Air Aspects of Operation Iraqi Freedom

By Group Captain Chris Finn

"The art of war is simple enough. Find out where your enemy is. Get at him as soon as you can. Strike him as hard as you can, and keep moving.

Ulysses S Grant (1822-1885)

The aim of this article is to take a first look, from unclassified sources, at Operation IRAQI FREEDOM from an air perspective. The article does not seek to pre-empt the official 'lessons learned' process but to identify the key

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areas in which this Operation, and the other major air campaigns of the post-Cold War era, may influence the development of British Air Power Doctrine, AP 3000, which is currently being re-written. Because of the available sources, and the need to keep the article to a manageable length, aspects of the conflict such as the use of Special Forces and Airborne Forces get only a brief mention. Whilst doctrinally incorrect, the term 'Air Campaign' is used as shorthand for 'the air elements of the Joint Campaign'. The article starts with a brief chronology of the air campaign, examines the nature of that campaign, identifies three key areas of interest and, finally, draws some lessons.

In United Nations Security Council Resolution (UNSCR) 1441, the Security Council stated that Iraq was in material breach of its obligations under UNSCR 687 and other Resolutions over the intervening 12 years to comply fully with an arms inspection regime and dismantle its weapons of mass destruction programme. Although diplomatic attempts to secure a further UNSCR failed, both US and UK governments viewed Iraq's failure to comply with the terms of UNSCR 1441 and previous UNSCRs as further material breach of its obligations, thus reviving the authority to use force under UNSCR 678[1].

On 17 March 2003 President Bush gave Saddam Hussein a 48 hour deadline in which to leave Iraq or face military action to remove him from power. The order to begin Operation IRAQI FREEDOM was issued by President Bush on Tuesday 18 March[2] 2003 and the Operation officially began at 0234 GMT on 20 March 2003. However, some operations were carried out on the previous day against Iraqi artillery, surface-to-surface missiles and air defence systems within the Southern No Fly Zone[3]. Later that evening coalition air forces attacked an Iraqi leadership compound in Baghdad[4]. As well as the leadership target of opportunity, intelligence service headquarters in Baghdad and a Republican Guard facility were attacked with nearly forty Tomahawk Land Attack Cruise Missiles (TLAM) and two USAF F117s also took part, dropping precision guided 2,000 lb penetration weapons. On the following day a further thirty TLAMs were launched against leadership and Republican Guard targets. Special Forces teams were inserted throughout Western and Southern Iraq on 19th of March, and on the 20th seized an airfield in Western Iraq and 2 major gas and oil terminals in the Northern Persian Gulf[5].

On the night of 21 March, the air campaign "began in earnest"[6], with the offensive sortie rate doubling from just over 500 to over 1,000 sorties per day at that point. At this stage there was some confusion in the media as to when the war had really begun and when the "shock and awe" air campaign would start. This was clarified in a briefing by CENTCOM Commander, General Tommy Franks[7], in which he reviewed the military objectives of IRAQI FREEDOM, which were:

- End the regime of Saddam Hussein.
- Identify, isolate and eliminate Iraq's weapons of mass destruction.
- Search for, capture and drive out terrorists from the country.
- Collect intelligence on terrorist networks.
- Collect intelligence on the global network of illicit weapons of mass destruction.
- End sanctions and immediately deliver humanitarian support to the displaced and to many needy Iraqi citizens.
- Secure Iraq's oilfields and resources, which belong to the Iraqi people.

He then went on to the clarify that the sequence of operations was S Day, the introduction of Special Operations Forces, followed by G Day, the introduction of ground forces, then A Day, the introduction of shock air forces. The night of 21/22 March 2003 also saw the first operational use of the United Kingdom's Stormshadow missile, released from the GR4 Tornado aircraft and designed for long-range, highly accurate and deep penetration against key regime targets[8].

By 24 March the air campaign had settled down into a pattern of attacks against leadership, command and control, defensive counter-air, now against airfields as well as IADS targets, and also armoured formations[9]. The 24 March was also the day on which a large formation of US Attack Helicopters attacked Republican Guard positions

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near Karbala in advance of the US 3rd Infantry Brigade. The helicopters were subject to heavy anti-aircraft fire, with one being shot down and all sustaining damage. The nature of tasking also appears to have shifted at this point, where of the 1,500 or so sorties flown on 24 March, more than 800 were attack sorties with only 200 of those being flown against pre-planned targets, the rest against emerging targets[10]. The weather began to play a part at this point, with blowing sand and dust and winds affecting in particular rotary wing operations, but the Coalition was able to continue an aggressive integrated operations plan between the air and land components, using all-weather precision-guided munitions, in particular the JDAM, to attack Republican Guard and other targets[11]. Both the Global Hawk UAV and the E8c JSTARS, equipped with synthetic-aperture radars which could detect ground targets through the weather and dust storms, were used to cue these attacks[12].

At this stage, 50% of the offensive missions were being focused on Republican Guard targets. Close air support was being conducted in support of both the ground advance in the south and of Special Forces in the west[13]. Just over a week into the war, despite high wind gusts and sand storms, coalition forces had moved over 200 miles and were now some 50 miles south of Baghdad, having secured Iraq's southern oil fields. The US 173rd Airborne Division had been deployed into the north of the country. Offensive air sorties were continuing at around 1,000 per day, and by that stage more than 650 TLAM and more than 5,000 PGMs had been dropped. Targets continued to be

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the Iraqi regime leadership and command and control, ballistic missile threats and major communications nodes, and Iraqi forces, particularly the Republican Guard, continuing to be attacked by both fixed and rotary wing aircraft[14]. However, the subsequent comment by General Myers that "We will engage them with the full weight of our combat power at a time and place of our choosing" demonstrates that major Iraqi formations were not at that stage being directly engaged by ground forces.

At this stage it was also assessed that the Coalition had "air supremacy" over approximately 95% of Iraq, with some surface-to-air missile systems still unlocated in the area between Baghdad and Tikrit, the so-called 'Super MEZ'. However, the Iraqis had not been using their early warning and fire control radars in that area to avoid being located and destroyed, and Coalition air forces were thus able to operate effectively in the MEZ[15]. By this stage, airfields had been secured in both Southern Iraq and in Kurdish territory, the latter being used for combat search and rescue and close air support aircraft, and both being used for logistics support[16]. As the number of pre-planned targets appeared to decline further, more and more targeting was done whilst aircraft were airborne. As Major General Renaurt, the CENTCOM Deputy Director of Operations, said "We have taken advantage of very rapid sensor-to-shooter links in order to retarget our airmen as they move around the country to respond to the situation on the battlefield that the commanders feel are critical to them"[17]. Poor weather, including thunder storms, were still affecting air operations but the pattern of airborne on-call aircraft with tanker support, as had happened in Operation ENDURING FREEDOM, had been established. With the lack of any credible air-to-air threat, swing role aircraft were now being employed almost exclusively on attack missions[18]. But the use of air power was by no means restricted to offensive and their supporting operations, with both leaflet dropping and airborne broadcasting taking place as part of the Information Campaign. There were also reports that at this stage TLAM failures caused the Saudi Arabian government to close some of their airspace to

A global hawk UAV had been operating in the vicinity of Baghdad from the beginning of the conflict

TLAM missiles, and this was confirmed by General Renuart who stated that they had "co-ordinated with the Saudis to hold on a couple of routes that might put them in a position where they could be close to any civilian population" [19].

By 1 April there was heavy fighting in and around Basrah between Iraqi and British forces. The US Army 5th Corps was engaging Republican Guard elements south of Baghdad whilst the 1st MEF consolidated its hold on Nasiryah and was moving northward to form a second access attack against Baghdad. Air attacks continued against all target categories and AC130 gun ships were used in the offensive counter-air role at H-2 airfield in the western Iraqi desert under the direction of Special Forces[20]. Whilst offensive sortie rates remained steady at some 1,000 per day, over the preceding three days the emphasis shifted to close air support and interdiction of four Republican Guard divisions with over 3,000 PGMs having been dropped in those three days, bringing the total to over 8,000 PGMs and 700 TLAMs used since Operation IRAQI FREEDOM began[21]. Information operations had extended to the point where Coalition radio broadcasts could cover all Iraq, and the range of television broadcasts on Iraqi Channel No 3 had been extended; the Iraqi military forces were a specific target audience for these broadcasts[22].

On 2 April, in what was clearly the build-up to the assault on Baghdad, again over 1,000 offensive sorties were flown and approximately 1,000 PGMs released, the targets primarily being the Republican Guard divisions[23], and against regular Iraqi forces in the north of the country[24].
In supporting the advance of the ground forces on Baghdad, offensive sortie rates remained high with a further increase in the use of precision weapons[25]. General Brookes commented in the CENTCOM briefing of 3 April, that "Particularly moving forces are very vulnerable to our air operations and our precision attacks"[26]. Baghdad Airport was taken by Coalition forces on 3 April 2003, and PGM expenditure was running at around 2,000 per day[27], with the Medina and Baghdad Republican Guard divisions ceasing to exist as fighting forces and the effectiveness of the other four being sufficiently degraded by both air

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and land attacks. This was described by General McCrystal thus: "What they are seeing is the doctrine and the synergy at work. The way we are designed to fight and are fighting is to use intelligence, surveillance and reconnaissance assets to identify enemy locations and then use our air and long-range shooters, our ATACMs, MLRS and artillery to attrit enemy forces so that when we finally close ground combat in fact it is not an even fight. What we believe we saw in the Baghdad and Medina divisions is, we would have treated both of those formations both materially and also morally to the point where, when the 1st MEF came to the Baghdad division and then the 3rd ID hit Medina division they were incapable of a coherent defence" [28].

The transition in the air war was marked by a Coalition Forces Air Component Command briefing given by the CFACC, Lieutenant General Michael Moseley, on 5 April[29] which gives an excellent overview of the air war to that date. The first key point was that airborne sensors were showing that the preponderance of the Republican Guard divisions outside Baghdad had been destroyed, and that the Iraqi military no longer existed as an organised fighting force. In addition to manned platforms such as JSTARS, Rivet Joint and the Nimrod R1, UAVs were also in constant use. Predators had been operating in the vicinity of Baghdad from the beginning of the conflict and there had been a Global Hawk over Baghdad throughout the conflict as well. The next point was that having developed and practised a concept of operations for a year, an urban close air support system was implemented on 5 April. This involved airborne Forward Air Controllers, in a variety of aircraft over the city 24 hours a day, with multiple formations of attack aircraft with differing weapon loads also stacked 24 hours a day to be able to respond to the Coalition Land Force Component Commander (CFLCC). In addition to this, the capability that existed throughout the conflict to have Special Operations and conventional forces spotting targets and then passing co-ordinates for B1 and B52 bombers to drop JDAMs on, was also seen as an option in the urban CAS environment. Whilst all the targets in Baghdad had to be controlled through CAS mechanisms, leadership and command and control targets were still being attacked outside Baghdad in the normal way.

By 8 April this phase of the air campaign had become one of supporting Coalition ground forces in and around Baghdad, attacking the remaining Republican Guard forces and Iraqi military forces in the north of the country, and attacking potential WMD delivery systems such as surface-to-air missiles and aircraft[30]. However, Iraqi SAM systems were still proving to be effective when an A10 aircraft on a CAS mission at low altitude in the area of Baghdad International Airport was shot down. An attack on a leadership target in the Mansour district of Baghdad led General McCrystal to discuss the time-sensitive targeting process (TST) as "being the linkage of multi-source intelligence to the capability to attack the target very quickly, in that case the process taking some 45 minutes"[31].

Comments on 9 April by Secretary Rumsfeld[32] gave the impression that the offensive air war had almost ceased; sortie rates and weapons utilisation were no longer being discussed in the press briefings. The CENTCOM briefing of the same day[33] referred to ongoing CAS in response to a question about collateral damage in Baghdad. This period also saw the continuing shift in the use of air transport resources to humanitarian relief and logistics resupply, and 101st Airborne conducted a helicopter-borne assault in the north of Iraq on 10 April. Sortie rates were still being reported at about 1,000 per day (although the figure no longer discriminated between offensive and other aircraft sorties), the missions being to provide CAS to ground forces in and around Baghdad and throughout Iraq, and to strike at leadership targets when and where they were found[34]. There was further evidence of the winding down of the campaign in a statement by the UK's Secretary of State for Defence that it was envisaged that a number of fixed and rotary wing aircraft would be withdrawn in the near future, starting with the return of the Tornado F3 over the next few days[35].

On 13 April, less than 800 sorties were flown and less than 200 PGMs dropped, and the 14th was the last day that aircraft from all five carrier battle-groups would fly concurrent missions into Iraq[36]. By 16 April, offensive air operations had decreased further with a significant decrease in the number of PGMs that were dropped, CAS being available to those forces that were still manoeuvring in areas where there may have still been some regime presence[37]. The US CENTAF Assessment and Analysis Division's initial report on Operation IRAQI FREEDOM, 'By the Numbers', put the start of the air campaign at 0300Z 19 Mar 03, and the end at 0259Z 18 Apr 03, a total of 30 days[38].

As Field Marshal von Moltke said, "No plan survives contact with the enemy", but the difficulty in the case of Operation IRAQI FREEDOM is to know, from open sources, what the plan was. General Franks made it clear in a briefing on 22 March[39] that the sequence of initiation of operations was Special Forces, ground forces and then air forces. However in a briefing the previous day[40], which tallies with the CENTAF view expressed in 'By the Numbers', and converting to local time, the ATO cycle started at 2300 hrs D on the night of Thursday 18 March. On the Wednesday there was a pre-planned series of attacks against air defence and air interdiction targets and on the Thursday some 30 TLAMs were launched against leadership and Republican Guard targets. Special Operating Forces were inserted on the Wednesday, and by Thursday had seized airfields in western Iraq, border posts in several locations and two major gas and oil terminals in the northern Persian Gulf[41].

At 1300D on Thursday 20 March, ground forces commenced their advance on Baghdad and their assault on the Al Faw Peninsula. At 0400D on the Friday, the main element of the air campaign started. But what happened at very short notice[42] was the attack on a leadership target of opportunity with the intention of killing Saddam Hussein if at all possible. General Franks' view about that attack, on what he called an emerging target, was that the plan was "a plan that is agile, a plan that is flexible, provides what we call branches to be able to undertake a number of actions at the same time"[43]. However, it is clear that this attack caused S and G Day to be brought forward slightly[44]. What is also clear is that the coalition did not intend to signal the start of the conflict by a massive precursor air campaign, as was the case with the 1991 war.

Towards the end of the conflict Secretary Rumsfeld commented "because of the way General Franks conducted the conflict, a lot of bad things didn't happen. The oil wells were not set afire like they were last time"[45]. This, coupled with the early insertion of Special Operations Forces referred to earlier, makes it clear that the intention was to deny Saddam Hussein time to initiate a 'scorched-earth' policy in the oil fields. General Moseley, in what is one of the two most informative reports on the air campaign[46], the other being the US CENTAF 'By the Numbers' report, suggests that one could go back 11 years to the start of Operations NORTHERN and SOUTHERN WATCH, as one possible start point of the air campaign. Throughout the decade there was a steady attrition the Iraqi integrated air defence system within the No-Fly Zones, that peaked during Operation DESERT FOX in December 1998. However, these operations did not cover the part of Iraq between 33° and 36° north, which included Baghdad and Tikrit, hence the concentration on suppressing and then destroying Iraqi air defence systems within the Baghdad/Tikrit 'Super MEZ' in the opening phase of the air campaign.

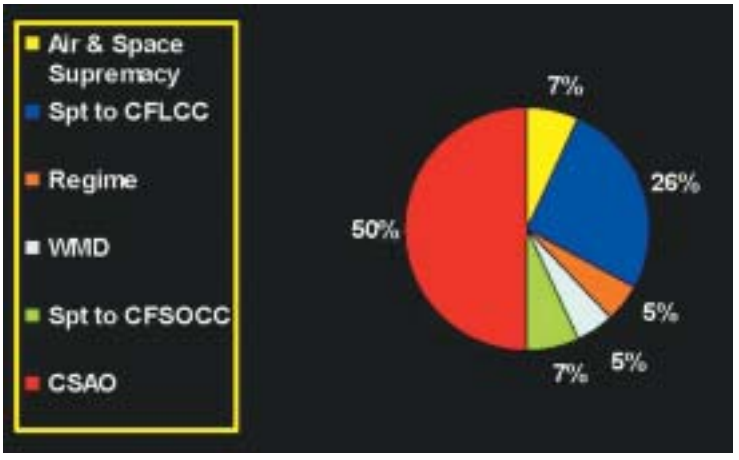
Moseley then went on to state that, "from June of last year (2002) up until the initiation of hostilities we increased our presence in the No Fly Zones to enforce the Security Council Resolutions, and by doing that he shot at us more and more and in doing that we were able to respond more on items that threatened us, the air defence system etc"[47]. Furthermore, on Friday 14 March, five days before the official start of the war, targets including a mobile early warning radar and an air defence command centre in the area of H3 were attacked by two B1B bombers operating from the USA[48]. Irregular peaks of activity above the baseline of daily Southern Watch sorties not only set the conditions for the almost immediate achievement of air superiority south of 33° north after 21 March but also achieved a level of tactical deception in that the attacks of 19 March would be

Once it became apparent that there was no air threat, swing-role aircraft such as the F15E were placed in the on-call 'stacks' with both air-to-air and air-to-ground weapons on board

seen as part of an ongoing pattern. This is supported by Air Marshal Brian Burridge's comment to the House of Commons Defence Committee that "I might say on timing that we recognise that Saddam had expectations about how this campaign would proceed based upon his experience of the previous campaign. The only way we could achieve tactical surprise was to do it a different way"[49].

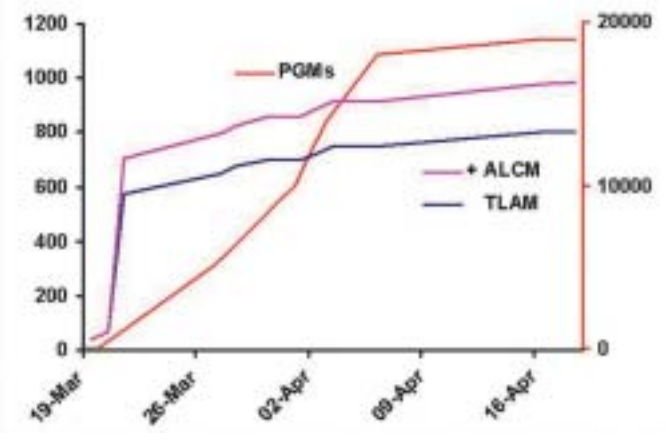
One major change to the plan occurred in January 2003 when, because of doubt about the likelihood of Turkey agreeing to UK forces operating through Turkey, the 'Northern Option' was dropped[50]. This particularly affected the RAF which was planning to operate in significant numbers from Turkey[51]. The UK Government then only had a matter of weeks to agree new basing options to the south of Iraq before the majority of offensive and support aircraft deployed during mid February to early March[52]. Finally, whilst it is not yet clear how long land combat actions were envisaged to last for, the speed of advance was far in excess of that assumed. This is clear from both the misnamed 'operational pause', where the land forces needed to regroup prior to the assault on Baghdad, and the statement in the 101st Airborne Division presentation that, "We planned for FOB seizures and actions in Baghdad, but fought in Najaf, Karbala and Hillah, with the plans for these actions being developed while the entire Division was on the move"[53].

Turning to the air campaign itself, the following pie chart shows the CFACC average approved apportionment[54].



The command and control, ISR, air refuelling and air mobility missions were considered by the CFACC to be the "cost of doing business" and were not included in the daily apportionment calculations. However, they have been shown this way to emphasise the balance between combat and combat support air operations. In Operation IRAQI FREEDOM 66% of offensive sorties were devoted to supporting the Land and Special Forces Component Commanders, and whilst that figure was 72% for Operation DESERT STORM, the conflicts were very different with the latter having a fairly short ground war in extensive precursor interdiction campaign. What is not clear from the above statistics, however, because both offensive and defensive sorties were considered in the counter air category, is what the breakdown between them was. With only 56 single-role fighters[55] the coalition could generate about 70 sorties per day, at the average sortie rate. When compared with the average number of OCA targets attacked per day this gives an approximate OCA/DCA ratio of 1:1. However, once it became apparent that there was no air threat swing-role aircraft such as the F15E were placed in the on-call 'stacks' with both air-to-air and air-to-ground weapons on board. These on-call missions were designated as X-AI and X-CAS etc to differentiate them from pre-planned ones[56]. Apart from the lack of an air threat, the critical factor in keeping the 'stacks' manned was the availability of air refuelling tankers[57].

The best measure of the tempo of the Operation, the points at which objectives shifted, can be seen in the following graph which shows the cumulative usage of sea and air-launched Cruise missiles and of other PGMs[58].



Cruise missile usage peaked on A Day, 21 March 2003, when over 500 were used against regime and IADs targets in the Baghdad area. PGM usage rates slowly crept up between 23 and 31 March to 1000 per day and then doubled to 2,000 per day as attacks intensified on the Republican Guard divisions defending Baghdad between 1-3 April. The rate then dropped as the focus became airborne CAS in the Baghdad area. The last summary of cumulative weapon usage was given in the DoD briefing on Monday 7 April[59], and marks the end of the intensive air campaign, relatively low weapons usage taking place for the final 12 days.

What we are seeing, therefore, is an air campaign with four main elements: firstly counter-regime and WMD targets, which would have been classed as 'strategic' targets during Operation DESERT STORM; then counter-air operations; shaping operations; and finally direct and indirect support to the Land Component Commander. This, however, was not a sequential campaign, offensive air power being employed against all of these objectives with differing emphasis at differing stages of the campaign. The only really sequential elements were the initial attacks on the Baghdad Super MEZ

The counter-air war was, however, completely one-sided as the Iraqi air force chose not to participate. After the war MiG 25s and SU25s were found buried in the desert outside Iraqi air bases

and on the Republican Guard Divisions around Baghdad with the aims of enabling subsequent air and land operations respectively.

Whilst there is no sortie breakdown for the combat support air ops sorties, the following statistics give some idea of the weight of effort: there were over 2,200 air transport missions within the theatre, 136 MEDEVAC missions and 554 Paratroops were dropped; 417 million lbs of jet fuel were offloaded by tankers. The in-theatre airlift was critical to the successful operations from FOBs seized during the advance on Baghdad. The air component played an integral part in the theatre information campaign, dropping nearly 32 million leaflets from aircraft as diverse as the B52 and the A10. The Commando Solo variant of the C130 flew 58 sorties and broadcast over 300 hours each of radio and TV, whilst the Compass Call variant, although primarily for electronic attack, was also involved in PSYOPs[60]. In addition to that, 116 C4I targets, including 10 media facilities, were attacked as part of the information warfare plan. Finally, this was the first time the CFAC was designated Space Co-ordinator; in addition to the now excepted communications, reconnaissance, navigation and weather functions, space-based systems also detected 26 Iraqi ground-to-ground missile launchers. This was also the first occasion in which a UAV was integrated into the targeting chain[61], but it is clear from various US divisional After Action Reports[62] that whilst they were of enormous use at Divisional level and below, their availability was by no means guaranteed.

'By the Numbers' states that there were seven manned coalition aircraft losses due to enemy fire — 4 Longbow Apaches, 2 Cobra and one A10, and 13 other losses, whereas it is likely that an F15E and a UH60 helicopter were also lost to ground fire[63]. However, of the non-combat losses, 1 RAF Tornado GR4 and a US Navy F18 were lost to Patriot SAMs and in another incident an F16CJ fired a anti-radiation missile at a Patriot that had engaged it on 24 March[64]. In response to these losses, 55 search and rescue missions were executed. The counter-air war was, however, completely one-sided as the Iraqi air force chose not to participate. After the war MiG 25s and SU25s were found buried in the desert outside Iraqi air bases[65].

The following graph shows the relative weight of effort in terms of DMPIs struck by operation objective, given to the various elements of the air campaign[66].

When comparing the two conflicts it should be noted that in Operation DESERT STORM regime suppression and counter weapons of mass destruction targets would have been classified as strategic targets. But what stands out is that, in addition to the 234 fixed AI targets, 79% of the targets attacked were to support the Land and Special Operations Forces Component Commanders, taking 65% of the sortie apportionment.

These last two tables compare the weapons utilisation and sorties flown for the 5 major post-Cold War conflicts in which US and UK air power have been involved[67].

Date	PGM	TLAM (Cum)	ALCM (Cum)	Total
19-Mar-03	0	40	0	40
20-Mar-03	2	70	0	70
21-Mar-03	700	574	129	703
27-Mar-03	5,000	650	146	796
28-Mar-03	6,000	675	151	826
30-Mar-03	8,000	700	157	857
31-mar-03	9,000	700	157	857
01-Apr-03	10,000	700	157	857
02-Apr-03	12,000	725	163	888
03-Apr-03	14,000	750	168	918
06-Apr-03	18,000	750	168	918
16-Apr-03	18,960	800	180	980
18-Apr-03	18,965	802	180	982

DMPIs by Op Cat	Qty
Counter Air	1,441
Counter land	234
Regime Chg	1,799
WMD	832
KI/CAS	15,592

Note: 985 Cruise Missiles were fired during Operation IRAQI FREEDOM

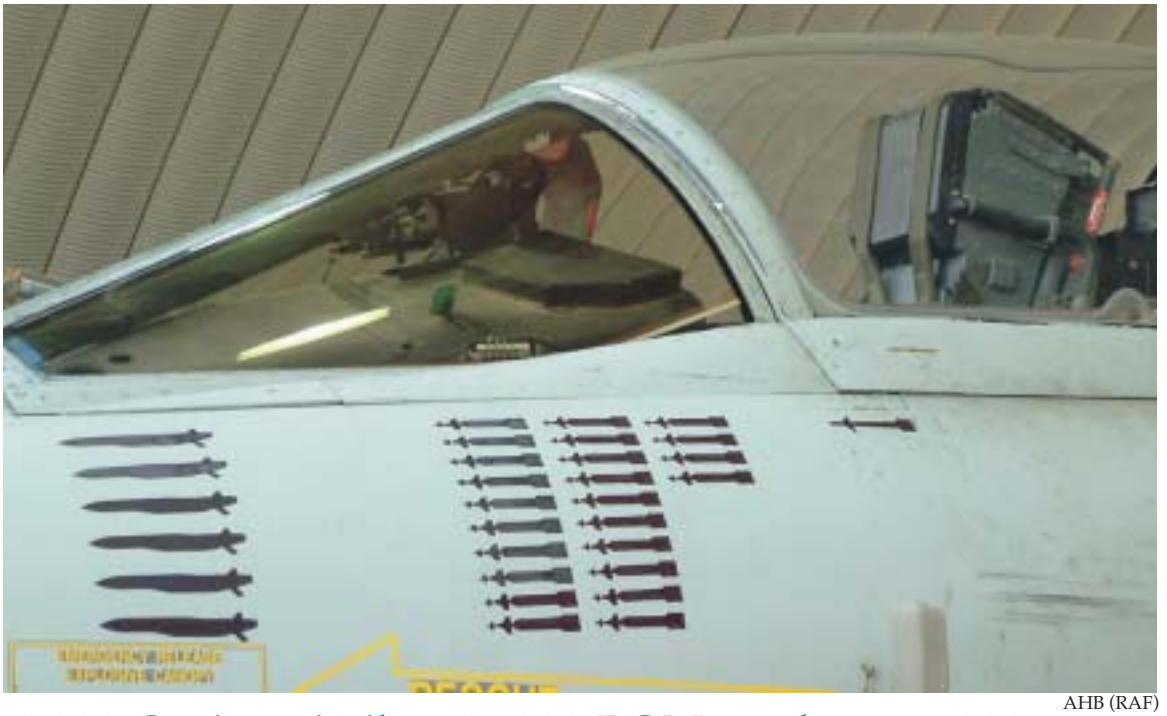
Category	%
Air & Space Supremacy	7
Spt to CLFLCC	26
Regime Chg	5
WMD	5
Spt to CFSOCC	7
CSAO	50

Note: During the intensive combat phase of Operation IRAQI FREEDOM which lasted 21 days, the average offensive sortie rate during that period was >1000/day and taking account of the inclusion of DCA aircraft in the statistics offensive sorties were about 48% of the total.

Ignoring Operation DELIBERATE FORCE, which is statistically insignificant, what stands out in both proportional and absolute terms is the steady increase in the use of precision weapons from Operation DESERT STORM to Operation IRAQI FREEDOM. However, IRAQI FREEDOM took less than half the time that DESERT STORM did and there was an increase in the overall proportion of offensive sorties in the latter conflict compared to the former.

So what then are the key issues that emerge, particularly in comparing Operation IRAQI FREEDOM with those preceding it back to Operation DESERT STORM? The first is what many people see as the rightful return of the air/land battle to its place at centre stage. The main element of the air/land campaign, from G Day to the fall of Baghdad, was only 18 days long. Two significant problems in providing air support to land operations are how to respond quickly enough to the land commanders request to attack targets in his 'deep' area, and how to provide effective and timely close air support to troops in contact without there being both air-to-ground and ground-to-air fratricide. For many decades the primary co-ordination mechanism has been the Fire Support Co-ordination Line, or FSCL, inside of which all targeting is the responsibility of the Land Component Commander and outside of which is the responsibility of the Air Component Commander. This was all very well in the Central Region of the 1970s where the FSCL was placed not that far beyond the range of tube artillery and was in preference on a prominent geographic feature due to the relatively rudimentary aircraft navigation systems of the time. However, with the advent of attack helicopters, the extended range Multiple Rocket Launcher System (MLRS) and the US Army Tactical Missile System (ATACMS) with a range of up to 100 nautical miles, the problem emerged of overlap between land and air systems. During Operation DESERT STORM, General Schwartzkopf was criticised for setting the FSCL too deep during the '100 Hour' land war which reduced the ability of fixed wing air to attack Iraqi land force targets. However, that has to be seen in the context of the communications and surveillance systems of the time. In Operation IRAQI FREEDOM General Franks planned to integrate the 'Joint Fires' of all the Component Commanders by employing a deep FSCL at or beyond the range of ATACMS[68]. The FSCL was also thrown around Baghdad as soon as ground troops commenced their final advance towards it. This, plus the speed of advance of the land forces, could have created significant problems for the CFACC and led to considerable friction. However, by embedding a 2-star airman, Major General Dan Leaf, with a large supporting staff, in the headquarters of the CFLCC, Lieutenant General David McKiernan, the CFACC, Lieutenant General Buzz Moseley, was clearly seeking to ameliorate the problems of friction, electronically integrating the headquarters as far as was possible. Of course, the benefits were two sided. CFLCC had the best chance of getting the air support he wanted, the CFACC could deal with non air support related targets and fly ISTAR and other support missions etc within the FSCL, again with the minimum of fuss[69]. Indeed the extended FSCL seemed to define far better the extended CFLCC's operational boundary than the line defining where target responsibilities lay between him and the CFACC.

One of the requirements of operating aircraft within the FSCL is that they are procedurally or actively controlled to prevent fratricide. Given the



AHB (RAF)

1,000 Cruise missiles, 19,000 PGMs and over 9,000 unguided munitions were dropped by aircraft

number of DMPIs quoted earlier, it would clearly be impossible to provide forward air controllers for every target within the boundary of the FSCL so another solution had to be arrived at, and that was the use of kill boxes[70]. A series of boxes, 30 min of latitude by 30 min of longitude, were set up inside the FSCL, which itself was being moved rapidly northwards with the ground force advance. When individual boxes were 'open' CFACC assets could attack targets within them without reference to the CFLCC, although he may well have initiated the targeting within that kill box. The boxes were declared closed by the CFLCC when his assets were either moving into or firing through them. That applied equally to Attack Helicopters and ATACMS. It is worth putting ATACMS deconfliction into context in that whilst nearly 1,000 Cruise missiles, 19,000 PGMs and over 9,000 unguided munitions were dropped by aircraft, only 414 ATACMS were used[71], although being ballistic missiles there was a greater vertical as well as a horizontal deconfliction issue. Whilst, some problems still occurred when Killboxes were closed earlier, from an air perspective, than needed to be, kill box Interdiction was the primary mechanism for eliminating the Republican Guard divisions as a fighting force.

If the kill box interdiction process worked then it appears, at least from a UK perspective, that the same cannot be said of CAS. In an interview on BBC Radio 4's *Today* programme, the Shadow Defence Secretary, Bernard Jenkin, stated "Whilst air strikes came in a very timely manner, there were occasions when it would have been preferable to have close air support very quickly and it took a considerable time to arrive because the Coalition as a whole had other priorities"[72]. He went on to suggest that RAF jets should not be pooled with US planes in future conflicts but retained to provide dedicated support for the British Army. The MOD's *First Reflections* report merely comments that "The integration of close air support aircraft requires further refinement and practice"[73]. Both sides of the argument were clearly laid out by Air Marshal Burridge in his oral evidence to the House of Commons; he made the point that we needed to look again at our procedures and doctrine and consider how we

could train better, having made the point that not pooling aircraft may mean a more inefficient use of air power; however high-tempo, post-modern warfare may just mean such aircraft ought to be a Corps level asset[74]. The GOC 1 (UK) Armoured Division, General Robin Brims, put the record straight at a recent Operation TELIC Study Day at the Joint Services Command and Staff College[75]. He firstly pointed out that , because 1 (UK) Armoured Division was directly subordinate to the 1st Marine Expeditionary Force, its CAS was provided through the US Marine Corps system by the 3rd Marine Air Wing (MAW) which was not a part of the Air Component. Furthermore US Marine ANGLICO sections were attached to all UK formations down to Battle Group level to provide their linkage to 3 MAW. In answer to a question as to why 7 Brigade had had no CAS for a week, he made the point that the Brigade was getting CAS, that "a week" was something of an exaggeration, that in the event in question the allocated CAS had been diverted quite correctly at the last minute to other troops in contact with a more urgent requirement, and concluded by saying that the commander "had to use his own guns instead".

The US Marine Corps analysis[76] was very different in that combat operations validated their quick fire procedures as a baseline TTP. Variations were introduced or improvised as required to adapt to conditions on the battlefield and it proved to be an effective way to employ Marine air in a reactive counter-fire role. With a direct air support centre providing the link between targeting assets at Division and below, it is clear that CAS was being run at Corps level and that within the FSCL there were two discrete sets of AI/CAS airspace, one for 1 MEF and the other for 5 (US) Corps. However, as the Commander US Marine Corps Forces Central Command, Lieutenant General Earl B Haylstone[77], said there was constant liaison between headquarters at all levels, including substantial British liaison elements in all Marine headquarters in addition to there always being an Air Force officer in them. In the CFACC's headquarters, all close air support "was headed up and planned by a Marine". The Joint Fires integration procedure was such that in the initial operation to seize the Al Faw Peninsula, in addition to air support, two Royal Navy frigates provided naval gunfire support[78]. The US Army was particularly enthusiastic about the effectiveness of the CAS it received, where it was assessed as one of the "winners" at their 2003 All Infantry Conference. The Corps level of the co-ordination of the joint targeting and fire support process worked well. Precision CAS was very effective in an urban environment; no more training was needed at lower echelons to improve this capability. AI/CAS techniques worked well and the size of the Corps rear area was such that CAS needed to be used for rear area fires as well as in support of the front echelons. The airspace was easily deconflicted, allowing simultaneous engagements and allowing the Divisional ALO to position "CAS stacks " thus reducing response times[79]. CAS was delivered by everything, from the B52 to the A10 and, whilst JDAMs were very effective, they required longer lead time than traditional CAS systems. However, the point was made that aerially delivered fires were an extremely powerful asset but external factors often kept them from the fight.

From the USAF perspective[80], the success of Killbox Interdiction and CAS (KI/CAS), and Urban CAS in particular, was down to the detailed plan put together by a joint team headed by a USMC Major. But the number of assets available to the CFACC also played a significant part in this. Gen Moseley commented that the CAS stacks could contain mixed assets from the USAF, USMC, US Navy, RAF and RAAF and that they could be put in place 24 hours per day, with aircraft returning with their bombs if their particular weapons load was not required. Whilst that appeared to be wasteful he further commented that "What we are looking for here is combat effectiveness, not necessarily combat efficiency"[81].

At the operational level it is worth comparing the air command and control structure of Operation IRAQI FREEDOM with that of Operation DESERT STORM. In the latter conflict a 43-day air campaign focused on strategic target sets and on shaping the battlefield for the culminating four-day ground campaign. The vast majority of offensive air targeting was therefore managed through the Air Tasking Order (ATO), as the majority of the targets were pre-planned and, until the last

100 hours, there was no FSCL to deconflict with. Because of the need for continuing SEAD and the relatively large numbers of aircraft needed, particularly for airfield targets, packages were put together from multiple bases and the ATO needed to be at those bases at least 12 hours before the combat cycle commenced to enable mission planning and co-ordination. This then fell in naturally with a 72-hour planning cycle which started with determining the Master Attack Plan (MAP) for the day in question. The system, however, was not as inflexible as many commentators point out, with the 'current' ATO being handled by combat ops. However, because of the pre-planned and finite timescales of the air campaign, the easiest response to the failure of a large mission for whatever reason was to cancel and reschedule. However it was possible to retarget or reschedule missions through combat ops at very short notice[82]. Furthermore, in the Kuwait theatre of operations, and in Iraq once the land campaign had commenced, there was significant CAS and battlefield air interdiction managed on a kill box basis with tanker supported CAS stacks being managed by an Airborne Battlefield Command and Control Centre.

In contrast, as has already been seen, the balance was completely reversed for Operation IRAQI FREEDOM with the vast majority of targeting being managed on a responsive basis. The ATO therefore changed from being primarily a targeting tool to being a resourcing tool where the critical path became the provision of air tanking resources, and then ensuring that crews and aircraft of all roles were available throughout the 24 hours period to be available in the air to meet the reactive tasking[83]. Because of the serious consequences of the use of Weapons of Mass Destruction (WMD), and the fleeting nature of some targets, a capability was developed by Commander US CENTCOM and the CFACC to find, fix, track, target, engage and assess these time-sensitive targets. In all 156 TSTs were attacked, 102 being related to WMD, 50 to Iraqi leadership and four to terrorist related targets. However, in addition to these, a further 686 'dynamic targets' were prosecuted using the same command and control mechanisms through re-targeting airborne aircraft[84]. This flexibility was made possible, as General Franks makes clear, by the development of a joint culture in the headquarters and by, for the first time, the integration rather than deconfliction of forces. He went on to say that the Blue Force Tracking and enhanced C4I systems greatly increased lethality and decreased response times. However, producing an integrated common operating procedure required workrounds because different tracking systems were service unique[85]. However, whilst there was a significant amount of 'data-suck' into the component and theatre headquarters, it was from systems such as Blue Force Tracker which were not available in the cockpits of attack aircraft.

If the 72-hour ATO cycle was swiftly adapted to be a resourcing rather than a targeting tool, the same was not always the case for land forces. The 1st Marine Division identified the fact that the planning to execution cycle, for AI, was too long and not responsive to changes in the scheme of manoeuvre. The result was that AI shaping efforts often did not focus on the enemy forces that 1 MEF would fight 48 hours hence. This was exacerbated by the speed with which the Division executed their scheme of manoeuvre[86]. 1 MID also identified in their 'Lessons Learned' that "there was no reliable and responsive process or means to determine whether AI targets on the prioritised target list were serviced and successfully attacked during and after ATO execution" [87]. One reason for this failure was that the tempo of the operation and the speed of advance by the land forces was such that the traditional intelligence analysis of photographic and other reconnaissance products could not keep up. Another reason is perhaps that the traditional BDA concept itself was no longer appropriate to a campaign planned according to an effects-based methodology.

Before seeking to answer this question it is worth examining what is meant by effects-based operations. The term effects-based operations, or EBO, occurs throughout the primary source material upon which this article has been based. In a briefing on that subject[88], Colonel Gary Crowder made the point that EBO was a different way of thinking about how we approach military planning by starting from the policy objectives rather than from the list of available targets. General John Jumper,

As with Operation DESERT STORM, the coalition indicated it was willing to take significant casualties by the provision of significant MEDEVAC facilities and, among other things, an 800-bed hospital ship. In the end, coalition combat casualties were remarkably low

US Air Force Chief of Staff, took a similar view[89], where he stated that "The USAF's emphasis on effects-based operations as opposed to fighting a war of attrition allowed it to employ platforms like the B1B strategic bomber in non-traditional ways to provide close air support". He then went on to say, "We are still not satisfied with bomb damage assessment. This gets into how we define bomb damage assessments. At the one level you need to know how the killing of targets is having a strategic outcome. This is what tends to be done by our intelligence agencies, they have very specific definitions of what is destroyed. It is the product of overhead imagery analysis that gets into these precise definitions"[90]. Another statement, this time by General Brookes, again linked effects to battle damage assessment (BDA) and image analysis, "They take a close look. Did we achieve the desired effect? Did all of our weapons hit?"[91]. From the UK perspective, an MOD report[92] states that "All targets were derived from the campaign plan and were selected to achieve a particular military effect such as the degradation of Iraqi command and control systems". However, Air Marshal Burridge's view[93] was that the "strategy to task" methodology provided an audit trail which linked the attacking of any specific target, or by inference any other activity within the air campaign, to the production of a specific operational and then strategic outcome.

In his article in the Autumn 2003 edition of the Air Power Review, Colonel Phil Meilinger quotes 2 definitions of EBO[94]. US Joint Forces Command definition is *"a set of actions planned, executed and assessed with a systems perspective that considers the effects needed to achieve policy aims via the integrated application of various instruments of power"*. The second unofficial definition from a RAND analyst, *"Effects-based operations are operations conceived and planned in a systems framework that considers the full range of direct, indirect and cascading effects which may – with differing degrees of probability – be achieved by the application of military, diplomatic, psychological and economic instruments"*[95]. From a military perspective one could therefore conclude that at the operational level, that level at which campaigns are planned and executed, the operative phrases are: policy objective, systems framework and direct, indirect and cascading effects. Whilst the definitions of effects-based operations are clearly strategic, a concept that could simply be described as 'decide the outcome before allocating the best mechanism, then have a plan that envisages alternatives and can cope with the unexpected', is applicable at the strategic, operational and tactical levels of war. It is here that the confusion arises. The above quotes from Generals Jumper and Brookes both exhibit this mixing of levels, and both state that strategic effect is immediately measurable in tactical outcome, ie what has been destroyed. This, Meilinger argues, is to completely misunderstand the concept of effects-based operations and that what is needed at the strategic level is a set of Measures of Effectiveness that reflect the desired strategic end state. The same is true at the operational level. In fact EBO is very similar to the well-established UK concepts of the Manoeuvrist Approach and the linked role of Mission Analysis as the start of any military planning process. Furthermore, as Meilinger repeatedly points out in his article, airmen have always understood the concept of EBO, but it is only now that technology, in the form of precision weapons and information systems, has enabled us to achieve it.

This then seems to indicate the true nature of the problems with the BDA process, in that it was predicted on measuring the physical outcome of destructive sorties, ie the tactical effect, whereas the commanders and the campaign planners were looking for assurance that operational and strategic effects were being achieved. Finally, none of the discussions outlined above addressed the measurement of non-kinetic effects, ie information warfare or the effect of coercive bombing, at any of the levels of war. When considered with the realities of high-tempo precision warfare it may therefore be better to quite simply assume that

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precision weapons will on, say, 90% of occasions achieve the destructive effect they are supposed to and then concentrate on assessing an enemy's behaviour, particularly at the operational level and above. This is not to suggest that imagery-based intelligence is redundant, far from it; it has a particular value in providing evidence to rebut collateral damage claims. But rather it would allow those assets to be concentrated more on time-sensitive and dynamic targeting and on strategic and operational analysis of the results.

Before seeking to draw some lessons from the analysis of this conflict, it is worth stating one caveat, particularly when comparing it to the other major post-Cold War campaigns. That caveat is the overwhelming military dominance that the coalition forces displayed. There was no doubt in the minds of either the coalition politicians or military planners that the end result would be anything other than a decisive victory. And, as with Operation DESERT STORM, the coalition indicated it was willing to take significant casualties by the provision of significant MEDEVAC facilities and, among other things, an 800-bed hospital ship. In the end, coalition combat casualties were remarkably low. That is due, in no small part, to the short duration of the combat phase itself. The coalition was also hugely dominant in terms of air power; roughly the same number of aircraft were employed as was in Operation DESERT STORM. Capabilities, particularly in terms of precision weapons and ISR, were significantly greater in Operation IRAQI FREEDOM. Furthermore, the Iraqi Air Force had not developed at all over the preceding 12 years and had had very limited opportunities to maintain their operational capability. Except in the No-Fly Zone gap from 33° to 36° North, the Iraqi air defence system had been steadily attrited by Operations NORTHERN and SOUTHERN WATCH, thus enabling the air and ground campaigns to coincide.

Air power can still be employed autonomously, both to achieve operational and strategic effects, as was in the case of regime and WMD targets, and in achieving and sustaining the required degree of control of the air across the theatre

So, what are the lessons we can draw from Op IRAQI FREEDOM? The first lesson to emerge is that of the continuing criticality of control of the air in modern warfare. In defeating Iraq in just 21 days of intensive combat, control of the air was essential. Without it the air assets would not have been able to operate with almost complete freedom throughout Iraq and land forces would not have had the shaping and supporting operations that they did. Furthermore, the land forces would not, with the exception of maintaining a defence against theatre ballistic missiles, have otherwise been able to conduct their operations without having to integrate their own defensive counter-air assets with those of the CFACC and with their own manoeuvre. However, as more modern surface-to-air missile and fighter systems are proliferating throughout the world it is highly unlikely that future major conflicts will be fought in such a relatively benign environment as Iraq as far as control of the air is concerned.

The next lesson as far as the application of air power is concerned is the blindingly obvious one of the value of overwhelming information superiority. Not just to enable flexible and responsive targeting but also to seize opportunities and conduct high tempo operations that far exceed the enemy's ability to respond. However, this reliance on information superiority does create its own vulnerabilities, for example when the Iraqis started using irregular and often illegal combatants, such as soldiers in civilian clothes, particularly in the rear areas.

The next lesson concerns the land-air interface. The first observation is that this was most definitely a non-linear battlespace. Discrete air and land operations took place in the north and the west of Iraq with 2 Corps operating on different axes initially, one towards Basra and one towards Baghdad, with the Marine elements of the Basra axis then swinging towards Baghdad as well. But whilst the FSCLs were not straight, and they were very fluid, the co-ordination between air and ground forces was still defined in terms of geographical co-ordinates, altitude and time. Furthermore, the nature of the sorties conducted in support of the CFLCC could still be characterised in terms of; direct support to troops in contact, attacks to shape the CFLCC's deep battle over the next 48 hours or so, and attacks to shape land operations within the theatre as a whole. In other words, CAS, BAI and AI respectively. Whilst the terminology could be said not to matter, because aircraft were repeatedly interchanged between targets in these 3 categories and indeed into the TST ones, there is a purpose in defining the tactical level effect the CFACC is seeking to achieve either on behalf of the CFLCC or the Theatre Commander. However, one lesson that the RAF and the British Army must take from Operation IRAQI FREEDOM is that KI/CAS procedures not only need to be developed further, and the concepts jointly understood, but they should also be exercised regularly at all levels of the command chain as well as at unit level.

However, despite the resurgence of land-air operations, air power can still be employed autonomously, both to achieve operational and strategic effects, as was in the case of regime and WMD targets, and in achieving and sustaining the required degree of control of the air across the theatre.

As with Operation ENDURING FREEDOM, the value of air refuelling cannot be overstated in the expeditionary context. Air refuelling was the major factor in determining fast jet sortie rates and enabled the 'on call' delivery of offensive air power which was essential to Commander CENTCOM's scheme of manoeuvre.

The requirement to be able to deploy and sustain the force is equally obvious. In this campaign a similar sized force to that used by the UK during Operation DESERT STORM was deployed in half the time. Access, basing and over-flight, particularly after the closure of the Turkish option, required the support of many other nations, in particular our established friends in the Gulf

Despite their relatively low profile, the air power operations appear to have been the key to the rapid degradation of Iraqi defences, and hence the relative ease with which the ground troops took over the country

region. However, asset-tracking was poor[96]. Furthermore, the move to reduced war stocks and "just in time delivery" implied a high degree of operational risk[97]. Manpower, particularly that in specialist and undermanned trades, was also a resource that needed to be carefully husbanded and managed.

Five RAF Regiment squadrons and three tactical survive-to-operate wings were deployed for force protection of RAF assets during Operation IRAQI FREEDOM. Whilst WMD were not, in the event, used against coalition forces and there were no suicide bomber or other terrorist type attacks reported on air bases in theatre, the possibility of such attacks cannot be excluded when planning for future conflicts.

The reliance of UK forces on space-based assets for communications, reconnaissance, environmental data and, in particular, navigation and targeting, is such that it now merits consideration in terms of British strategic air power doctrine as a core enabling capability on a par with sustainability and force protection.

Although an effects-based campaign could be conducted without the benefit of a networked C4 ISR system, and vice versa, the air aspects in particular of Operation IRAQI FREEDOM highlighted their mutual benefits. However, in Operation IRAQI FREEDOM there was more a one-way data flow with high fidelity tactical information being available in the greatest detail at the highest headquarters, but not being disseminated down to individual combatant units. Effects-based operations is really a strategic concept, with some operational application, with the concept of strategy-to-task linking it to the various tactical mechanisms that can be employed, be they kinetic

or non-kinetic. Furthermore, the language of effects-based operations is generally very loosely applied with little understanding as to its true meaning. Net-centric warfare, to use the latest variation on its title, has universal application. Employment of the two concepts together enabled a campaign that was characterised by its integrated nature and high tempo. However the high tempo of operations, and the lack of a universally available common operational picture, may have contributed to some incidents of fratricide between coalition forces.

The last lesson concerns US/UK compatibility. As it is most unlikely that the UK will ever fight another major campaign of the nature of Operation IRAQI FREEDOM except as a coalition partner with the United States of America, increasing our compatibility in terms of both equipment and doctrine is essential. That is not to say that we should just adopt their higher level concepts and doctrine, there are sound cultural and structural reasons for not doing so. But we need to develop an understanding, particularly in our middle ranking officers, of our shared concepts for the employment of air power to enable them to understand the context of any combined operations and headquarters in which they may find themselves involved.

In conclusion, Secretary of Defense Rumsfeld has identified[98] the key lessons of Operation IRAQI FREEDOM as: Speed, Jointness, Intelligence and Precision. All these characteristics have been seen to a greater or lesser extent in all the post-Cold War conflicts that involved the significant use of air power. However, the decisive role that airpower played in Operation IRAQI FREEDOM has not been widely recognized. As Timothy Garden observed " despite their relatively low profile, the air power operations appear to have been the key to the rapid degradation of Iraqi defences, and hence the relative ease with which the ground troops took over the country."[99]

Operation IRAQI FREEDOM has given us an insight into a future battlespace in which air, land and maritime forces become less and less deconflicted and more and more integrated. However, the level of integration varied not only across the Components, but also across their component parts. Levels of communications, data links and concomitant flexibility of operations varied between the divisions. The same was true of individual air platforms, particularly in the provision of tactical data-links, but the CFACC did have the benefit of a much flatter, de-layered command and control structure than his land counterpart. The electronic linkage of the CENTCOM and Component Command Headquarters in particular, perhaps, point to a future construct where, whilst continuing to be environmental resource providers, component commanders may no longer function as individual tactical commanders, but rather as the environmental experts within an entirely integrated planning and operational process. The concepts of the core capabilities of air power still appear valid. However, the active capabilities, what air power can deliver: information exploitation, control of the air, strategic effect, direct and indirect support operations and combat support air operations will be better expressed in terms of the effect they can achieve. Force protection, sustainability and, in the future, space, are the enablers of those effects. However, what has changed and is continuing to change are the technologies, particularly for command and control or weapon delivery, and the attendant campaign planning and implementation philosophies.

But whilst our methods of waging war are constantly developing, some concepts are enduring. The quotation from General Ulysses S Grant that headed this article is a very good description of modern, high tempo, precision and networked air warfare. Airmen need to understand not only the technological aspects but also the underpinning concepts and history if they are to apply air power effectively and flexibly in the future.

Notes:

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3 Statement to the House of Commons – Secretary of State for Defence, 20 March 2003.

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[8] Defence Secretary and Chief of Defence Staff Press Conference at the Ministry of Defence, London, 22 March 2003.
[9] HQ US CENTCOM News Release No 03–03–59, 24 March 2003.
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[31] DoD News Briefing – ASD P A Clarke and Major General McCrystal, 8 April 2003.
[32] DoD News Briefing – Secretary Rumsfeld and General Myers, 9 April 2003.
[33] CENTCOM Operation IRAQI FREEDOM News Briefing, 9 April 2003.
[34] DoD News Briefing – Secretary Rumsfeld and General Myers, 11 April 2003.
[35] Written Ministerial Statement to the House of Commons by Secretary of State for Defence, Geoff Hoon, 11 April 2003.
[36] DoD News Briefing – ASD P A Clarke and Major General McCrystal, 14 April 2003.
[37] CENTCOM Operation IRAQI FREEDOM Briefing, 16 April 2003.
[38] US CENTAF Operation IRAQI FREEDOM, 'By the Numbers', 30 April 2003, p 2. (Hereafter referred to as 'By the Numbers') [J0]Tape 2 starts here.
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[40] DoD News Briefing – Secretary Rumsfeld and General Myers, 21 March 2003.
[41] Ibid.
[42] Ibid.
[43] HQ CENTAF News Release No 03–03–44, 22 March 2003.
[44] Secretary of State for Defence in answer to Question 65 during Oral Evidence to the House of Commons Defence Committee on 14 May 2003.
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[52] *First Reflections*, p 47.
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[56] Interview with Wing Commander Roger Hyslop, Chief of Combat Operations, Operation IRAQI FREEDOM CAOC, 30 September 2003.
[57] Statement by General Tommy Franks to the Senate Armed Services Committee, p7.
[58] Derived from DoD briefings end noted earlier.
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[81] Ibid.
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[84] By the Numbers, p 9.
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[92] *First Reflections*, p 5.
[93] Oral Evidence taken before the Defence Committee, 11 June 2003.
[94] *Royal Air Force Air Power Review*, Volume 6, No 3, Autumn 2003, 'A History of Effects-Based Operations', Phillip S Meilinger.
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[J0]Tape 5 starts here.
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