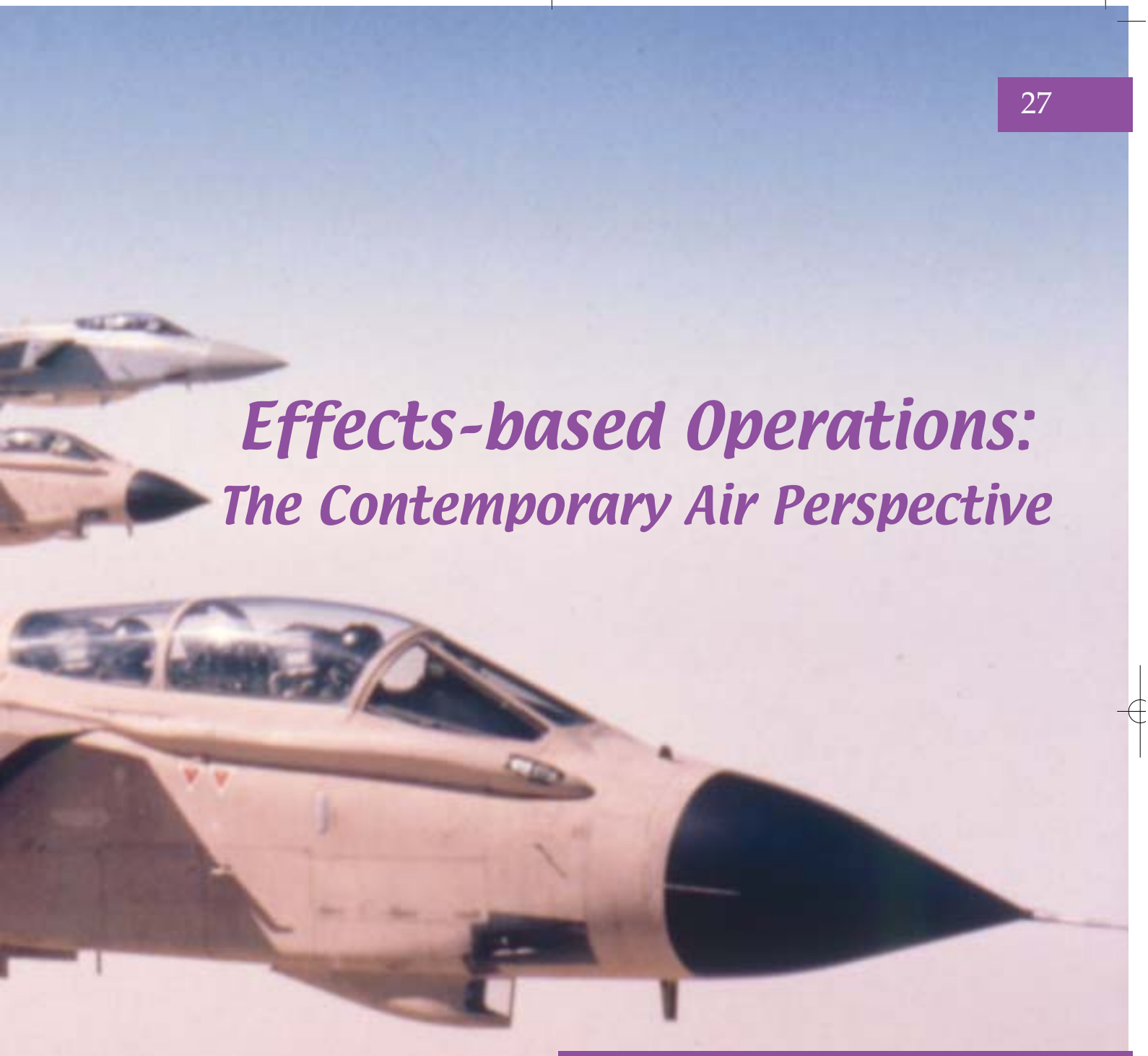

Effects-based Operations:
The Contemporary Air Perspective

By Air Commodore Stuart Peach

'*Of all men's miseries the bitterest is this: to know so much and have control over nothing*'
(Herodotus 484 to 424 BC)

This article discusses effects-based operations from the air perspective. Warfare waged from the air has been a factor in war for a century. Since the earliest days of air warfare, airmen have attempted to define and measure the success of operations conducted in the air in terms of the effect achieved on the enemy. Thus, an obvious starting point is that the study of effects-based operations is not a new concept for warfare waged from the air. In this, the centennial year of the first powered flight, the report card for aerial warfare shows early promise, a steady improve-

A precision hit on one of Saddam's palaces

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ment with potential to do more and better in the future. But, success in recent operations is mixed with the baggage of history: the oft-held fallacy that air warfare equals the strategic bombardment of the enemy.[1]

Some argue that war has changed, and that modern technology, specifically the communications networks of the information age, with or without a revolution in military or strategic affairs, have enabled 'near perfect' knowledge and situational awareness.[2] This knowledge enables the enemy's every move to be predicted, spotted, and analysed for his intent so that the generic 'Coalition' can respond immediately. In this generic world, our forces strike swiftly with great precision, hitting just enough of the things that the enemy holds dear without collateral or unintended damage that will turn public support (our Achilles' heel) against us. In turn, the enemy will comply with the course of action that 'our' form of warfare has mapped out for him. Of course the real world is more complicated than that: the axioms of war over the centuries have not changed. War remains as it always has: brutal and violent, riddled with the unexpected or unpredicted. People die; some rise to heroic acts; some muddle through; some surprise; some disappoint. The crucial factor, however, is that war remains an interaction between people. Machines enable, networks allow interaction and interoperability, but the human factor prevails. Therefore, any study on effects-based operations in the air environment should focus upon human factors and the interactions between people in the realm known as command and control rather than on machines and their possibilities.

We study military history and define a military doctrine to teach the current generation of warriors how to wage war. Almost by definition, as Sir Michael Howard has pithily observed: 'Whatever doctrine the armed forces are working on, they have got it wrong…it does not matter that they have got it wrong. What matters, is their capacity to get it right quickly when the moment arrives. It is the task of military science in peace to ensure it is not too badly wrong.'[3] Of course there are trends in war, glimpses from operations and lessons identified, which point to new futures and

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new doctrines. But, predictive doctrine is very hard. Conceptual models can be offered, as they are by the Director General of the UK Joint Concepts and Doctrine Centre elsewhere, providing a useful shorthand route to avoid the charge that our doctrine is constantly fighting the last war. But, the interaction of humans and the fog of memory tend towards 'that which is taught'.

The historiography of war is enriched by the 'battles of the memoirs' that tend to follow each conflict.[4] Memoirs help to explain human interaction up to a point. Inevitably, however, the perspective is skewed either by the view up or down the 'straw' of the individual to enhance or protect his reputation or, by the received wisdom of the victors, more often than the vanquished.[5] Thus, despite the rapid publication, even plethora, of information on war, determining how good 'we' were at effects-based operations through the study of war remains difficult.

When a war is raging across great distances across the grand strategic, strategic, operational and tactical levels, involving different sovereign nations with their own ways in war and own motivations regarding 'best' outcomes, dispassionate analysis becomes even more elusive.[6] Clausewitz's truism on war that 'in war, even the most simple thing is difficult' is arguably more true now because of the complexity surrounding decision-making and the many streams of information, than it was when written two hundred years ago. War, therefore, generates friction between the opposite sides and amongst allies in coalition. Despite this inherent friction inside the military machine, each side is attempting to achieve an effect on their respective enemy.

Air power has been employed to create and sustain such an effect since the very first days of war in the air in 1914. In much writing on the effects achieved, the taxonomy can be loose and the language imprecise. In his excellent work, Paths to Heaven, Phil Meilinger shows how thinking and words on air power grew in stridency and volume throughout the 1920s, preventing the emergence of international doctrines. Instead each nation went its own way.[7] For the purposes of this brief study, the definition employed is the one offered by the UK Joint Doctrine and Concepts Centre:

Operations designed to influence the will of an adversary, own forces or neutrals through the co-ordinated application of military capability, in order to achieve the desired strategic objectives.

Once the lexicon is tightened, a method to explain why we have 'ways' in air war and 'how' we have measured effect in air warfare so far could be of use. The method offered is to examine effects-based air operations from the UK's historical experience (to complement Phil Meilinger's study of US experience), build into a strengths, weaknesses, opportunities and threat analysis for air power from a British perspective, concluding with key challenges and emerging issues for further study.

British Air Power Perceptions

In Britain, the potential of aircraft to achieve an effect on an enemy was understood well before the First World War. Balloons operated by the Royal Engineers had been deployed to offer a wider perspective of the battlefield in order to enhance the accuracy and hence destructive effect of artillery. Aerial photography from balloons was employed by the British Army during the Boer War in South Africa to make artillery more accurate and offer a perspective of what Wellington called 'the other side of the hill'.[8] The early potential of the aeroplane for military operations was clearly understood by many of the military thinkers in the UK. Lieutenant (later Lord) Brabazon received Royal Aero Club Pilot Licence Number One in 1911 and lobbied the War Office hard to take aeroplanes seriously. Winston Churchill qualified as a pilot in the same year. Overseas, air bombing began by the Italians in Libya in 1911 with – according to contemporary accounts – a dramatic effect on the enemy.[9]

By the start of World War One, all the protagonists could boast some form of air force or another. Few individuals could have predicted the spurt that total industrial war between industrialised nations would bring to this new form of warfare. By 1918, all of the roles and missions conducted by

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An RAF S.E.5

aeroplanes to this day had been tried. Some, such as aerial reconnaissance and air-to-air fighting had become extremely sophisticated. As early as 1916, both Germany and France realised that a decisive point in the campaign for victory at Verdun lay in air superiority. This enabled aerial reconnaissance which enabled the more accurate placement of artillery fire.[10] At Verdun, effects-based air operations were a reality.[11] The measurement of effect was crude and tragic: the number of casualties inflicted. Elsewhere the bombardment of a new target group, the civilian population, was to have a profound and unintended effect: to bring the whole question of air power *per se* into the political arena. The unreadiness of British air defences for Zeppelin attacks in 1917 led to domestic political turmoil at an already difficult time for the government. This led, in turn, to Prime Minister Lloyd George's formation of the Smuts committee to examine the state of the air defence of Great Britain, which set the conditions for the creation of the Royal Air Force in 1918, an effect the Germans probably did not intend with their early Zeppelin raids.

In the context of the time, however, retribution as an effect was very much the 'way' in total war and provided political backing for the industrial urge to create four- engined bombers to take the war to Germany as the Germans had brought the war to London. Therefore, it is not surprising that, when the Royal Air Force was formed in 1918 and the four-engined bomber became a military reality, 'main effort' for Trenchard's 'Independent Force' of 1918 was to take the war to the German people. Industrial lobbying of ministers and military

leaders was a trait in the UK 'way' in air warfare as early as 1916.[12] The effect of the raids by the RAF's independent force in terms of casualties and damage to infrastructure in the industrial areas of western Germany was slight, but the long-term effect in terms of shaping UK thinking on air power was profound. At the time, Trenchard saw all this bombing as a distraction from his perceived main effort: to support the British Expeditionary Force on the Western front in France.[13]

Thus, we see even in the 'pre-teen' years of air power, employment strategies and methods of doctrine being shaped as much by political and industrial concerns and influences as by tactical considerations. Perhaps this is an enduring trend and one ripe for further study by military students.

The stoic, unquestioning defence of bomber crews' ability to find, fix and bomb their targets of the early war years was replaced by a more harsh yardstick: aiming point imagery from the fixed camera within the bomber

At the end of the First World War, the Royal Air Force was the largest air force in the world. But, in an effect that no-one could have predicted, within two years the fledgling Service was embarked upon a fight for its survival. It was this fight that set the conditions for the creation of an unusual operational doctrine in the form of air control. This idea was the air force response to the burdensome cost of policing troublesome mandates and colonies at a time when the British exchequer was on the brink of financial collapse because of the cost of the First World War. From small acorns did large trees of doctrine grow. By 1939, the idea of air control, although manifest in many different ways in different areas of the Empire had an enduring effect: the survival of the Royal Air Force as an independent Service. More importantly for this survey, however, air control shaped the experience and, hence, the personal 'way' in command of all the men who were to hold high command of the Royal Air Force for much of the Second World War.[14] The debate on how effective air control was in keeping the peace became irrelevant. The long-term effect was on 'how' the Royal Air Force went to war.

In the Second World War, the British way in war and strategic effect in terms of air power became hopelessly muddled with the strategic bombing offensive against Germany. This baggage drawn from history and shaped by controversy rages to this day. The rich historiography on the ends, ways and means of the conduct of the strategic bomber offensive has had a lasting effect on the perception of aerial warfare. As Phil Meilinger makes clear from the US perspective elsewhere in this Review, the debate on targeting strategy against Germany had all the hallmarks that attract future generations of historians: controversy, friction between allies and generals, emotion, and lots of survivors to interview and loads of data to support one thesis or another. In the Royal Air Force, the debate was no less heated or emotional during the Campaign as it was to become after the war. In Harris's pejorative term, the 'meddlers' from the Air Ministry sent incessant and conflicting directives to the hard-pressed commander-in-chief of Bomber Command. The personal and harrowing accounts of the courageous and undaunted young men who flew to Germany night after night added to the grievous losses of aircrew; everyone had a point of view.[15]

If we examine this rich seam of historiography in a little more detail with an eye to effects-based operations, one thread emerges. From 1939 to 1945, the question of what constitutes a valid target lay at the heart of this intensive Campaign both for the RAF and USAAF. In the RAF, from 1939 to 1942, the conduct of the Campaign was guided and led

by men who had 'earned their spurs' in the First World War. Often they had come quite early to the notice of Trenchard and had 'grown up' as commanders out in the Empire executing the doctrine of air control.[16]

By 1942, following controversy over accuracy which culminated in the Air Ministry's Butt Report, the officers of an earlier age in air warfare were replaced with men who had shot quickly through the middle ranks to become air officers at an age often twenty years younger than the men they replaced. These were the 'new men'. They had credibility with the crews, they were tactically adept and technically trained; airmen such as Bennett (Air Officer Commanding 8 Group) and Cochrane (Air Officer Commanding 5 Group) changed the 'way' Bomber Command engaged in the Strategic Bomber Offensive.

Thereby, the way effects were measured changed with them – the human factor. The stoic, unquestioning defence of bomber crews' ability to find, fix and bomb their targets of the early war years was replaced by a more harsh yardstick: aiming point imagery from the fixed camera within the bomber.[17] Literally, in 8 (Pathfinder) Group, without a validated photograph of the target, the mission did not count towards the total for an operational tour.[18]

These hard-nosed new commanders who had all flown in the current war, understood the strategic requirement: to support Harris as Commander-in-Chief. They entertained few doubts as to the wisdom of the strategy. Instead, they concentrated on how to hit the area targets more efficiently and effectively. As commanders, they were determined to stem the loss of their most valuable resource: aircrew.[19] The result was a concatenation of tactical and technical innovation with operational art and strategy. The choreography was outstanding, the numbers of aircraft continued to increase in number and performance, accuracy steadily improved by day (as Phil Meilinger shows for the USAAF) and by night for Bomber Command with the technical innovations and technical skills of the pathfinders and the specialist squadrons of 5 Group. The effect on the enemy was cumulative and measured by armies of photographic interpreters poring over aerial photographs backed up by the scientists of the Operational Research Branch.[20] Overy, in 'Why the Allies Won', finally brought closure to the 'so what' debate with his forensic examination of the data to prove the damaging effect of the relentless bombardment on Germany, particularly in 1944/45.[21] At the tactical level, battle damage assessment reach new heights of sophistication basked up by skilled research scientists to measure with careful precision the effect that was being wrought on the enemy.

But, as in many later conflicts, aerial warfare focused upon two- dimensional measurement of damage that could be seen. The effect on what the enemy holds most dear remained the 'holy grail' that only gradually emerged in the years that followed when the German side of the story became available. This limitation in combat assessment should ring bells of warning to those who today talk of near-perfect situational awareness and information dominance.

As a result of the strategic bomber offensive, the Royal Air Force entered the Cold War with a rich heritage of sacrifice and achievement and a 'way' in air war which was highly distinctive and different from the USA with its newly independent and confident USAF, born in 1947. In Britain, in the early post-war years, anything technology could offer to reduce aircrew losses in a future war, would be snapped up by those in command who had fought through the war. The enormous (albeit fragile and transitory) residual capacity in the British aircraft and weapon industry appeared to offer such a choice through jet bombers and the weapons to go with them.

In the Cold War, this suited the strategic mood (and industrial policy).[22] Therefore, we should not now be surprised that serious debate about air power and air warfare became synonymous with nuclear operations. The bomber barons of the Second World War held the high command positions of the Royal Air Force for much of the 1950s and 1960s. In a UK version of Eisenhower's famous descriptor 'the military/industrial

AHB (RAF)

An RAF Hunter on patrol, 1966

Their performance on exercises and inspections became almost legendary within NATO's tactical air forces evaluation programme. But, their equipment in terms of modernity slipped behind even smaller countries

complex', in the UK in the mid 1950s, theory, government, science, industry and Service combined to create an air-delivered nuclear deterrent and the means of delivery. Both almost broke the Service's piggy bank which, in turn, accelerated the neglect of the tactical air forces deployed in Germany.

Wynn's definitive study on Royal Air Force nuclear operations shows the depth and intensity of investment, research, development and the support structures (headquarters, bases, training and so on) in order to create and then sustain the V-Force.[23] In strategic terms, deterrence worked and the V-Force was rather gracefully retired after a conventional outing by the Vulcan in the Falklands War and sterling service by the Victor as a tanker aircraft.[24] The effect on the Service, however, of this concentration of resources in search of a strategically dominant role was very deep and long lasting.

Despite the apparent neglect, the tactical prowess of the RAF's tactical air forces based forward in Germany under NATO's doctrine of forward defence was never in doubt. Their performance on exercises and inspections became almost legendary within NATO's tactical air forces evaluation programme. But, their equipment in terms of modernity slipped behind even smaller countries. For these countries, tactical air support using US provided aircraft such as F-84, F-86, F-104, F-4, F-16 became their *raison d'etre*.[25] Within NATO, any debate on air strategy quickly became conflated with force goals, perceptions of national effort and national interest. The Royal Air Force, on the other hand, along with the USAF, the French and Soviet Air Force, had global interests. This led to three, often conflicting, centres of gravity for much of the Cold War: support to UK world-wide interests (bases, strategic air transport, forward presence, exercises etc), the V-force (strategic deterrence and main effort) and the tactical air forces based in Germany (forward defence, NATO's flexible response).

Of course there were operational excursions outside the tectonic plates of the Cold War. The Berlin Airlift represents a classic example of the use of air power for strategic effect. Operations over Suez were less impressive – particularly between components (Fleet Air Arm and Royal Air Force) and allies (UK, France and Israel). Similarly, the retreat from Empire offered several examples of tactical innovation: the use of helicopters in Malaya, show

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RAF Buccaneer

of force operations, outstanding performance from small force elements at the end of immense lines of communications in the Falklands War. All paled against Cold War orthodoxy. The British way in air warfare became rather rigidly taught at the Royal Air Force Staff College with a deep emphasis on staffwork and what Air Vice-Marshal Professor Tony Mason has called the doctrine of equipment replacement, rather than operational planning as at other war colleges.[26]

So what? The prolonged nature of the Cold War, the potential for conflict and the institutionalised nature of the stand-off solidified and strengthened rigidity in and between levels of war between allies and between services as much on the NATO side as on the Warsaw Pact. Of course, much was common and much was harmonious. But, there were differences of opinion between the USAF and the RAF, which were to play out after the Cold War was over.

NATO air doctrine appeared to be the same across the Allied Command Europe structure. The doctrine differed in application, however, between the British commanded sector in Northern Germany (Second Allied Tactical Air Force) and southern Germany (Fourth Allied Tactical Air Force) commanded and dominated by the US. This thinking did not lead to seminal shifts such as Warden's 'Air Campaign' in 1989 in US thinking, but the emphasis in northern Germany was very much the UK's refinement of the air/land battle in order to lend greater breathing space to outnumbered positional forces.[27] The Royal Air Force with Canberra, Hunter, Buccaneer and later Tornado, working with Allies, became expert in air interdiction and offensive counter air missions with ultra low level

flying as the enabling tactic. The other Allied air forces in the British sector followed suit. This was 'what was taught' at the NATO Tactical Leadership Programme. This way in war required highly trained crews, an element of *auftragstaktik* and decentralised mission command.

In the US sector in southern Germany, however, a divergent way in air war was developed. Following the Vietnam experience and a highly influential RAND study into the doctrine of air/land operations, tactical emphasis switched steadily to medium level to reduce the risk from ground fire and the growing threat from man portable shoulder-launched missiles.[28] This change in emphasis of tactical doctrine is not merely a fall-out between two close air forces, it represents a different 'way' in air war which has remained a source of misunderstanding ever since the Cold War of the North German plains became a hot war in the Persian Gulf.

The development of the US air strategy for the first Gulf War is well-trodden ground. Warden's famous briefing to Horner, the subsequent merger of Warden's ideas into conventional air thinking, is all well known. What is not so well known, however, is that the Royal Air Force 'way' in air warfare had an impact within the Campaign. The British JP 233 airfield denial weapon had been developed as part of the air/land strategy in the Cold War. It was designed to disrupt activity at Warsaw Pact airfields with a mixture of runway denial munitions and aerial-delivered mines. Horner asked for it as part of his strategy. The UK air commanders, Air Vice-Marshal Sandy Wilson and Air Vice-Marshal Bill Wratten both enjoyed access to and, therefore, opportunity to influence US thinking. UK forces were extensively engaged flying over 10% of the Coalition mission total.[29] JP 233 was employed to excellent effect with great skill and bravery by the Royal Air Force in the opening week of the Gulf War. Despite the diver-

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An RAF Tornado deploying JP 233

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gent doctrine, the effect required by the air commander was achieved and measured by UK-provided tactical air reconnaissance. The subsequent disruption to the Iraqi Air Force helped to enable the Coalition to declare air superiority and operate free from interference by the Iraqi Air Force at medium level altitudes.

This USAF 'way' in air war, however, required a large supporting cast of electronic warfare, suppression of enemy air defences, jamming, signals intelligence, tanker, airborne command and control aircraft. This became the 'western' way in air war. Only the US could afford it. Since the Cold War, the main effort in all other European air forces (including the Royal Air Force, Fleet Air Arm and Army Air Corps) has been to work out how to spend enough to stay broadly interoperable with the USA. Post Gulf war analysis in the UK focused upon enhancement to the ability to fight at medium level altitudes and greater emphasis upon precision-guided munitions.

If this was an RAF success for effects-based operations, the first Gulf War exposed many problems with air command and control process for the UK and the US. Much has been made of the way General Horner organised and structured his headquarters to enable Coalition operations and orchestrate the conflicting demands placed upon him as the designated Coalition Force Air Component Commander with his other vital roles as the Theatre Air Defence Commander and the Airspace Control Authority.[30] RAF staff officers provided much-needed expertise in these areas. As for targeting, target lists abounded: some strategic, some operational, some tactical. The effect meant to be achieved upon the enemy was harder to determine in a task-to-strategy audit analysis.

Moreover, the feedback of effects from day-to-day operations into operational planning, despite the best efforts of the reconnaissance aircrews, was not well handled. The fusion of the many and varied means available: signals intelligence, satellite imagery, mission reports, tactical air reconnaissance did not readily find its way into the hands of those that needed it. Therefore, effects-based operations could not be claimed as the central tenet; rather it was the sheer weight of air effort over the thirty-nine days of the air war that was probably the deciding factor.

After the conflict, the answer appeared to be the creation of more staff places inside the air operations centre in order to feed the information monster, including more focus within the RAF on training for battle staffs. The Air Component Headquarters appeared set to grow. Thus, despite the clearly decisive effect air warfare had achieved in the first Gulf War, uneasy questions remained. Integration of air and land forces at the 'interface' of close air support was not as good as it had been in the British sector of NATO during the Cold War. The British and US 'ways' in air war had diverged slightly but importantly and the fusion of command and control with combat assessment to offer a view on the effect achieved had not been as successful as it could have been. Instead of learning and changing, on both sides of the Atlantic, the proponents of air power sallied forth with a rapid sequence of ever more grandiose claims of new dawns and new ages; mankind could be saved by air power alone![31]

The close season for war in the air was short. A year after the Gulf War, conflict broke out in the Balkans. The international military response was mixed. The debate over the effectiveness of pinprick attacks by NATO aircraft with confused

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RAF Tornados patrolling the skies over Iraq

command and control and 'dual key' arrangements between NATO and the UN is probably the nadir of international decision making in recent years.[32] The claims for air power seemed to be ringing hollow in this new operating environment with confused boundaries, complex command and control arrangements and lack of shared situational awareness.

The West seemed to stumble from one setback to the next. Field Marshal Montgomery might have called it a lack of grip. The grip came in 1995. Not for the first or last time in military history, the personal relationship between the nominated NATO Land Component Commander, Lieutenant General Sir Rupert Smith (UK Army) and the nominated NATO Air Component Commander, Lieutenant General Mike Ryan (USAF) set the conditions for military success in Operation Deliberate Force. Working together and broadly in cadence with political/diplomatic line of operations, they managed in a short campaign to convince the Serbs that NATO was serious in its request for compliance. Air Power operated with many constraints, but achieved the aim.[33] One reason was that target-validity was very carefully planned and coordinated between the two components.

Despite the success in achieving the aim, however, several of the Gulf War questions lay unanswered. The new processes in the Combined Air Operations Centre – especially when more than ten air force were engaged in the operation – required more and more people. The size of the

Combined Air Operations Centre at Vicenza was almost double that of General Horner's in the Gulf War.

In the mid 1990s, patrol operations went on in the Balkans out of Italy and, in support of United Nations' Security Council Resolution 688, over Iraq. Air operations against Iraq were mounted from Turkey, Kuwait and Saudi Arabia. The new generation of airmen trained since the Cold War (but commanded by Cold War warriors) understood that, although the day-to-day deterrent patrols appeared to achieve an effect, the operational situation could change very quickly, either through enemy action or a mishap. But, despite the grip shown during Deliberate Force, operations in both Theatres continued with a surprising lack of clarity of purpose in terms of effects-based planning. Some spikes in activity were directed top down, such as show of force missions in Bosnia or Operation Desert Fox in 1998, others were prosecuted bottom-up.[34] Other than the inherent right of self-defence (which can hold many interpretations across many air forces), the question of what constitutes a valid target became rather blurred. In the Balkans, the priority was to deny the Yugoslavian Air Force the ability to fly and interfere with the UN/NATO operation. Over Iraq, the stated aim was to deny the Iraqi Air Force freedom of action to intervene in the ground situation; in both cases a strategy of denial but without many of the 'what ifs' in place should the operational situation change.

In 1999, despite the NATO presence, the crisis over Kosovo developed into a full-scale air war. Again, much has been written on the details of the air war and the friction within the command chain as national interests and different shading in the desired outcome tended to blur and almost fracture NATO's unity of purpose. Building on the situational awareness from the patrol and show of force missions, the designated Coalition Force Air Component Commander, Lieutenant General Mike Short, planned a short war at the behest of his superiors. The plan had all the hallmarks of what had become the USAF 'way' in war. First, air needed to establish air superiority. Next, the suppression of enemy air defences to defeat the Serbian Integrated Air Defence System; followed by carefully selected, screened and approved attacks against 'fixed' interdiction targets and targets which could or should achieve an operational or even strategic effect.

This was where the fun started between the nations and the layers of command. This time the question of what constitutes a valid target could not be properly or easily answered. It depended on who was asking the question and where they sat in the relative chains of command. In theory, for NATO, the North Atlantic Council set the strategic guidelines and delegated the conduct of military operations to the designated Theatre commander, General Wesley Clarke. But as he makes very clear in his book 'Waging Modern War', in practice many of the capitals within the participating nations wanted a say and often a veto over targeting.[35] The Campaign dragged on.

Although the Coalition declared air superiority, Serbian air defences had not collapsed, they hid and took opportunity shots against NATO aircraft requiring the full orchestra of NATO air power to fly night after night. From time to time, authority was given to strike targets inside Serbia, but the main weight of effort was directed within Kosovo. The strategic decision to rule out the employment of ground forces placed more constraints upon NATO airmen as did the masterly use of camouflage, concealment and deception tactics by the Serbian forces, employing the Soviet doctrine of Maskirovka. After seventy-eight days of mounting friction and frustration within the NATO command chain, Milosevic blinked, NATO cohesion remained intact (just) and air power could chalk up another victory. This time, however, the celebrations were more muted, the post war analysis more angst-ridden. Although the internal processes within the Combined Air Operations Centre had been improved, the time taken and number of people necessary to manage air operations remained a drag on rapid and timely decision-making. The NATO Combined Air Operations Centre in Vicenza numbered around 500 for Operation Deliberate Force. During Operation Allied Force, the number reached 1,000. The doubling law held good. That said, there were

In a 'back to the future' Campaign, air power played a decisive role in support of Afghan proxy forces

A USAF B-52 preparing for take-off to Afghanistan

improvements in air tasking. The time taken from spotting a target in the Kosovo Engagement Zone to the allocation of an aircraft to attack the target steadily reduced during the Campaign. What became known as 'Time sensitive targeting', was born. Similarly, US-led Combat Search and Rescue Forces again proved their worth in politically-charged complex environments.

In the inevitable post-conflict quest for lessons to identify, the unavoidable impression was that the friction created in order to satisfy the political requirement for multinationality probably exceeded the tangible military benefit offered by that multinationality. A lesson that was not lost on the air power thinkers in Maxwell and Washington as potential air allies lagged further and further behind in interoperability and air technology.

Again the close season to absorb lessons and train a new generation of airmen to exploit new technology and new doctrine was short. Air operations had continued over Iraq since 1992. The Coalition had ebbed and flowed as coalitions do. By the late 1990s, only the US and the UK were flying offensive missions over Iraq. Over time, the no-fly zones became increasingly dangerous places for Coalition aircrew. Even if the Iraqi Air Force flew very little to challenge Coalition air superiority (apart from much publicised raids to shoot down Coalition Unmanned Aerial Vehicles such as Predator), the Iraqi Air Defence forces were shooting at Coalition aircraft nearly every day. Coalition aircraft responded in self-defence. Iraqi air defences grew bolder and the Coalition responded.

Both the UK and US introduced updated weapon systems and updated procedures. Lessons had been identified from Kosovo. The Combined Air Operations Centre became a warfighting element in its own right.[36] The UK also learned lessons. The Royal Air Force's already impressive tactical reconnaissance capability was enhanced with the introduction of new reconnaissance pods for Jaguar and Tornado. Tactics, techniques, procedures and counter-measures were constantly updated to cater for the enemy's new boldness. The UK 'way' in air war responded to treatment. Effects were being achieved. Then the world changed.

After Sep 11 2001, Operation Enduring Freedom suddenly presented Coalition air forces with a new target set: the Taliban regime in Afghanistan. The state of the infrastructure of Afghanistan after almost a quarter of a century of continuous warfare meant that there was little in the way of fixed arrays of targets to be struck by western air power. Nor was there much in the way of a recognisable air force or an integrated air defence system. Instead, in a 'back to the future' Campaign, air power played a decisive role in support of Afghan proxy forces. Close air support designated by US and other special forces proved to have a devastating effect on the morale and fighting power of the Taliban forces. Kabul fell and the regime collapsed. The pressure brought to bear by air power

Despite the advances in defence communications networks and the enormous sophistication of intelligence and reconnaissance assets, getting the right information into the right hands at the right time remains a challenge

continued to mount as the winter made ground campaigning difficult.

This modern form of punishment attack from the air (pioneered by the Royal Air Force in the Middle East in the 1920s), culminated in December 2001/January 2002 in waves of B-52 and B-1B attacks against the 'Tora Bora' Range in eastern Afghanistan. This time UK played an air power supporting role with intelligence, surveillance and reconnaissance, command and control, air to air refuelling, air transport aircraft and, as ever, a lot of helicopters. The effect achieved was out of all proportion to the numbers deployed, drawing private praise from US air commanders.[37] A recognisable UK 'way' in air warfare remained intact.

If air power had offered a decisive enabling effect in the Afghanistan Campaign, the second Gulf war did not appear to follow the traditional route as described above. Instead of the orchestral analogy: commander as conductor, bringing the symphony carefully to life in a deliberately planned sequence of attacks, this time a sudden crescendo from the percussion section started the air war with an attempt to decapitate the Iraqi regime using cruise missiles. In the second Gulf War, the air coalition was much smaller. The participating air forces were all elements of the US, all elements of UK air power (RAF, Fleet Air Arm and the Army Air Corps) and the Royal Australian Air Force.

This gave advantages in the pursuit of an effects-based strategy. Interoperability was easier to achieve and many of the crews were very experienced in the operating environment. Technology was harnessed in support of the Campaign objectives. Building on the success in support of ground forces in Afghanistan, Close Air Support became a critical role in order to sustain momentum and help to prevent the over-stretched ground forces operating with disadvantageous force ratios over long and vulnerable lines of communication, from reaching their culminating point.

Simultaneously air operations continued against a wide variety of interdiction, counter-air and regime targets. Time sensitive targeting was now a powerful reality with command and control fusion and rapid response now a routine. Lessons from this most recent of conflicts will take time to compile. But, the nagging doubts of previous conflicts remain. The interpretation of what constitutes a valid target requires education and understanding between allies, components and within military (and political) headquarters operating across and between the levels of war. Despite the advances in defence communications networks and the enormous sophistication of intelligence and reconnaissance assets, getting the right information into the right hands at the right time remains a challenge.

Whilst the lessons are absorbed, if there is one enduring theme that emerges throughout the case studies from recent operations, it is the difficulty of incorporating a robust method and process of how to measure effect (once the enduring question of what constitutes a valid target has been answered). A generic model is offered below.

How to measure effect

Throughout military history, generals and those working in support of generals have developed a campaign plan in order to specify how they intend to meet the objectives of their campaign. This process known simply as campaign planning has spawned its own rather Clausewitzian lexicon: centres of gravity, decisive points, lines of operation, branches, sequels, culminating points and so on. It is a flexible process and the interpretation of it to suit the local context in space and time is almost a definition of operational art. There are many shaping factors to influence a campaign plan, which the air planner may need to take into account. For example, weapons of mass destruction.

The mere hint of presence and a lack of accountability or knowledge of potential employment

options – especially in failed states or states of refuge where sub-state terrorism groups or group activists may prevent rational calculation to be made – may become Campaign main effort before conventional component operations can begin. Such shaping factors at the strategic level may affect operational level planning considerations. As a further example, in the era of truly multi-role aircraft, the aircraft required to undertake missions to find, fix and strike weapons of mass destruction may well be the same aircraft that are required, say, for close air support. Nonetheless, these shaping factors must be factored into the assumptions that underpin the campaign plan.

Another area of potential difficulty for the putative effects-based air campaign planner is defining and understanding the enemy. The enemy may have his own plans to disrupt our campaign plan at every stage. Western intelligence staffs, perhaps especially air intelligence staffs, are highly skilled at analysing images or electronic intelligence but may be less adept at identifying enemy intent by thinking like the enemy. Capability can be measured and potential assessed in a reasonably coherent way, but measuring his intent balanced against 'our' capabilities and 'our' potential to take the initiative and disrupt his plans is another example of the operational art required in the intelligence preparation or shaping of the potential battle space. This process, best described as the fusion of operational results with intelligence knowledge, is crucial to making sense out of combat assessment. Again it is a key and recognisable UK way in air warfare.[38]

The key word in understanding the generic model is fusion. Each element may be achieved at unit level, close to the actual air mission in time and space. For example, first phase initial assessment of air tactical reconnaissance may take place in cockpit to form the basis of a mission report in the case of time sensitive targeting or, via datalink, in a control cabin close to the deployed operating base. Other critical elements of the combat assessment process may take place hundreds or thousands of kilometres away in fusion centres or reachback facilities relatively safe from the enemy's reach. Provided the reachback commanders understand the in-place commander's intent and has sufficient situational awareness from all sources, thereby mixing high-grade all-source intelligence with tactical results and commander's requests for information, great value can be added to create a fused combat assessment product. This product can turn effects-based planning into operational reality.[39]

Within the overall process of effects-based planning, therefore, the role and place of combat assessment is crucial and often the weak point. In the succession of campaigns illustrated in the case studies, someone in the Combined Air Operations Centre probably had the right 'nugget' of information somewhere, but was unable to place the information in the right hands – the operational or tactical decision-maker – at exactly the right time. This remains a key challenge for the development of processes to make combat assessment the catalyst for the delivery of effects-based operations.

Of course any metric which requires the integration of objective military assessment (mission reports, imagery analysis etc) with subjective assessments of future enemy intent and the effect of information or psychological operations on the enemy's will to fight, is difficult. But, if the process is robust enough to allow military judgement and operational art to be exercised by empowered commanders backed up by the fusion of results, bounded by the rigour of science, then combat assessment could be the next big and yet achievable challenge for air power.

Turning to the 'how' question: one way to overcome the apparent complexity and mythology of campaign planning is to break tasks down into objectives, objectives down into sub-objectives, sub-objectives into target sets, target sets into targets and targets into individual desired points of impact. This linear and hierarchical process enables each task to be linked to the overall s trategy and, conversely and usefully, provides an audit trail back from an individual mission or task to the overall strategy of the Campaign (a discipline lacking in many air campaigns). The diagram below offers a picture of this process.

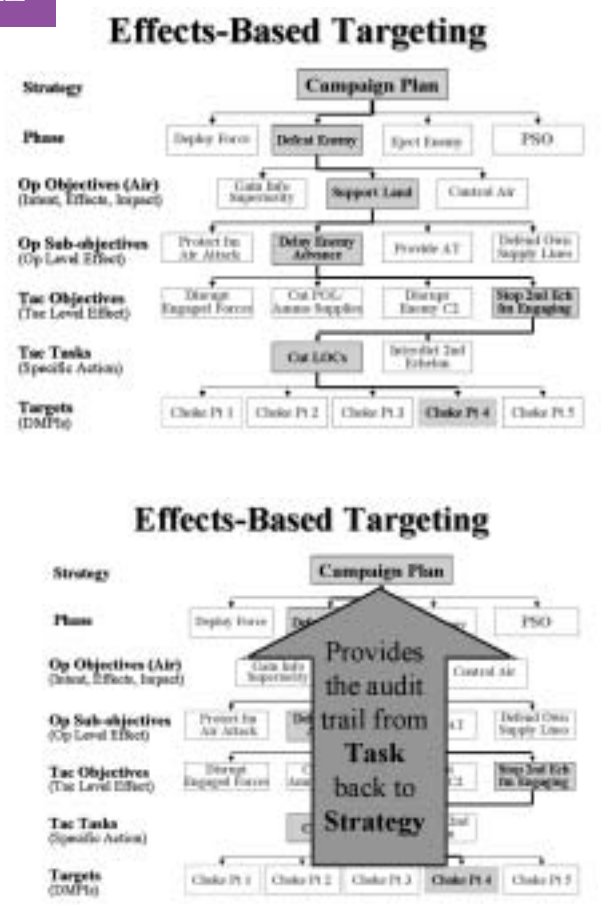

Figure 1: The Strategy to Task Process

As demonstrated, for a measure of effect to be valid, it must fill four objective criteria. Is it quantifiable? For example, are the enemy's surface to air missile radars still transmitting in a particular area over a given time – perhaps measured by signals intelligence. Is the task achievable? Can we reach those radars with either manned or unmanned vehicles at an acceptable level of risk? Can the effect achieved be collected by available means? And last, but often the acid test once operations have begun, is the effect still valid and relevant in the prevailing operational situation? For example, will the removal or disruption of the surface to air missile raiders enable us to achieve the effect we seek? And so on.

Some may see this analysis as simplistic. But, when applied consistently and merged with operational analysis, this model works. Without combat assessment, however, any approach to effects-based operations for air power may well be stillborn.

'So What' Analysis

As the foregoing analysis of the evolution of the UK 'way' in effects-based aerial warfare has attempted to show, the creation of an effects-based operations strategy for air power is achievable. The speed of response of contemporary air power makes it an early if not first option of choice for decision-makers. Speed of response can be a powerful indicator of intent. An early deployment of a small but potent force either afloat or ashore on friendly bases can diffuse a situation through deterrent effect or, offer a force on mind to deter further aggression.

The reach and perspective of modern air power to sustain a presence and offer intrusive reconnaissance and surveillance can also offer a powerful political message whilst containing or defining an acceptable level of operational risk for the political process whilst coalition or diplomatic options are closed off. Thus, the global reach of air power to reach a crisis area with speed is a key strength in any consideration of the adoption of an effects-based strategy.

At the same time, however, expeditionary operations expose a potential flank of vulnerability to the enemy. Host nation support is a vexed question. On the one hand the presence of 'foreign' forces can inflame local sensitivities and make a bad situation worse. On the other hand, the presence of foreign potential intervention forces can reassure reluctant allies. Host nation support restrictions can be mitigated by poising the force afloat in an aircraft carrier. Force protection of deployed air assets is another challenge. Local air defences may be able to offer protection during the vulnerable build-up stage, but the vulnerability of large (and therefore obviously foreign) forces 'locked' into remote locations can create a vulnerability in the shape of force protection as more and more forces have to be deployed in the force protection role.

As for opportunities, at the beginning of the twenty first century, there are several enabling technologies that allow air power to exploit the information age through network-enabled capability. Examples include datalinks, interoperable secure

Ownership of the platform is irrelevant; it is the process of ensuring the product is shared and exploited by those who need it that counts in effects-based warfare

radios and common command and control/tasking networks. If the fusion of information in warfare is the critical challenge for the method of creating a process to deliver effects-based planning, so the fusion and integration of information warfare in all of its manifestations with warfighting, is the key if not ultimate challenge for future technology. Airmen are already exploiting unmanned aerial vehicle technology to excellent effect. Ownership of the platform is irrelevant; it is the process of ensuring the product is shared and exploited by those who need it that counts in effects-based warfare.

Of course there are threats to all this progress. Interoperability is a tenet of modern operations that must not be taken for granted. The concept is both vertical and horizontal. Air forces may be able to interoperate with each other, but may (in the process) have drifted apart from, say, their national land component. If, as a truism, air/land integration is the most complex and complicated of air power roles and missions, such a drift between the components of a nation must be addressed. Much work is in hand but much remains to be done. Another threat, which requires equal attention but is much more difficult, is how to apply the potential of air power to a non-state, terrorist enemy. Recent operations over Afghanistan and Iraq have, however, demonstrated that airmen can and do respond to new challenges with flexibility in approach and flexibility and discipline in execution of air operations.

Above all, however, the central thesis is that, despite the apparent blurring of many 'ways' in air war into one US 'way' in air warfare, in fact a distinctive and highly capable UK way in air warfare remains intact. Again ownership is not the issue. With the advent of the Joint Harrier Force and the Joint Helicopter Command in the UK, effects launched from the air can be created for joint effect. Within the Royal Air Force, the UK retains highly developed capabilities and operationally experienced personnel which add value to any effects-based strategy. The commitment to reconnaissance, long range attack, interpretation and all source intelligence, complemented by an understanding of warfare and command and control at the strategic and operational level all point to component force elements ready for the next challenge.

Conclusion

I have attempted to demonstrate that the UK has understood effects-based operations in the air environment since the earliest days of air warfare. A distinctive British 'way' in air war developed during and between both World Wars, and continued to retain its edge during the Cold War. Since the Cold War, contrary to much US-inspired writing, the UK has retained its own 'way' and in some elements added lustre to its credibility with a string of successful deployments covering the full range of air power roles and missions. In addition, many of the UK's key strengths: command and control, campaign planning, integrated mission support, tactical reconnaissance, long range attack are particularly useful in support of effects-based operations.

Since the days of air control over Iraq in the 1920s, relatively junior UK air commanders have traditionally been asked to deliver much with little expenditure of national treasure. Air commanders are schooled to think at the operational and strategic level with their colleagues at the UK Joint Services Command and Staff College.

Air Vice-Marshal Professor Tony Mason's warning that Tornado replaces Buccaneer, Buccaneer replaces Canberra, Canberra replaces Mosquito and so on, should be noted as such. Of course such simple Cold War analysis should be behind us in the era of smart procurement. The full and creative fusion across the lines of development of concepts, doctrine, training, people, equipment, sustainability and decision support to joint effect is now the focus, rather than all on equipment.

The risk of reversion to former ways is always there, however; hence the power of the warning.

In the effects-based era, particularly against non-state enemies, the next step is the fusion of force development between allies to ensure conceptual, doctrinal and interoperability in training and exercising (what Lieutenant General Sir Anthony Pigot has called the interoperability of the mind) is required as well as interoperability between equipment. Equipment commonality is often the easy part and the focus of too much staff activity. In addition, other challenges abound. In the UK, too much research and development funding is directed towards cost and risk reduction rather than innovation and technology exploitation in the prevailing procurement culture.[40]

The integration of information operations and the means to measure the effect of psychological operations properly must be an area of renewed effort. Thus far, too many attempts have focused upon simple indicators such as the number of leaflets dropped or hours of broadcast, rather than the impact upon the target population. We also need to reverse the trend of steadily increasing the number of airmen deployed forward to deliver command and control inside the Combined Air Operations Centre. The doubling law should become at least the halving law!

Above all, the UK should retain its distinctive 'way' in air warfare. Despite the risks and challenges, the UK has retained a balanced capability which provides – to any Coalition – a range of options and capabilities proven time and again by hard-won operational experience and robust command and control. But, to paraphrase the NATO Tactical Leadership Programme aphorism slightly, we are only as good as our last war. We need to accept that the price to achieve an effects-based operations strategy is as much about cultural and structural change as the seduction of technology. In effects-based operations as in war, even the most simple task can be difficult.

Notes:

1 The strategic bombardment campaigns of the twentieth century continue to attract authors in search of answers on the effect of bombardment. See Pape, R, Bombing to win, Cornell, USA, 1998, Niellands, R, *The Bomber War*, Hutchinson, London, 2000 and Biddle, T, *The Evolution of Strategic Bombing*, Washington, 2002 for recent academic works. In the UK, Lindqvist, S, A History of Bombing, Granta, London, 2001 for an unusual reader on the polemics of the subject.

2 The descriptor RMA to denote a revolution in military affairs crossed the Atlantic almost ten years ago. As is often the case, conceptual aspirations were divorced from technical realities. See Friedman, G & M, *The Future of War*, New York 1998 for a Toffler-inspired vision of future war balanced, more recently, by Colin Gray's, *Strategy*, London 2001 for a more realistic view from the UK side of the Atlantic.

3 Quoted in AP 3000 3rd Edition, Chapter 11, 3.11.1, London, HMSO, 1999.

4 One trend which is new is the speed by which commanders deliver their memoirs. The early 1990s witnessed a crop of books from the senior commanders of the Gulf War offering their story. Gordon & Trainor, *The Generals' War*', Little Brown, USA, 1995 offered a more balanced assessment. After the Kosovo Campaign of 1999, General Wesley Clark produced his memoir: *Waging Modern War* as early as 2001. Thus, rarely are students or commentators short of material. The problem is that the information flow is very one-sided. Bookshelves are less full of Yugoslavian and Iraqi memoirs.

5 For example, the lessons learned in air warfare from the First World War took on a very different hue between the victors and the defeated. See Corum, J, *The Luftwaffe Creating the Operational Air War, 1918 to 1940*, Kansas, 1997. Similarly, tactical level memoirs can offer vivid descriptions of 'what it was like', but are less likely to answer the 'why' questions. In particular, there is dearth of perspectives from the enemy's point of view from recent operations, despite the best efforts of he western media. See Weymouth & Henig, *The Kosovo Crisis*, Reuters, 2001 for a reader on the subjcet

6 Napoleon was probably the last general to 'manage' the tactical, operational and strategic levels of war in the shape of one man. See Gates: '*The Wars of Napoleon*, Macmillan, London, 2001 and Holmes, R, *Wellington*, Harper Collins, London, 2003 for the profound influence of individual commanders in those wars. The Prussian General Staff organization and structure which grew out of the Napoleonic War remains the basic way by which we go to war in the UK, Western Europe, the USA and Australia. The staff branches for administration, intelligence, operations, logistics, plans, communications, training and finance would all be familiar to Clauseweitz. Often it is the human friction and lag inherent in these (often vast) staff structures which inhibit timely decision making and the intellectual assessment of military cause and effect on an enemy.

7 See Meilinger, *Paths to Heaven*, Maxwell AUP, Alabama, 1998 and Peach, 'It's the Effect that Counts' in Gray (Ed), *British Air Power*, TSO, London 2003 for the influence of the 1920s in shaping the doctrine of the Second World War.

8 Few volumes on air power concentrate on the Boer War. During the conflict, the British 'way' in colonial war was

severely tested. Many of the enemy's tactics, techniques and procedures were adopted to great effect, but the lessons were not learned for the Great War. See: E. Lee *To The Bitter End* (A Photographic History of the Boer War), Penguin, London 1985. Pp 34-35.

[9] See Pape, op cit for a vignette.

[10] See J. Bailey, *The First World War and the Birth of the Modern Style of Warfare*, Strategic Combat Studies Institute Paper No 22, 1996.

[11] In his classic account of Verdun, Alastair Horne makes much of air superiority as a decisive factor in the battle. 'See A. Horne, *The Price of Glory: Verdun 1916*, Papermac, London, 1990, Pp 160.

[12] See Mason, R.A, Air Power, *A Centennial Appraisal*, Brasseys, London, 1994 for a description of the plethora of types and engines that plagued the Royal Flying Corps and the fledgling Royal Air Force.

[13] See Melvin M, *The Land/Air Interface*, in Gray, P.W. (Ed), *British Air Power*, TSO, London, 2003, P65-68 for an excellent account of how the simplistic mythology of Trenchard as an early exponent of bombing persists. In fact, Trenchard and all the founding fathers of the RAF were wedded to the primacy of air support to the Land Component. Air power evangelism came later.

[14] See Omissi. D, *Air Power and Colonial Control, MUP, Manchester, 1990 and Air Policing*, 1919 to 1939, MUP, Manchester, 1991, Cooper, M, *The Birth of Independent AirPower*, Allen, London, 1986 and Towle, P, *Pilots & Rebels*, Brasseys London, 1991, for the full story of air control.

[15] Harris's own account, although ghost written, *Bomber offensive*, appeared as early as 1947. Personal accounts have continued to emerge. Most middle ranking commanders either published autobiographies such as Air Vice-Marshal Don Bennett: *Pathfinder* or have been the subject of biographies. Each year still sees the emergence of new accounts.

[16] The influence of Trenchard upon the selection of commanders shaped both the Second World War and the early years of the Cold War. See Vincent Orange, *Tedder*, Cass, London, 2003 for how the father of the Royal Air Force's influence cast a long shadow over the Service he helped to create. Of note, despite the towering figures in the Royal avy and British Army, no single commander was able to exert so much influence for so long, possibly since Nelson upon the Royal Navy after Trafalgar.

[17] See Terraine, *Right of the Line*, Hodder, London, 1985, for highly readable accounts of the profound difficulties encountered by the 'original' crews of Bomber Command in 1939 in attempting to take the war to the enemy.

[18] This may appear tactical detail for a survey on effects-based operations. In fact, in interviews with veterans, all contended it was Bennett's insistence on aim point imagery (which in the Lancaster and Halifax was triggered automatically when the bomb doors were open and weapons released) did more than any diktat from the Air Ministry to exhort the crews to greater accuracy. By the end of 1943, the practice had been adopted across Bomber Command. See Peach, S, *Pathfinder Station, A History of RAF Wyton*, Cambridge, 1982.

[19] Rivalry between the Groups, Stations and Squadrons of Bomber Command remains an understudied area. For example, the extra pay (through rank and a special badge) of the Pathfinders was resented. Cochrane in 5 Group created his own specialist low level squadrons. 617 Squadron remained an elite unit outside the Pathfinders and enjoyed an intense rivalry with IX(B) Squadron which culminated in both claiming the sinking of the Tirpitz in 1944. An area ripe for further study in the effect it may have had on the pursuit of ever greater effects through accuracy to enhance the Squadron's reputation.

[20] Both became and have remained key skills of the Royal Air Force: photographic interpretation and operational analysis. Encouraged by Churchill, the photographic reconnaissance squadrons of Spitfires and Mosquitos, ranged far and wide over Europe. Flying high and fast, albeit unarmed, their presence was one of the catalysts for the German development of the Me 262 jet fighter. It is a key tactical skill the Royal Air Force has retained. In the Cold War, Hunter and Canberra, now Jaguar and Tornado offer an important contribution to the measurement of effect through combat assessment to this day. Similar arguments apply to OA; a key skill retained at the tactical level with an operational effect.

[21] Overy's *Why the Allies' Won*, Pimlico, London, 1995 offered as much of a watershed in historical thinking on the bomber offensive, as had the publication of the official histories in the 1960s.

[22] See Barnett, C, *The Lost Victory*, Hodder, London, 1995 Ch12 for a sobering reflection of the seeds of decline already evident in the British aircraft industry in the 1940s despite government backing and a 'vision' in the shape of the Brabazon Report.

[23] See Wynn, H, *RAF Nuclear Deterrent Forces*, AHB, London, 1991 for details of the extent, depth and expense of the British commitment to nuclear forces throughout the 1950s and 1960s.

[24] The Vulcan flew long range, air to air refuelled medium level conventional bombing raids on sovereign British territory in 1982 having prepared for twenty years to deliver nuclear weapons on the Warsaw Pact from low level. Sir Michael Howard's quote on doctrine refers.

[25] Commencing with NATO's rearmament at the time of the Korean War under the original Lisbon force goals, European air forces especially Belgium, Denmark, Germany, Netherlands, Norway became important, almost guaranteed, export markets for US aircraft and weapons.

[26] Throughout the Cold War, the majority of RAF Staff College papers focused upon better, faster, further type issues rather than strategic questions. The creation of the Director Defence Studies (RAF) post by the Chief of the Air staff in 1977 was, in part, an attempt to widen the debate.

[27] The air/land interface between the Royal Air Force in Germany and the British Army of the Rhine offers an excellent

example of mutual understanding. See Peach, S A Continental Commitment; The RAF in Germany 1945 to 1993, RAF Historical Society, 1999.

28 The RAND Corporation published the 'Air/land Battle' in 1985. Drawing upon lessons from Vietnam and USAF global engagement in the Pacific and Korea, it represented a rejection of the UK's low level penetration doctrine in favour of a supported medium level air doctrine.

29 See Hallion, *Storm over Iraq*, Smithsonian, 1992 for details. It was the range of UK capabilities, ability to operate at the operational level and the willingness to engage in offensive operations which marked out a niche in Horner's headquarters.

30 See Horner, C with Clancy T, *Every Man a Tiger*, Pan, London, 1999, P.316.

31 Many claims were made for air power: *The Gulf War Air Power Survey*, Hallion's *Storm over Iraq*, conferences at Maxwell and RUSI in the UK, all when re-examined in 2003 have something of an evangelical tone.

32 See Sims, B, *Unfinest Hour*, Penguin, London, 2001 for a rather depressing polemic on the muddled responses to the unfloding Balkans imbroglio and its effect upon military option planning.

33 See Holbrooke R, *To End a War*, Little Brown, USA, 1999 for acknowledgement of the need to keep diplomacy and high politics in cadence with military operations.

34 M. Knights, *Bombing Iraq: Influence and Decision-Making in the Targeting, Planning and Weaponeering of Modern Air Campaigns.* Unpublished PhD thesis, Kings College London, 2002, Chapter VII, Pp 199-232.

35 See Clark, *Waging Modern War*, BBS, New York, 2001, Part III, for a description of the bureaucracy and time taken in the target clearance process.

36 See, Jumper, J in RAF APR, 2, II, *Air War Kosovo*, for an exposition of the requirement to make the Combined Air Operations Centre part of the warfighting element rather than a headquarters.

37 The effect of sustained UK investment in ISR systems, AAR and mobility through helicopters continued to offer, what in USAF parlance have become known as high value air assets. During operations in Afghanistan in the summer of 2002, a single squadron of Chinooks flew over 1,700 operational flying hours with only one sortie lost to unserviceability.

38 The UK Air Warfare Centre was created from the fusion of the Central Trials and Tactics Organisation and the Electronic Warfare Operational Support Element in 1993. The vision of Air Chief Marshal Sir John Thomson, its mission is integrated mission support. The UK Air Warfare Centre teaches effects-based air operations planning, based upon historical experience and campaign planning.

39 A note of caution and pragmatism: reachback is not a substitute word for command of deployed forces or the need for in-theatre headquarters staff. It is a means of fusing information from many sources into one product to suit the deployed commander. There are two governing dynamics:

sufficient bandwidth and the support of the Theatre Air Commander.

40 Chief Executive QinetiQ speaking at QinetiQ update briefing in 2002.