

## Waging Effects-Based Operations

Joshua H. Ho

### A New Way of War?

From the onset of the opening salvos on 21 March 2003, it was evident that *Operation Iraqi Freedom* was going to be a different kind of war and as it turned out, *Operation Iraqi Freedom* was a landmark victory in many respects. For example, 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 were relatively low for a major war. *Operation Iraqi Freedom* also took half as long and required only one-third as many troops in comparison to *Operation Desert Storm* about a decade earlier.<sup>1</sup> The swift and overwhelming nature of the American victory in Iraq have prompted many to claim the arrival of a new way of war known as effects based operations, or EBO.

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 marry the means with the ends by identifying the outcomes or strategic objectives desired in a campaign and then deriving the means required to achieve those outcomes. If we view EBO as the marriage of means with ends, then EBO can be considered as the making of strategy, or grand strategy as some would prefer, which is the use of force or the threat of force for political ends.<sup>2</sup> 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 like psychological operations. Although the idea of destruction as a means to an end and not an end in itself is not a new one, what is new is the attempt to describe the impact that physical action has in both the physical as well as the cognitive or psychological domains 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.<sup>3</sup>

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<sup>1</sup> M P Noonan, 'The Military Lessons of Operation Iraqi Freedom', *FPRI E-Notes*, Foreign Policy Research Institute, 1 May 2003.

<sup>2</sup> C Gray, *Strategy for Chaos: Revolutions in Military Affairs and the Evidence of History*, Frank Cass, London, 2002, p. 3.

<sup>3</sup> M Gell-Mann, *The Quark and the Jaguar: Adventures in the Simple and the Complex*, W H Freeman and Company, New York, 1994, p. 17.

## **The Conduct of Effects Based Operations in History**

Despite the many proponents of EBO in the US, critics argue that the thinking on shaping the behaviour of the adversary espoused by EBO is not new and resonates with the ideas of prominent strategic thinkers in history like Sun Tzu and Clausewitz. For example, both Sun Tzu and 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.<sup>4</sup> 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.<sup>5</sup> 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.<sup>6</sup> Both Liddell Hart and Douhet 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.

Critics would also point out that thinking and concept of EBO is not only rooted in historical strategic thought, but that the tenets of EBO have also been applied in previous military campaigns.<sup>7</sup> For example, the US Air Force's attempt in the Second World War to disrupt the German war economy via strategic bombing campaigns on critical nodes would be cited as an example of EBO thinking and application. However such bombing may not have been as successful as previously thought. Take for example the strategic bombing campaigns on the ball bearing factories at Schweinfurt.<sup>8</sup> It was thought then that the 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. However, although the strategic bombing campaign resulted in critical damage 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 that made existing equipment less reliant on ball bearings.

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<sup>4</sup> See Tao Hanzhang, *Sun Tzu's Art of War*, Sterling Publishing, New York, 1987, p. 99, and C von Clausewitz, *On War*, ed and transl M Howard & P Paret, Princeton University Press, Princeton, NJ, 1976, p. 566.

<sup>5</sup> B H Liddell Hart, *Strategy*, Praeger, New York, 1972, pp. 338-339.

<sup>6</sup> Giulio Douhet, *The Command of the Air*, transl D Ferrari, Coward-McCann, New York, 1942, p. 20.

<sup>7</sup> E Mann, G Endersby & T Searle, 'Dominant Effects: Effects-Based Joint Operations', *Aerospace Power Journal*, Fall 2001, p. 93.

<sup>8</sup> D J Gleeson, G Linde, K McGrath, A J Murphy, W Murray, T O'Leary, and J B Resnick, *New Perspectives on Effects-Based Operations: Annotated Briefing*, Institute for Defense Analyses, Alexandria, VA, June 2001, pp. 28-29.

Although the tenets of EBO had been crudely applied since the Second World War, the dominant approach to warfare was still focused on the destruction of the adversary's military assets. If the concept of effects based operations is not new, then what has changed to make it different from traditional strategy making? One can say that the conduct of EBO has now become more feasible because advances in technology have altered the way that force is applied, rendering the instruments of war, not only more lethal but also more precise. Also the application of technology and sophisticated computer modelling has also led some to think that shaping adversary behaviour in a precise and predictable manner is distinctly achievable.

### **Effects Based Operations as the Conduct of Rapid Decisive Operations**

In the operational domain, EBO is primarily associated with a very specific concept of operations known as 'rapid dominance', or 'shock and awe', as it is more popularly known. 'Rapid dominance', or 'rapid decisive operations' (RDO), 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 physical capture and occupation of territory if necessary'.<sup>9</sup> The execution of *Operation Iraqi Freedom* provided a visible example of this where cruise missile strikes and air bombardment were conducted on hundreds of targets in parallel with the deployment of manoeuvre forces on the ground.

However, before 'rapid dominance' can be achieved, an effects based approach to planning is required. The US Joint Forces Command has coined the term effects based planning to describe this planning aspect of EBO. The planning methodology of EBO 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 General Tommy Frank's eight operational objectives. And in turn Frank's eight operational objectives were translated to the missions of his component commanders, which were in turn

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<sup>9</sup> 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 H Ullman & J P Wade, *Rapid Dominance - A Force for All Seasons*, Royal United Services Institute for Defence Studies, RUSI Whitehall Paper Series, London, 1998, pp. 1-2.

translated into tactical action plans.<sup>10</sup> The strength of the planning process lay in the fact that each mission could be traced back to an operational objective.

'Rapid dominance' also requires targeting to be both effective and efficient.<sup>11</sup> Effective and efficient targeting is achieved through exploitation of the key weak points of the enemy by analysing its capabilities as a total system.<sup>12</sup> 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,<sup>13</sup> which emphasises attacks on all desired targets simultaneously rather than in sequence. Besides targeting, battle damage assessment in the form of sensor allocation to assess the effects of the engagement is also needed. In definitional terms, the US Joint Forces Command uses the term 'effects-based' targeting to describe 'efficient' targeting.<sup>14</sup>

As an example of efficient and effective targeting, 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.<sup>15</sup>

## Capabilities Required for the Conduct of Effects Based Operations

Although simple in theory, the conduct of effects based operations is difficult in practice and a whole suite of capabilities is required for the successful

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<sup>10</sup> P Adams, "'Shock and Awe' – An Inevitable Victory", in S Beck & M Downing, eds, *The Battle for Iraq: BBC News Correspondents on the War against Saddam and a New World Agenda*, BBC Worldwide Limited, London, 2003, p. 105.

<sup>11</sup> 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 *Operation Desert Storm*.

<sup>12</sup> N Cook, 'The Proving Ground for America's New "Warform"', *Scotland on Sunday*, 23 March 2003.

<sup>13</sup> Parallel operations exploit the three dimensions of time, space and levels of war (tactical, operational, strategic) to achieve simultaneity. See D A Deptula, *Effects-Based Operations: Change in the Nature of Warfare*, Defense and Airpower Series, Aerospace Education Foundation, VA, 2001, pp. 3-6.

<sup>14</sup> 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 from <<http://www.jfcom.mil/about/glossary.htm>>.

<sup>15</sup> Adams, p.107.

execution of effects based operations. These capabilities include the ability to sense, manage knowledge, and create precise effects.

### **SENSING**

Sensing is the first component capability required in the conduct of EBO. Manned, unmanned aircraft and space-based platforms with its attendant sensors used during *Operation 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.<sup>16</sup> A high altitude UAV, the Global Hawk, was used as a strike co-ordination and reconnaissance asset, and was particularly effective in locating air defence and surface-to-surface missiles through the use of its synthetic aperture radar (SAR) which could see through sandstorms.<sup>17</sup> Medium altitude UAV like the Predator was used as surveillance and as autonomous strike assets. Manned surveillance assets such as the U-2 high 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.<sup>18</sup> The eavesdropping 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

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<sup>16</sup> 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 D A Fulghum, 'Offensive Gathers Speed', *Aviation Week & Space Technology*, vol. 158, issue 12, 24 March 2003, p. 22.

<sup>17</sup> 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 M Streetly, 'Airborne Surveillance Assets Hit the Spot in Iraq', *Jane's Intelligence Review*, 1 July 2003.

<sup>18</sup> Cook.

were interdicted.<sup>19</sup> Hence, 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.

### **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 computer software models and associated hardware are needed in the generation of the different courses of action. The models assist in anticipating effects of hitting targets so that sensor platforms can be appropriately positioned to monitor those effects. Such models include Colonel John Warden's 'Five Rings' theory of aerospace warfare,<sup>20</sup> Jason Barlow's National Elements of Value (NEV) model, Maris McCrabb's meta model which incorporates both the Warden and Barlow models, and the Leontief Input-Output model.<sup>21</sup>

A system that has been developed to enhance targeting is the Automated Assistance with Intelligence Preparation of the Battlespace (A2IPB).<sup>22</sup> The A2IPB allows soldiers to 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.<sup>23</sup> 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 are features of the system.<sup>24</sup> The A2IPB is also able to interoperate with target development systems; intelligence, surveillance reconnaissance management and employment systems; fusion systems; and intelligence command and control databases.<sup>25</sup>

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<sup>19</sup> M Knights, 'USA Learns Lessons in Time-Critical Targeting', *Jane's Intelligence Review*, 1 July 2003.

<sup>20</sup> J. N.T. Shanahan, 'Shock-Based Operations: New Wine in an Old Jar', *Air & Space Power Chronicles*, 15 October 2001, p. 4.

<sup>21</sup> M A Gallagher, A W Snodgrass, G Ehlers, 'Input-Output Modelling for Effects Based Operations', *Paper for Military Operations Research Society Workshop on Analysing Effects Based Operations*, 29-30 January 2002.

<sup>22</sup> Zel Technologies LLC, 'A2IPB Passes DoDIIS Certification Testing', *News Event of 2005*, 9 February 2005. <[http://www.zeltech.com/News/News\\_FEB09\\_05\\_A2IPBbetallTest.asp](http://www.zeltech.com/News/News_FEB09_05_A2IPBbetallTest.asp)>.

<sup>23</sup> B Ames, 'Air Force Predicts Enemy Moves with New Software', *Military & Aerospace Electronics*, 1 September 2003, p. 2.

<sup>24</sup> H S Kenyon, 'Unconventional Information Operations to Shorten Wars', *Signal*, vol. 57, iss. 12, 1 August 2003, p. 2.

<sup>25</sup> 'Federal Contracts', *The Washington Post*, 16 June 2003.

Besides the creation of knowledge, equally crucial is the ability to convey information from the sensors to the knowledge processors and to communicate the courses of action to the war fighters who will execute the missions. In Operation Iraqi Freedom, satellite communications was 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.<sup>26</sup> 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.<sup>27</sup>

#### **CREATING PRECISE EFFECTS**

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 with physical action. Creating precise effects will include the use of precision guided munitions, the employment of manoeuvre and Special Forces and crucially, in order to shape behaviour, the ability to conduct information operations.

#### **PRECISION GUIDED MUNITIONS**

There has been a noticeable trend of the increased use of PGMs in conflicts,<sup>28</sup> with the increased usage being attributed to the increasing accuracy of precision guided munitions developed since the Second World War.<sup>29</sup> 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

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<sup>26</sup> J Williamson, 'Bigger, Better C4ISR Systems Underpin US Warfighting Efforts', *Jane's International Defense Review*, 1 August 2003, p. 1.

<sup>27</sup> '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.

<sup>28</sup> During *Operation Desert Storm*, 7.7 percent of the weapons dropped were precision munitions, increasing to 40 percent in *Operation Allied Force* against Serbia in 1999, 60 percent in *Operation Enduring Freedom* in 2001, and 70 percent in *Operation Iraqi Freedom* in 2003; see N Cook, 'Effects-Based Air Operations - Cause and Effect', *Jane's Defence Weekly*, 18 June 2003.

<sup>29</sup> 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 M Cerasini, *The Future of War: The Face of 21<sup>st</sup> Century Warfare*, Alpha, United States, 2003, p. 11.

size.<sup>30</sup> However, by the time of *Operation Enduring Freedom* and *Operation Iraqi Freedom*, technology had improved to such an extent that up to 24 similar targets could be targeted by one B-1 sortie with the GPS guided Joint Direct Attack Munitions (JDAM).<sup>31</sup>

Parallel improvements in stealth capability of aircraft have also allowed the bombing missions to be carried out more effectively by reducing the number of escorts required to protect the bombers since vital installations and other high value targets are well protected by radar-guided guns and missiles. For instance, during *Operation Desert Storm*, a force package of 33 aircraft required to protect 8 bombers embarked on a bombing mission, translated to an escort ratio of about 5-to-1 aircraft.<sup>32</sup> But by the time *Operation Iraqi Freedom* was conducted, a bomber could proceed for a bombing mission with literally no escort aircraft, and one F-117 sortie was able to deliver two bombs to just as many targets.<sup>33</sup> Mobile and Special Forces

Another tool used to create effects during *Operation 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,<sup>34</sup> pockets of resistance by irregular forces still held out.<sup>35</sup> 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.<sup>36</sup> 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 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.<sup>37</sup> In effect, it was Special Forces coupled with air power working in concert with the lightly armed local Kurds and the 173<sup>rd</sup> Airborne, which effectively replaced the 4<sup>th</sup> Infantry Division, and formed the Northern Front.

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<sup>30</sup> G L Crowder, 'Effects-Based Operations: The Impact of Precision Strike Weapons on Air Warfare Doctrines', *Military Technology*, June 2003, p. 16.

<sup>31</sup> *Ibid*, p. 16.

<sup>32</sup> 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.

<sup>33</sup> 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 Deptula, p. 18.

<sup>34</sup> Saddam Hussein did not exert his influence much after the first two decapitation strikes and had effectively lost control over his forces. See Adams, p.119

<sup>35</sup> R Brims, '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.

<sup>36</sup> 'Operations Iraqi Freedom: A Chronology', *Army Magazine*, May 2003, p. 1.

<sup>37</sup> This represents a reduction in area of 97 percent, from 155,960 square miles to 5,009 square miles, shrinkage of 97 percent. See Noonan, p. 3.

Special Forces were also involved in the liaison with Kurdish forces to ensure that they took no action to prompt Turkey to invade.<sup>38</sup> The Special Forces proved to be so 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.<sup>39</sup>

#### **INFORMATION OPERATIONS**

During *Operation Iraqi Freedom*, 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.<sup>40</sup> Many of the leaflets were dropped even before the 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.<sup>41</sup> 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.<sup>42</sup>

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 4<sup>th</sup> Infantry Division was a vital part of the war, even though it was not. This was achieved by keeping the 4<sup>th</sup> 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 4<sup>th</sup> 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.<sup>43</sup>

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<sup>38</sup> K Burger, 'What Went Right?', *Jane's Defence Weekly*, 30 April 2003.

<sup>39</sup> J Pangyanszki, 'A Textbook Case for the War Colleges for the Future', *CNN.com*, 19 April 2003.

<sup>40</sup> J Dunnigan, 'Combat Lessons Learned', *StrategyWorld.com*, 10 June 2003.

<sup>41</sup> Kenyon, p. 2.

<sup>42</sup> A Koch, 'Information Warfare Tools Rolled Out in Iraq', *Jane's Defence Weekly*, 6 August 2003.

<sup>43</sup> *Ibid.*

## **Challenges in the Conduct of Effects Based Operations**

The ability to conduct EBO may allow one to achieve a swift and decisive victory with minimal casualties and limited collateral damage on civilians and associated infrastructure. However, achieving this level of superiority on the battlefield is resource intensive, both in terms of hardware, software, and intellectual capacity. A whole array of resources starting with the need to have a comprehensive awareness of the battlefield by employing pervasive and persistent sensors, the need to have the ability to manage the knowledge created of both expected enemy courses of action and own responses to achieve the desired strategic outcomes, and the need to effect outcomes through precise application of force as well as by non-violent means on the targets of choice.

The range and depth of assets employed by the US during *Operation Iraqi Freedom* means that the acquisition of resources to conduct EBO is costly. The US had attained its current superior military position largely by outspending everyone else; and its 2004 military expenditure is greater than the combined total of the next top 14 spending countries in the world.<sup>44</sup> Even when the effect of purchasing power parity is accounted for, the US still spends more than the combined total of the next top 6 spending countries in the world. Not only is the conduct of EBOs costly in monetary terms, the conduct of EBOs also requires a high level of professional mastery. The ability to conduct joint level operations in the five dimensions of land, sea, air, space, and cyberspace is a pre-requisite. In addition, the conduct of EBOs relies on a robust defence eco-system with a highly developed research and development capability that is the intellectual base for the creation of effectors, the development of targeting models, the provision of net assessments of the adversary, and the conduct of training and education for the professional force to achieve the high degree of professional mastery desired.

Even then, the US military still faces some hurdles when it comes to the conduct of effects based operations, despite its high level of sophistication. The hurdles lie in both the physical and the cognitive domains and are attributed to limitations in sensor technology and in the ability to completely model adversary behaviour.

Firstly, despite the advances in deployed sensors seen in *Operation Iraqi Freedom*, current sensors are still unable to perform some critical functions. For example, they are still unable to detect and identify high value, well-protected mobile missile launchers; discriminate less well protected mobile targets, like trucks, from civilian vehicles; and detect, identify and

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<sup>44</sup> The US accounts for 47% of the world's share of military expenditure. See 'The 15 Major Spenders in 2004', *SIPRI Data on Military Expenditure*, 2005; <[http://www.sipri.org/contents/milap/milex/mex\\_major\\_spenders.pdf](http://www.sipri.org/contents/milap/milex/mex_major_spenders.pdf)>.

discriminate targets hiding in foliage or within buildings.<sup>45</sup> These shortcomings in sensor technology will be more acutely felt by militaries operating in the region with hot and humid climates peppered with the occasional thunderstorm. The dense undergrowth and thick overhead canopies found in the rainforests of the region will also pose a challenge to current sensors.

Secondly, current targeting models assume that the physical effects achieved will translate to behavioural outcomes. Historically, this is not true primarily because human systems behave as a complex adaptive system (CAS).<sup>46</sup> A complex adaptive system 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. Although behavioural models that have been developed attempt to address this weakness by incorporating both a targeting model and a situational aware, recognition primed (SARP)<sup>47</sup> decision-making model to determine the required actions needed to shape adversary behaviour, this level of modelling is still insufficient for the conduct of EBO. Only complex adaptive system (CAS) models are adequate to the task but the downside is that the development of CAS models is still in their infancy. CAS models attempt to incorporate targeting models, behavioural models and include statistical and probabilistic methods to model the non-linearity of adversary behaviour.<sup>48</sup> CAS models require powerful, high performance systems that are capable of self-learning to drive the model. Such a self-learning system is not available now and may only be technically feasible within the next few years. More critically, the development of country specific cultural-military-economic models is also slow and lagging behind developments in information technology.<sup>49</sup>

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<sup>45</sup> A Vick, R M Moore, B R Pirnie, and J Stillion, *Meeting the Challenges of Elusive Ground Targets*, RAND, Santa Monica, CA, 2001, pp. 32-36, 40-43, 64-65, 110-115, 121-133.

<sup>46</sup> M McCrabb and J 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.

<sup>47</sup> 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. 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.

<sup>48</sup> M 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.

<sup>49</sup> Shanahan, p. 8.

## **Is Australia Vulnerable to Effects Based Operations?**

Having described what effects based operations is, the capabilities required for its conduct, and the challenges that the leading practitioners of effects based operations still have to contend with, let me return to the initial question of the paper: is Australia, the Great South Land, vulnerable to a potential adversary conducting effects based operations against it? In my mind, unless Australia has to face the US in a war, it is unlikely that any adversary, be it state or non-state, will be able to employ EBO in its entirety against Australia due primarily to the resource intensive nature of EBO. This resource intensiveness includes the high level of capital expenditure required on equipment development and procurement, the high level of intellectual capacity needed to develop the knowledge aspects of EBO, as well as the high level of sophistication and professional mastery required of the military forces or the fighter in the case of non-state actors. Such a level of sophistication is not evident in any military other than that of the US. Even then, the US has also not quite mastered the conduct of EBO and what we saw in *Operation Iraqi Freedom* may only be a precursor of what the US is capable of doing with a fully networked military.

However, this is not to preclude the use of certain elements of EBO by hostile elements. The more likely scenario is that the planning aspect of EBO, that is the emphasis on the strategy to task links in planning, and at most the targeting aspects of EBO can be used against Australia in the current environment. It is also conceivable that Australia may end up deploying troops into environments where EBO is conducted in the future, especially if Australia were to participate in coalition operations in concert with the US. If that were to happen, it may be necessary for Australia to level up or at least match the sophistication of US forces or find some niche area where it can contribute. Other than these two possibilities, it is difficult to conceive of an adversary using the whole gamut of EBO activities against Australia, just as it is difficult to imagine any military that will come close to challenging US superiority either in the near or distant future. The sophistication of EBO as a form of war is perhaps best summed up by a journalist who had termed EBO as 'PhD level warfare'.<sup>50</sup>

*Lieutenant Colonel Joshua H. Ho is a Senior Fellow at the Institute of Defence and Strategic Studies, Nanyang Technological University, Singapore. [ISHHo@ntu.edu.sg](mailto:ISHHo@ntu.edu.sg).*

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<sup>50</sup> G Mills, 'New War, Fresh Tactics... and Old Lessons', *The Straits Times*, 27 March 2003.