of force. The gathering of a coalition for the operation and its execution using combined forces ensured that the US was not acting alone.

The fourth theory treats EBO as rapid dominance. It relies on the employment of a series of unrelenting "waves of powerful strikes across many targets combining sea, air, land and space forces to affect and influence the adversary's perception and includes the

---

[27] The US Joint Forces Command defines effects-based operations 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. (Available at http://www.jfcom.mil/about/glossary.htm).
[28] Desmond Saunders-Newton & Aaron B. Frank, Op Cit., p. 2.
[29] Benjamin S. Lambeth, "Lessons from the War in Kosovo", *Joint Forces Quarterly*, Spring 2002, p. 13.

physical capture and occupation of territory if necessary."[30] The execution of Operation Iraqi Freedom provided a visible example of this theory where cruise missile strikes and air bombardment were conducted on hundreds of targets in parallel with the deployment of manoeuvre forces on the ground. The manoeuvre force moved with such rapidity that they reached Baghdad airport, just 20 kilometres from the city centre in 13 days. Rapid dominance is usually what people refer to when they discuss EBO.

The fifth theory focuses on EBO as interaction and collaboration between the operational commander and the other key actors in a campaign in order to deal with uncertainty in operations arising from a complex and adaptive adversary.[31] In concept, the interaction between the operational commander and his civilian leaders, his tactical commanders and the sources of knowledge about the enemy as complex adaptive systems are to be learning experiences for the participants not only in the planning but also in the execution phases of a campaign as well. Appealing though it may be, there is little indication that this theory was applied in the ground battle during Operation Iraqi Freedom, although a limited application was the dynamic incorporation of lessons learned into the coalition's execution of operations.[32]

The sixth theory focuses on EBO as network-centric warfare. The theory also considers the adversary as a complex adaptive system.[33] It proposes that four ingredients are required to deal with complexity and uncertainty: the ability to generate different action options for decision makers by linking diverse sets of engagement and sensor

---

[30] The four characteristics of rapid dominance have been described to be: full knowledge of self, adversary and the environment; brilliance in execution; rapidity; and control of the operating environment.   See Harlan K. Ullman & James P. Wade, *Rapid Dominance - A Force for All Seasons* (London: Royal United Services Institute for Defence Studies, RUSI Whitehall Paper Series, 1998), pp. 1-2.

[31] Dennis J. Gleeson, Gwen Linde, Kathleen McGrath, Adrienne J. Murphy, Williamson Murray, Tom O'Leary, and Joel B. Resnick, Op Cit., pp. 6-9.

[32] A Joint Forces Command team began a lessons learned process before the war started and provided immediate feedback during the duration of the war, which allowed CENTCOM to apply the lessons in real time to improve coalition performance during the war. See SECDEF Donald H. Rumsfeld, and General Tommy R. Franks, "Summary of Lesson Learned: Prepared Testimony to the Senate Armed Services Committee", *Power Point Slides*, 9 July 2003. (Available at http://www.senate.gov/~armed services/testimony.cfm?wit id=187&id=843)

[33] The theory considers conflict as a clash of complex adaptive systems that are entities that evolve and adapt to their environments and as a result the behaviour of such systems can never be entirely predicted. See Edward A. Smith Jr., *Effects Based Operations: Applying Network Centric Warfare in Peace, Crisis, and War* (Washington, D.C.: DoD CCRP Publication Series, November 2002), p. 26.

capabilities; the agility to adapt to an intelligent adversary's actions through shared awareness of an unfolding situation; the ability to coordinate complex actions in synergy at different levels through shared situation awareness and common understanding of command intent; and the ability to mobilise knowledge and expertise to bear to provide timely support to decision makers at all levels. The networking of resources in the entire war fighting enterprise is proposed as the way in which to master uncertainty and deal with complexity.[34]

Although there was no demonstration of this networked form of warfare since the 4th Infantry Division, reputedly the most networked force in the US Army, was not used in Operation Iraqi Freedom, the dramatic results achieved in the US Army's Division 21 advanced war fighting experiments have been cited by the proponents as proof of the efficacy of network-centric warfare. For example, some experiments have shown that 75 percent of the current combat platforms can triumph over twice the number of enemy forces, in half the time, at over three times the size of the battle space when networked.[35]

The Practice of Effects Based Operations

Despite differing interpretation as to the key elements in each of the six theories of EBO, some common capabilities are needed before EBO can be successfully conducted. Since EBO link physical action to effects, the abilities to conduct and integrate precise physical actions plus the skills to observe the effects arising from those physical actions are important capabilities to develop. In addition, in order to generate the next set of actions, there is a need to analyse if the effects generated have met desired outcomes and are able to communicate both the information generated from effects assessment and the decisions for the next course of action. Capabilities to sense what is happening in the battlefield, to understand what is happening, to create and communicate

---

[34] The concept of Network Centric Warfare proposes interlocking links between a sensor network, a weapons network as well as a command, control and planning network to increase the tempo and responsiveness of forces. See David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority* (Washington, D.C.: DoD CCRP Publication Series, August 1999), pp. 87-93.
[35] Ibid., p. 180.

knowledge derived from battlefield information, and to create precise effects are needed for the conduct of EBO.[36]

Sensing

Sensing is the first component capability required in the conduct of EBO. It is the process of identifying targets to be struck, cuing action upon positive identification and evaluating the effects achieved from the action. Manned, unmanned aircraft and space-based platforms with its attendant sensors used during Ops Iraqi Freedom and sensing technologies employed in the war have advanced to such an extent that achieving positive identification for fixed installations and static weapons emplacements has become a reality.

Area wide search and locate capabilities were provided by satellites, long endurance high altitude and medium altitude unmanned aerial vehicles (UAVs), as well as manned surveillance aircraft. The National Reconnaissance Office (NRO) employed three advanced KH-11 type visible and infrared imaging spacecraft, and 2 to 3 Lacrosse all-weather imaging radar spacecraft that provided 24-hour coverage to image fixed installations, detect Iraqi armour, static weapons emplacements and missiles launches.[37] A high altitude UAV, the Global Hawk, was used as a strike co-ordination and reconnaissance asset. It was particularly effective in locating air defence and surface-to-surface missiles through the use if its synthetic aperture radar (SAR) which could see through sandstorms.[38] Medium altitude UAV like the Predator was used as surveillance and as autonomous strike assets. Manned surveillance assets such as the U-2 high

---

[36] The capabilities were derived from the British model of the decision cycle based on the sense, understand, develop intent and synchronise effects process. (Available at UK MoD website, http://www.mod.uk/issues/nec/intro.htm). In contrast, Colonel John Boyd's model of the decision cycle is based on the, observe, orient, decide, act (OODA) process. See John N.T. Shanahan, "Shock-Based Operations: New Wine in an Old Jar", *Air & Space Power Chronicles*, 15 October 2001, p. 2.

[37] At least one of the satellites was in a position to image portions of the battlefield every 2 to 3 hours with about 12 passes over Iraq per day. In total, the space-based assets detected 26 missile launches, 1,493 static infra-red 'events' and 186 high explosive events. See David A. Fulghum, "Offensive Gathers Speed", *Aviation Week & Space Technology*, Vol. 158, Issue 12, 24 March 2003, p. 22.

[38] The single Global Hawk available was able to locate up to 50 surface-to-air missile (SAM) launchers, more than 10 SAM batteries and approximately 70 missile transport vehicles and could remain in the area for 24 hours. See Martin Streetly, "Airborne Surveillance Assets Hit the Spot in Iraq", *Jane's Intelligence Review*, 1 July 2003.

altitude surveillance aircraft and the Joint Surveillance and Target Attack Radar System (JSTARS) were used extensively to provide dynamic surveillance and targeting during sandstorms.

Besides imagery, another valuable source of sensing information was from signals intelligence obtained via electronic eavesdropping with the RC 135 Rivet Joint aircraft. The platform can be used to sift airwaves for mobile phone transmissions and locate the caller's position.[39]   The capability proved particularly useful in locating surface-to-surface missiles and SAM launchers as their operators gave their position away through too much chatter. The Iraqi leadership was also located when they were forced to use high frequency radio, which was easily intercepted and exploited for intelligence once their fibre-optic landline and public switching networks were interdicted.[40]

The combination of sensing capabilities across useable bands of the electro-magnetic spectrum on platforms operating at different altitudes allowed continuous surveillance and targeting to be performed under different anti-aircraft threat situations. However, there are limitations to the current sensing capabilities: (1) the inability to detect and identify high value, well-protected mobile missile launchers; (2) the failure to against discriminate less well protected mobile targets, like trucks, from civilian vehicles; and (3) the incapacity to detect, identify and discriminate targets hiding in foliage or within buildings.[41]   Future developments are likely to focus on solutions like the development of satellites with GMTI, SAR and ISAR[42] capabilities, enhancing Global Hawk with GMTI features and foliage penetrating radars, and developing mini and micro UAVs to detect and identify targets under foliage, and within or under infrastructure.

---

[39] Nick Cook, "The Proving Ground for America's New 'War Form'", *Scotland on Sunday*, 23 March 2003.
[40] Michael Knights, "USA Learns Lessons in Time-Critical Targeting", *Jane's Intelligence Review*, 1 July 2003.
[41] Alan Vick, Richard M. Moore, Bruce R. Pirnie, and John Stillion, *Meeting the Challenges of Elusive Ground Targets*" (Santa Monica, CA: RAND, 2001), pp. 32-36, 40-43, 64-65, 110-115, 121-133.
[42] GMTI – Ground Moving Target Indicating Radar, SAR-Synthetic Aperture Radar, ISAR-Inverse Synthetic Aperture Radar.

Managing Knowledge

The aim of the sensing component is to collect information about the adversary and the efficacy of effects created by previous actions. Adversary behaviour and his next likely courses of action are predicted based on sensing information to generate the next set of actions to be taken by own forces. Both software models and associated hardware are needed in the generation of the courses of action. The models assist in anticipating effects of hitting targets so that sensor platforms can be appropriately positioned to monitor those effects. Equally crucial is the ability to convey the information from the sensors to the knowledge processors and communicate the courses of action to the players who will execute the missions. Both knowledge creation and knowledge communication are principal components of knowledge management.

Creating Knowledge

Targeting is the process of generating the targets to be attacked and is a basic level of course of action generation. Current linear models centre on Colonel John Warden's "Five Rings" theory of aerospace warfare, which contend that the war effort should be directed primarily at the enemy's physical side as the moral or human side is beyond the realm of predictability. In his model, the critical core is the enemy leadership, while the orbiting systems are organic essentials like infrastructure, population and the opponent's fielded military forces.[43] Jason Barlow's National Elements of Value (NEV) model enhances the Warden model by detailing the relative importance of the target systems to the national leadership and the relative importance of the target systems to each other. Maris McCrabb attempted a further enhancement the Warden model. He developed a Meta model combining the Warden and Barlow models with an agent adaptation model. McCrabb's model determines the various ways an adversary might react to an attack based on three scenarios of: (1) what is most beneficial and what is

---

[43] John N.T. Shanahan, Op Cit., p. 4.

most restrictive to the adversary, (2) what is known about the adversary's capabilities, and (3) what if the adversary had certain currently unknown capabilities.[44]

Another model option that can be used for targeting is the Leontief Input-Output model.[45] The model takes each target as an input factor and the outputs are the effects of striking the targets on different sectors of the military, like active forces and reserves, level of training, weapons store, status of weapons, and logistics ability. The model allows one to determine the target that has the most effect on the elements of military power and assist in the analysis of possible secondary and tertiary effects.

Systems currently being developed to enhance targeting is known as the Automated Assistance with Intelligence Preparation of the Battlespace (A2IPB), where soldiers input the latest battlefield conditions into the program and it replies with the enemy's most likely next geographical move for the Air Force and the Army. Terrain, weather and force organisation information is used and matched with templates of enemy doctrine to predict the future movement of enemy force.[46] Data mining to identify new connections between subjects, the use of artificial intelligence to help sift through information and correlate large volumes of information like satellite imagery and enhanced visualisation systems to display the information and knowledge generated will be features of the system.[47] The A2PIB is expected to be developed by 2004 and will be able to interoperate with:[48] (1) target development systems, (2) intelligence, surveillance reconnaissance management and employment systems, (3) fusion systems, and (4) intelligence command and control databases.

---

[44] Daniel F. Fayette, "Effects Based Operations: Application of New Concepts, Tactics, and Software Tools Support the Air Force Vision for Effects Based Operations" *Air Force Research Laboratory's Horizons*, June 2001. (Available at http://www.afrlhorizons.com/Briefs/June01/IF00015.html)
[45] Mark A. Gallagher, Anthony W. Snodgrass, Greg Ehlers, "Input-Output Modelling for Effects Based Operations", *Paper for Military Operations Research Society Workshop on Analysing Effects Based Operations*, 29-30 January 2002.
[46] Ben Ames, "Air Force Predicts Enemy Moves with New Software", *Military & Aerospace Electronics*, 1 September 2003.
[47] Henry S. Kenyon, "Unconventional Information Operations to Shorten Wars", *Signal*, Volume 57, Issue 12, 1 August 2003.
[48] _____, "Federal Contracts", *The Washington Post*, 16 June 2003.

The targeting models assume that the physical effects achieved will translate to behavioural outcomes. Historically, this has not been shown to be true.[49] Behavioural models address this weakness and incorporate both a targeting model and a situational aware, recognition primed (SARP) decision-making model to determine the required actions needed to shape adversary behaviour. The recognition primed model postulates that all decisions flow from analogies drawn from both the current and previous situations that have been experienced by a person. It asserts that a person frames the existing situation by recognising the patterns from a previous experience, and matches that to the current situation. Subsequently action is taken based on the actions that the person has previously taken.[50] The SARP goes one step further by incorporating prospect theory into the model. Prospect theory allows one to determine an individual's propensity for risk and the kind of actions individuals with different risk profiles would undertake. By incorporating prospect theory, the model does not need a store of the adversaries' previous experiences, but seeks to affect their perception of the situation through alteration of their appetite for risk.

Despite the power of behavioural models like SARP, they fail to recognise the adversary as a complex adaptive system (CAS). A CAS is one in which the interacting autonomous and semi-autonomous entities comprising the system can adjust their behaviour as a result of externalities acting on the system. CAS models incorporate targeting and behavioural models and include statistical and probabilistic methods to model the non-linearity of adversary behaviour.[51] CAS models are the most powerful of all the models. Because CAS models are so powerful, they require high performance systems that are capable of self-learning to drive the model. Although advances in information systems suggest that such a self-learning system might be technically

---

[49] Maris McCrabb and Joseph A. Caroli, "Behavioral Modeling and Wargaming for Effects Based Operations", *Paper for Military Operations Research Society Workshop on Analysing Effects Based Operations*, 29-30 January 2002.
[50] Gary Klein, *Sources of Power: How People Make Decisions* (Massachussetts: MIT Press, 1998).
[51] Michael Senglaub, "The Analytic & Philosophical Imperatives of Effects Based Operations (EBO)", *Paper for Military Operations Research Society Workshop on Analysing Effects Based Operations*, 29-30 January 2002.

feasible within the next few years; the development of a cultural-military-economic model is still lagging behind developments in information technology.[52]

Communicating Knowledge

Another aspect of hardware is the communications backbone needed to communicate command intent. In Operation Iraqi Freedom, satellite communications were used extensively to convey command intent and aid collaboration between commanders, superiors and peers in the fast moving battlefield. So heavy was the requirement for bandwidth that commercial satellites were used to meet 84 percent of the requirements.[53] The Global Command and Control System (GCCS), which can use satellite or radio frequencies for transmission, was also a critical backbone in providing accurate location of blue forces down to the platoon level. Based on the desired need for more bandwidth after Iraqi Freedom, the Distributed Common Ground System (DCGS) will be enhanced to an architecture that is capable of integrating command, control, intelligence and surveillance (C2ISR) operations across globally distributed forces.[54] In addition, DCGS will also be backward compatible and be able to incorporate future modular change.

Effecting

The next step after sensing the environment, deciding on the course of action to take based on an analysis of adversary information and creating knowledge through computer models is to create precise effects through physical action with "effectors".

---

[52] John N.T. Shanahan, Op Cit., p. 8.
[53] The coalition had 30 times the bandwidth available in 1991 for a force 45% smaller. See John Williamson, "Bigger, Better C4ISR Systems Underpin US Warfighting Efforts", *Jane's International Defense Review*, 1 August 2003.
[54] _____, "Raytheon and Lockheed Martin Expand Roles of BAE Systems and General Dynamics in Pursuit of Distributed Common Ground System 10.2 Program", *PR Newswire*, 17 July 2003.

Precision Guided Munitions

The first class of "effectors" is precision guided munitions (PGMs) and there has been a noticeable trend of the increased use of PGMs in conflicts.[55] The increased usage can be attributed to the increasing accuracy of precision guided munitions developed since the Second World War.[56] During the Second World War, 1,500 B-17 bomber sorties were required to drop 9,000 bombs to destroy a target of 600 square metres in size.[57] During the Vietnam War, the accuracy of precision weaponry had improved to such an extent that the same 600 square metre target only required dropping 176 bombs from 30 F-4 sorties. During Desert Storm, the laser guided bombs proved so accurate that they accounted for 75 percent of the damage upon Iraqi strategic and operational targets, even though they constituted only 4.3 percent of the total tonnage expended.[58] The technology had improved to such an extent that by the time of Operation Enduring Freedom and Iraqi Freedom, up to 24 similar targets could be targeted by one B-1 sortie with the GPS guided Joint Direct Attack Munitions (JDAM).[59]

Parallel improvements in stealth capability of aircraft have also allowed the bombing missions to be carried out more effectively. As vital installations and other high value targets are well protected by radar-guided guns and missiles, a force package of aircraft is usually assigned with the bombers to neutralise air defences in order to get bomb-dropping aircraft in and out of the target area safely. During Desert Storm, a force package of 33 aircraft required to protect 8 bombers embarked on a bombing mission,

---

[55] During Desert Storm, 7.7 percent of the weapons dropped were precision munitions, increasing to 40 percent in Operations Allied Force against Serbia in 1999, 60 percent in Operations Enduring Freedom in 2001, and 70 percent in Operations Iraqi Freedom in 2003. See Nick Cook, "Effects-Based Air Operations - Cause and Effect", *Jane's Defence Weekly*, 18 June 2003.

[56] Precision-guided bombs first made their debut in World War II on 9 September 1943 when a German Dornier Do 217 bomber dropped two Fritz-X radio-guided glide bombs on the Italian battleships Italia and Roma from 18,000 feet to prevent them from being turned over to the Allies. The Italia was heavily damaged while the Roma was destroyed. See Marc Cerasini, *The Future of War: The Face of 21st Century Warfare* (United States: Alpha, 2003), p.11.

[57] Gary L. Crowder, "Effects-Based Operations: The Impact of Precision Strike Weapons on Air Warfare Doctrines", *Military Technology*, June 2003, p. 16.

[58] Richard P. Hallion, "Precision Weapons, Power Projection, and the Revolution in Military Affairs", *Paper delivered during the USAF Air Armament Summit*, 26 May 1999, p. 5.

[59] Gary L. Crowder, Op Cit., p. 16.

translated to an escort ratio of about 5-to-1 aircraft.[60]   By the time Operation Iraqi Freedom was conducted, the increased use of stealth aircraft meant that a bomber could proceed for a bombing mission with literally no escort aircraft, that is, one F-117 sortie was able to deliver two bombs to just as many targets.[61]

Now that stealth and precision technology has matured, the next level of development will be to make attacks more surgical through the development of small diameter bombs of about 130 kilograms. These small diameter bombs are more suitable against small, mobile targets and urban targets.[62]   Other developments include combining precision with an all weather capability by fixing laser seekers to the current JDAMs; increasing stand-off accuracy by attaching a wingkit to the JDAM[63] and through air-to-surface missiles like JASSM;[64] and developing a responsive call-for-fire system with a loitering precision attack platform like the RQ-5A Hunter unmanned air vehicle (UAV)[65] or the modified Tactical Tomahawk (TacTom) missile.[66]   Hence, dramatic improvements in accuracy of precision weapons over the last 60 years and the parallel development in stealth technology have made it possible for the US to conduct strikes on infrastructure deep in enemy territory with limited collateral damage to civilian personnel and infrastructure and the ability to facilitate the conduct of EBO.

---

[60] An accompanying force package will consist of aircraft to suppress enemy early warning and surface-to-air missile radars, destroy or jam enemy defensive missile systems and defend against enemy aircraft attacks and may take up to 80 percent of the total force package. (Ibid, p. 17).

[61] The F-117 attacked 43 percent of the targets on the master target list during the entire war even though they flew only 2 percent of the total combat sorties. See David A. Deptula, *Effects-Based Operations: Change in the Nature of Warfare* (Virginia: Aerospace Education Foundation, Defense and Airpower Series, 2001), p. 18.

[62] Michael Sirak, "Boeing Wins Small Diameter Bomb Deal", *Jane's Defence Weekly*, 3 September 2003.

[63] Michael Sirak, "USAF Seeks to Combine Laser, GPS in Bomb", *Jane's Defence Weekly*, 8 October 2003.

[64] Michael Sirak, "US Air Force Plans Substantial Increase in Cruise Missile Buy", *Jane's Defence Weekly*, 17 September 2003.

[65] Kim Burger, "US Army Test Precision-Strike Unmanned Air Vehicle", *Jane's Defence Weekly*, 3 September 2003.

[66] _____,"USN Eyes Tactical Tomahawk as 'Call-for-Fires' Weapon", *International Defense Review*, 1 September 2003.

Manoeuvre Forces

Another tool used to create effects during Iraqi Freedom is the deployment of mobile forces like armour and armoured infantry. Although the air campaign did much to reduce Saddam's ability to command and largely reduced the combat power of the Iraqi Army,[67] pockets of resistance by irregular forces still held out.[68] The coalition knew that it had to insert forces into the capital quickly in order to force the regime to capitulate. The 5th Corps bypassed urban areas and headed straight for the jugular, reaching within 50 miles of Baghdad in 5 days.[69] The sight of M1 tanks and M2 Bradley fighting vehicles entering the capital was more than sufficient to convince the Iraqis that Saddam's regime was no longer in control. The pulling down of the statue of Saddam Hussein provided the proverbial final straw that broke the regime's back. Future developments will likely to focus on better support to facilitate speed in operations, either by improving the efficiency of the manoeuvre platforms or by improving the effectiveness of the logistics support.

Special Forces

The employment of Special Forces was also a key feature in Operation Iraqi Freedom. Active mainly in the north and west of Iraq, Special Forces comprised nearly eight percent of the combined force package and managed to narrow the battle space from a California to a Connecticut sized space.[70] In effect, it was Special Forces coupled with air power working in concert with the lightly armed local Kurds and the 173rd Airborne, which effectively replaced the 4th Infantry Division, and formed the Northern Front. Special Forces were also involved in the liaison with Kurdish forces to ensure that they took no action to prompt Turkey to invade.[71] The Special Forces proved to be so

---

[67] Saddam Hussein did not exert his influence much after the first two decapitation strikes and had effectively lost control over his forces. See Paul Adams, Op Cit., p.119.
[68] Major General Robin Brims (UK), "The British Army and the War in Iraq", *Briefing conducted during the Australian Land Warfare Studies Centre – Chief of Army's Conference*, 2 October 2003.
[69] _____,"Operations Iraqi Freedom: A Chronology", *Army Magazine*, May 2003. .
[70] This represents a reduction in area of 97 percent, from 155,960 square miles to 5,009 square miles, a shrinkage of 97 percent. See Michael P. Noonan, Op Cit.
[71] Kim Burger, "What Went Right?", *Jane's Defence Weekly*, 30 April 2003.

useful that they were assigned multiple roles: directing air attacks and raids against a terrorist camp on the Iraqi-Iranian border, searching for Baath leadership along the highways from Baghdad to Tikrit, seizing selected targets like oilfields to prevent Iraqi leadership from setting them on fire, holding dams to prevent the leadership from flooding large parts of the country, and occupying airfields for subsequent use by the coalition and denial of its use by Iraqis who may have intended to launch Scud missiles at Israel.[72]   They also held key towns in the north and important buildings like the presidential palace in denial missions, disrupted internal Iraqi lines of communication in Baghdad and other command and control facilities, as well as provided information on the whereabouts of Iraqi leaders, which ultimately aided attacks against Saddam Hussein and his spokesman, General Ali Hassan Majid ('Chemical Ali').[73]   There were also reports that the US military, the Central Intelligence Agency and Iraqi exiles conducted a broad covert effort inside Iraq three months before the start of the war to forge alliances with Iraqi military leaders to persuade them to cooperate and not fight.[74]

The multi-role capability of the Special Forces and its civilian equivalent, the CIA, was a highly desirable factor in EBO as they could fulfil and perform a variety of missions ranging from surgical destruction, psychological operations, persuasion, and liaison that contributed to the overall creation of effects.   Future developments in this area will likely focus on further integration of Special Forces and regular force operations and the provision of on-call firepower to the Special Forces.

Information Operations

Another 'effector' was the conduct of information operations to directly influence the psyche of the Iraqis. A psychological war was waged with over 50 million leaflets dropped over Iraq and hundreds of hours of radio/television broadcasts made to scare the Iraqis into inactivity or desertion.[75]   Many of the leaflets were dropped even before the

---

[72] Jennifer Pangyanszki, Op Cit.
[73] _____,"Lessons from the Iraq War", *IISS Strategic Comments*, Volume 9, Issue 3.
[74] Dexter Filkins & Douglas Jehl, "US Moved to Undermine Iraqi Military Before War", *The New York Times*, 10 August 2003.
[75] Jim Dunnigan, (ed), Op Cit.

war began. They contained instructions on how to surrender and gave warnings of the consequences for anyone thinking of using chemical or biological weapons. In addition, text messages were sent to the mobile phones of individual Iraqi commanders to persuade them not to fight. Jamming of communications nodes was another strategy used to neutralise the Iraqi air defence system without destroying them.[76] Other information operations included 'communications herding', whereby most frequencies were jammed, forcing the Iraqis to broadcast from a small set of other frequencies that were more easily disrupted or exploited for intelligence.[77]

Besides persuasion, deception was the flip side of information operations. Saddam was led to believe that the war would start later than it did by deceiving him into thinking that the 4th Infantry Division was a vital part of the war, even though it was not. This was achieved by keeping the 4th Infantry Division floating off Turkey after it was clear that they would not be allowed to transit through Turkey, and by sending troops of the 4th Infantry Division slowly to the Gulf to give the impression that the US needed to open the northern front in order to succeed. Both actions caused Saddam to leave the oilfields in the South relatively undefended.[78] Further enhancements to information operations is likely to focus on further integration of information operations with military operations and the development of platforms that provide integrated Electronic Support Measures in addition to Electronic Counter Measure capabilities with previously unachievable location accuracy.[79]

Potential and Challenges of Effects Based Operations

EBO holds promise for the future of warfare as successful execution can allow militaries to economise on the employment of force and reduce the numbers of troops needed on the ground during the hot war phase. The economy of ground force employment will limit own casualties and adversary casualties. Similarly collateral

---

[76] Henry S. Kenyon, Op Cit.
[77] Andrew Koch, "Information Warfare Tools Rolled Out in Iraq", *Janes' Defence Weekly*, 6 August 2003.
[78] Andrew Koch, "Information War Played Major Role in Iraq", *Jane's Defence Weekly*, 23 July 2003.
[79] ___, "Lockheed Martin to Lead UK's Soothsayer EW Programme", *Jane's Defence Industry*, 1 October 2003.

damage in terms of civilian casualties and infrastructure damage can be minimised. However, achieving economy of effort on the battlefield is not a simple task. To do this a whole array of resources are required starting with: (1) the need to have a comprehensive awareness of the battlefield by employing pervasive and persistent sensors, (2) the ability to manage the knowledge created of both expected enemy courses of action and own responses to achieve the desired strategic outcomes, and (3) the ability to effect those outcomes through precise application of kinetic and non-kinetic means on the targets of choice.

The range and depth of assets employed by the US during Iraqi Freedom suggest that the acquisition of resources to conduct EBO is costly. The US had attained its current superior military position by outspending everyone else; in fact its 2002 military expenditure is greater than the combined total of the next top 14 spending countries in the world.[80] Inherent in the US philosophy is the choice to spend money in order to save both own and civilian lives on the battlefield and reduce infrastructure damage. Even then, the US has not been able to fulfil all aspects of EBO due to the weaknesses inherent in existing combat systems. The US has reached a high level of attainment in effects based planning and targeting and possibly the conduct of rapid dominance, but has some way to go in employing all sources of national power in conflict resolution, as evidenced by the post-war difficulties in Iraq.

The quick pace of the war forced the coalition to deal with the post-war situation as soon as they moved into cities and areas once under the dominion of the Republican Guard and Saddam loyalists. There was no clear delineation between the war and the post-war phase as some units of the coalition were already encountering post-war issues whilst other units were still moving to Baghdad. Inadequate planning with respect to the post war effort has cost the US dearly in terms of lives and money. Indeed, the ability of armies to conduct General Krulak's three-block war of conventional conflict,

---

[80] The US accounts for 42% of the world's share of military expenditure. See "The 15 Major Spender Countries in 2002", *SIPRI Data on Military Expenditure*, 2003. (Available at http://projects.sipri.se/milex/mex_data_index.html).

unconventional operations and post war action, right down to the lowest levels of the hierarchy will be the hallmark of future successful operations.[81]

Although some form of collaboration exists through chat rooms, messaging, and Operational Net Assessment (ONA),[82] it is unlikely that collaboration will be fully achieved until all the forces are networked in a common architecture with the ability to track everyone's position automatically. Finally, the U.S has some way to go in conducting EBO by treating the adversary as a complex adaptive system. The challenge will be the development of a cultural-military-economic model that is so comprehensive as to be able to foretell what the likely behaviour or actions of the adversary are to own actions.

If the US has some way to go in the conduct of EBO, the other major coalition partners in the operation, namely the United Kingdom and Australia are not even in the same ballpark when it comes to the conduct of EBO. These two countries are still very much focussed on effects based planning with a limited ability in effects based targeting.

Conclusion

So far, the US approach to EBO has focused mainly on the instrumental, or the technological aspects, but not the existential aspects of war. If we believe that despite our best efforts to instrumentalise war, Clausewitzian fog is inevitable, it would also be necessary then to focus on the human aspects of war, or what will enable the soldier to better operate in a complex environment. Of primary importance is professional military education. The ability of the soldiers to find workaround solutions to problems encountered on the battlefield and to continue to operate despite imperfect equipment, was a strength highlighted time and again in lessons on the conduct of Iraqi Freedom.

---

[81] General Charles C. Krulak, USMC, "The Strategic Corporal: Leadership in the Three Block War", *Marines Magazine*, January 1999, p. 3.

[82] Operational net assessment relies on specially indoctrinated military and federal agency personnel, unique organisation and a secure computer network program to seamlessly and quickly store, analyse and share information about a particular enemy. See Michael Wimbish, "Joint Experiment will Test Information Linkage Concept" available at http://www.jfcom.mil/about/experiments/mc02/ona.htm.

Hence, the successful conduct of EBO requires capabilities as diverse as precision guided munitions, persistent sensors, and computer models. It also requires one to have capabilities to conduct information operations, special operations and manoeuvre warfare. If one does not possess the full spectrum of such capabilities, the conduct of EBO is likely to be limited. More importantly, it requires the humans in the loop to know the adversary and self so well as to allow one to effectively dictate the pace of war and render the adversary struggling to keep up. This brings to mind General Krulak's idea of the strategic corporal having to exercise an exceptional degree of independence, maturity, restraint and judgement in the conduct of operations in the 21st century. So important is this requirement for the mastery of knowledge that some people have dubbed effects based operations 'PhD level warfare'.[83]

---

[83] Greg Mills, "New War, Fresh Tactics... and Old Lessons", *The Straits Times*, 27 March 2003.

Bibiliography

Alberts, David S., Garstka, John J., and Stein, Frederick P., *Network Centric Warfare: Developing and Leveraging Information Superiority* (Washington, D.C.: DoD CCRP Publication Series, August 1999).

Sara Beck & Malcolm Downing (eds.), *The Battle for Iraq: BBC News Correspondents on the War against Saddam and a New World Agenda* (London: BBC Worldwide Limited, 2003).

Cerasini, Marc, *The Future of War: The Face of 21ˢᵗ Century Warfare* (United States: Alpha, 2003).

Cordesman, Anthony, *The Iraq War: Strategy, Tactics, and Military Lessons* (Washington D.C.: CSIS Press, 2003).

Deptula, David A., *Effects-Based Operations: Change in the Nature of Warfare* (Virginia: Defense and Airpower Series, Aerospace Foundation, 2001).

Douhet, Giulio, *The Command of the Air,* translated by Dino Ferrari (New York: Coward-McCann, 1942).

Gell-Mann, Murray, *The Quark and the Jaguar: Adventures in the Simple and the Complex* (New York: W.H. Freeman and Company, 1994).

Gleeson, Dennis J., Linde, Gwen, McGrath, Kathleen, Murphy, Adrienne J., Murray, Williamson, O'Leary , Tom, and Resnick, Joel B., *New Perspectives on Effects-Based Operations: Annotated Briefing* (Alexandria, Virginia: Institute for Defense Analyses, June 2001).

Howard, Michael, and Paret, Peter (edited and translated), *Carl von Clausewitz: On War* (Princeton: Princeton University Press, 1976).

Klein, Gary, *Sources of Power: How People Make Decisions* (Massachussetts: MIT Press, 1998).

Liddell Hart, Basil H., *Strategy* (New York: Praeger, 1972).

O'Hanlon, Michael, *Technological Change and the Future of Warfare* (Washington D.C.: Brookings Institution Press, 2000).

Smith Jr., Edward A., *Effects Based Operations: Applying Network Centric Warfare in Peace, Crisis, and War* (Washington, D.C.: DoD CCRP Publication Series, November 2002).

Tao, Hanzhang, *Sun Tzu's Art of War* (New York: Sterling Publishing, 1987).

The International Institute of Strategic Studies, *The Military Balance: 2003-2003* (London: Oxford University Press, October 2002).

Ullman, Harlan K., and Wade, James P., *Rapid Dominance - A Force for All Seasons* (London: Royal United Services Institute for Defence Studies, RUSI Whitehall Paper Series, 1998).

Vick, Alan, Moore, Richard M., Pirnie, Bruce R., and Stillion, John, *Meeting the Challenges of Elusive Ground Targets*" (Santa Monica, CA: RAND, 2001).

IDSS Working Paper Series