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Airpower and Effects-Based Operations: Delivering Lethal Strategic Effects

Major Maxime Renaud

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AIRPOWER AND EFFECTS-BASED OPERATIONS: DELIVERING LETHAL STRATEGIC EFFECTS

By Major Maxime Renaud

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ABSTRACT

The subject of Effects-Based Operations (EBO) is controversial, especially within the United States Joint Forces circles. Ever since the advent of airpower, many theorists saw airpower as a revolution to warfare, capable of affecting the enemy's core. Some even argued that airpower alone could win wars. Others, such as United States Marine Corps General Mattis, challenge this position. They believe that the concepts related to EBOs are fundamentally flawed. This paper aims at analyzing elements of airpower that enable an effects-based approach and ultimately determine whether airpower using EBOs can successfully meet national-strategic objectives in a conventional, near-peer conflict. While EBOs are generally regarded as a whole-of-government approach, this study investigates the military element only. When studying Effects-Based Operations, three themes appear: intelligence, technology, and command and control. A system-of-systems approach to intelligence, enabled by empathy and a robust foreign exploitation program, allows an optimal understanding of an enemy's cognitive and physical understanding, supporting Effects-Based Operations. Keeping the technological advantage over an enemy using both kinetic and non-kinetic means allows for the achievement of direct and indirect effects in the cognitive domain forcing an enemy to capitulate. Special Access Programs protect the technological advantage and prevent the enemy from applying an effects-based approach against Western countries. Finally, establishing control of the air, balancing threat and operational tempo when determining aircraft basing, and ensuring all air assets are controlled by a single commander is crucial in fully exploiting the potential of airpower. This study revealed that while airpower can most likely win against a near-peer adversary, it may not be the most efficient use of resources to achieve strategic objectives.

CHAPTER 1 – INTRODUCTION

As the aeroplane is the most mobile weapon we possess, it is destined to become the dominant offensive arm of the future.

-Major General John Frederick Charles Fuller, The Army in My Time

INTRODUCTION

When Orville and Wilbur Wright took flight in the Wright Flyer on 17 December 1903, the military now had one more tool at its disposal. While powered aircraft were first used militarily in 1911 by the Italians against the Turks, it was not until the First World War that their use in a military role became significant. Initially, aircraft were used to directly support ground commanders, providing reconnaissance, and later conducting attacks on enemy forces. In order to counteract enemy aircraft, counter-air tactics were developed, marking the infancy of air-to-air combat. It did not take long for commanders to realize that aircraft not only influenced tactical maneuver warfare but also provided a strategic reach. Indeed, "by the late stages of the war, ground-attack aircraft had forced almost all large-scale troop movements to be carried out at night or in bad weather."[1] Commanders also realized that not only could aircraft have an impact on troop movements, but they could also conduct air attacks deep into enemy territory. While this role was "never effectively implemented in World War I," it became an essential element of airpower during the Second World War.[2]

Giulio Douhet, an Italian airpower theorist, postulated between the great wars that taking command of the air means victory.[3] Airpower can strike far behind the line of

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[1] The New Encyclopaedia Britannica, 15th ed., s.v. "Air Warfare."

[2] The New Encyclopaedia Britannica, 15th ed., s.v. "Air Warfare;" The New Encyclopaedia Britannica, 15th ed., s.v. "Strategic Bombing."

[3] Giulio Douhet, *The Command of the Air*, trans. by Dino Ferrari, ed. by Joseph Patrick Harahan and Richard H. Kohn (Tuscaloosa: University of Alabama Press, 2009), 28.

contact between fighting foes, targeting the will of nations. During the Second World War, Douhet's concept of strategic bombing was developed and used to its full potential. The Allies struck targets deep into Germany, destroying vital links such as "electric power, rail transportation, fuel, steel, and armament and munitions factories."[4] The destruction of those targets was meant to collapse the German warfighting capacity and the country's will to fight. The Second World War was the catalyst for a revolution in the usage of airpower. The concepts developed during the Second World War were used by the West in virtually every war since, with varying degrees of success.

On one end of the spectrum, strategic airpower during the Vietnam War failed to bring North Vietnam to its knees. On the opposite end, Instant Thunder, a strategic bombing plan developed by Colonel John Warden used during Operation Desert Storm, indeed demonstrated airpower's capability to hit an enemy's capacity to wage war and shape the battlefield for an eventual ground forces attack. Later, in 1999, the North Atlantic Treaty Organization successfully met its objective to "put an end to the human rights abuses that were then being perpetrated against the ethnic Albanian population in Kosovo" with airpower alone.[5]

These successes bolstered airpower proponents. Some, such as Warden, suggested that "airpower [is] the American form of war."[6] Warden's airpower theories gave rise to a more critical role for airpower in military operations and a new form of campaign planning that revolves around effects rather than attrition. The term "effects-based

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[4] Gian P. Gentile, *How Effective is Strategic Bombing?: Lessons Learned from World War II to Kosovo* (New York: New York University Press, 2001), 18.

[5] Benjamin S. Lambeth, *Operation Allied Force: Lessons for the Future* (Santa Monica, CA: RAND, 2001). https://www.rand.org/pubs/research_briefs/RB75.html.

[6] John Andreas Olsen, *John Warden and the Renaissance of American Air Power* (Washington, D.C: Potomac Books, 2011), 240.

operations" was born and was eventually implemented into United States military doctrine. These concepts are often met by fervent critics. General Jim Mattis, former commander of the United States Joint Force Command, was opposed to the concept of effects-based operations. In 2008, in a guidance letter he issued to his staff, he ordered that the "[United States Joint Forces Command] will no longer use, sponsor, or export the terms and concepts related to [effects-based operations], [operational net assessment], and [system-of-systems analysis] in our training, doctrine development, and support of [Joint Professional Military Education]."[7] Clearly, the issue is both divisive and worthy of investigation. Can airpower alone, using effects-based operations, successfully meet national-strategic objectives in a conventional, near-peer conflict? This paper will aim to answer that question while investigating conditions that would minimize the use of forces unrelated to airpower. Within the context of effects-based operations, this paper will first provide some key definitions for airpower and effects-based operations, followed by investigations of intelligence and technological elements enabling airpower. A discussion of command and control will follow, and the paper will finish with two case studies, one of the Kosovo War and one of the 2006 Lebanon War, using the elements uncovered. Before we can discuss airpower intelligently, it is essential to define it.

DEFINING AIRPOWER

History

Mitchell defined airpower in 1925 as "the ability to do something in the air."[8] This definition is too broad and is not useful in the analysis of operational warfare. Chief

[7] James N. Mattis, "USJFCOM Commander's Guidance for Effects-Based Operations," *Parameters* 38, no. 3 (2008): 23.

[8] Air Power Development Center, "Defining Air Power: Part I. Evolution of the Term," *Pathfinder* 133 (May 2010): 3.

Marshall John Slessor, the then Commandant of the United Kingdom Imperial Defence College, postulated, in 1949, that airpower is "not only air forces themselves."[9] Instead, he proposed a more encompassing definition: "[Airpower] is a compound of air forces and all those things on which air forces directly or indirectly depend," a definition that was influenced by the crucial role airpower played in the outcome of the Second World War.[10] The importance of airpower was also felt across the Atlantic Ocean as the United States Army Air Force defined it as "the total ability of a nation to fly, to act through the air space, to use controlled flight."[11] Airpower was viewed more and more as a strategic tool. Immediately after the war, General Henry Arnold, then General of the U.S. Army, said, "air power includes a nation's ability to deliver cargo, people, destructive missiles and war-making potential through the air to a desired destination to accomplish a desired purpose."[12] The Second World War had a profound effect on the modern definitions of airpower. It introduced joint concepts and airpower's ability to affect strategic and political objectives.

Modern Definitions

After the Second World War and into the post-Vietnam era, much debate occurred on what constitutes airpower both in its literal sense and in practice. The Commonwealth countries' air forces put a significant amount of effort into narrowing their definition of airpower. Some key questions revolved around the inclusion of other

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[9] John Slessor, "The Past Development of Air Power," *Journal of the Royal United Service Institution* 94, no. 574 (1949): 223.

[10] *Ibid*; Air Power Development Center, "Defining Air Power: Part I. Evolution of the Term," *Pathfinder* 133 (May 2010): 3.

[11] Eugene Morlock Emme, *The Impact of Air Power: National Security and World Politic* (Princeton, N.J: Van Nostrand, 1959), 130.

[12] Air Power Development Center, "Defining Air Power: Part I. Evolution of the Term," *Pathfinder* 133 (May 2010): 3.

domains, such as space, in the definition. The Royal Australian Air Force (RAAF) eventually defined airpower as "[t]he ability of a nation to assert its will by projecting military power in, through and from the air domain."[13] While this definition acknowledges airpower's strategic nature, it fails to integrate the space domain, limiting itself exclusively to the air domain. Instead, the RAAF defined space power separately as "[t]he total strength of a nation's capability to conduct and influence activities to, in, through and from space to achieve its objectives."[14] The distinction between air and space in RAAF doctrine may be due to space operations' complexity and the relative difficulty a small service, like the RAAF, could have operating in the space domain.[15] The Royal Air Force echoes' the RAAF's sentiments and defines air and space power separately.[16] In contrast, the Royal Canadian Air Force leaves the space domain entirely out of its doctrine manual and defines airpower as "[t]he element of military power that is applied within or from the air operating environment to create effects above, on or below the surface of the Earth."[17]

The only five-eyes partner to include other domains in its definition of airpower is the United States Air Force (USAF). It currently defines airpower as "the ability to project military power or influence through the control and exploitation of air, space, and cyberspace to achieve strategic, operational, or tactical objectives."[18] This definition is

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[13] Royal Australian Air Force, *The Air Power Manual,* AAP 1000–D (Tuggeranong: Airpower Development Centre, 2013), 215.

[14] *Ibid*, 123.

[15] Air Power Development Center, "Defining Air Power: Part II. Consideration for a New Definition," *Pathfinder* 133 (May 2010): 8.

[16] Ministry of Defense, *UK Air and Space Power*, JDP 0-30 (Shrivenham: Development, Concepts and Doctrine Centre, July 2013), 121.

[17] Department of National Defence, *Royal Canadian Air Force Doctrine*, B-GA-400-000/FP-001 (Ottawa: National Defence, 2016), 51.

[18] Air Force, *Air Force Basic Doctrine*, Volume 1 (Washington, D.C.: Department of the Air Force, 2013), 25.

joint and all-inclusive and takes into consideration the capabilities of any air vehicle. This definition will be used throughout this paper. This means that air vehicles from all services and their weapons, ballistic missiles, cruise missiles, surface-to-air missiles and their launch network, satellites, offensive cyber capabilities, and electronic support measures are included in this definition. Also included are force protection elements required to protect airpower employers. For example, a carrier task group protecting an aircraft carrier would be considered part of airpower in this definition. Now that airpower is defined, it is equally vital to define how it will be used.

DEFINING EFFECT-BASED OPERATIONS

How airpower is used has been, and still is, very controversial. How airpower was first integrated into military operations and how it evolved thereafter is perhaps at the center of the debate. During the First World War, airpower's role was to support ground troops directly.[19] While the Royal Air Force was created immediately after the First World War, in 1918, U.S. airmen were part of the U.S. Army Air Service and, later, the U.S. Army Air Forces until 1947. This influenced an army-centric vision of airpower in that airpower "provide[s] interdiction and direct battlefield air support of ground forces."[20] The U.S. Marine Corps (USMC) shares this vision as its "construct of combat units is based on the Marine Air Ground Task Force (MAGTF) where an aviation element is tasked to provide support to ground forces."[21] This vision, which was still present in the AirLand Battle doctrine published in the mid-1980s, prevented an

[19] Jeanne M. Holm Center, *Air power through WW1*, (Washington, D.C.: Air University Press, 2020), 10.

[20] Merrick E. Krause, "Airpower in Modern War," *Air & Space Power Journal* 29, no. 3 (2015), 44.

[21] Michael H. Johnson, "Cleared to Engage: Improving Joint Close Air Support Effectiveness" (Air Command and Staff College Course Paper, Air University, 2008), 4.

unrestricted use of airpower's capability in support of strategic objectives. In other words, the U.S. Army and the U.S. Marine Corps see ground-manoeuver warfare as the only effective means of waging war.

Clausewitz, an influential operational art theorist, postulated in the 1800s that "[i]t is possible to increase the likelihood of success without defeating the enemy's forces," referring to "operations that have direct political repercussions …."[22] The U.S. Army and USMC's positions on the use of airpower are strictly against Clausewitz's widely accepted theory. Shortly after its first use during the First World War, it became increasingly clear that, given its attributes of speed and reach, airpower could have repercussions on an enemy's political system. Early airpower theorists argued "that airpower could prevent wars of attrition—killing one another piecemeal. They believed that air warfare could reduce casualties and spare nations from wars of annihilation."[23] This belief was solidified during the Second World War when both sides used airpower to strategic ends. The allies conducted a strategic bombing campaign over Germany. Allied bombers employed weapons on German infrastructure to reduce the nation's will and capability to wage war.[24] Similarly, the Germans used their so-called vengeance weapon, the V-2 rockets, on British cities, aimed at decreasing the nation's morale. Whether or not the means employed by both sides achieved their strategic goals is debatable. However, the notion of airpower providing national-strategic effects was taking roots in military doctrine. It was not until the Gulf War that effects-based

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[22] Carl von Clausewitz, *On War*, ed. and trans. J. J. Graham and F. N. Maude (Jersey City, N.J.: Start Publishing LLC, 2013), 92.

[23] Merrick E. Krause, "Airpower in Modern War," *Air & Space Power Journal* 29, no. 3 (2015), 42.

[24] Tami Davis Biddle, "British and American Approaches to Strategic Bombing: Their Origins and Implementation in the World War II Combined Bomber Offensive," *Journal of Strategic Studies* 18, no. 1 (1995): 125.

operations became widely accepted. John Warden, the U.S. strategist that designed the Gulf War air campaign, used a theoretical five-ring model to select targets coalition airpower was to strike first. The plan to attack strategic targets with airpower before a limited ground attack was counter to the American AirLand Battle doctrine and contingency plans in place. His plan was, however, widely accepted throughout Washington and the forces involved in the Gulf War.[25] After the Gulf War, the term Effects-Based Operations (EBO) became more and more prominent and, in 2001, the concept became the "'centerpiece' for [the U.S. Air Force's] input to the Quadrennial Defense Review of 2001."[26] While General Mattis vehemently opposed this concept in 2008, it remains part of the military lexicon, particularly within airpower circles. This paper will analyze the capability of airpower through the lens of EBO. While the concepts underlying EBO originated from the West, they are not exclusive to the Western world. Chapter two will discuss Warden's theory in more detail.

The Western view

The first official appearance of Effects-Based Operations terminology in a U.S. Air Force (USAF) document is in a 2001 RAND corporation report prepared for the Secretary of Defense and the USAF. The report, titled *Effects-Based Operations*, defines EBO as "operations conceived and planned in a systems framework that considers the full range of direct, indirect, and cascading effects, which may … be achieved by the application of military, diplomatic, psychological, and economic instruments."[27] The U.S.

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[25] Norman H. Schwarzkopf, and Peter Petre, *It Doesn't Take a Hero: General H. Norman Schwarzkopf, The Autobiography* (New York: Bantam Books, 1992), 390.

[26] Charles M. Kyle, "RMA to ONA: The Saga of an Effects-based Operation" (United States Army Command and General Staff College Course Paper, US Army School of Advanced Military Studies, 2008), ii.

[27] Paul K. Davis, *Effects-Based Operations: A Grand Challenge for the Analytical Community*, MR-1477 (Santa Monica, CA: RAND, 2001), 7.

Joint Force Command (USJFCOM) defined, shortly thereafter, EBO as "a process for obtaining a desired strategic outcome or effect … on the enemy through the synergistic and accumulative application of military and non-military capabilities at all levels of conflict."[28]

The concept of EBO "spawned numerous, interchangeable terms, such as 'effects-based planning,' 'effects-based thinking,' 'effects-based operations,' 'effects-based approach,' or 'effects-based approach to operations.'"[29] This explosion of terminology created confusion and ambiguity on what EBO actually is. This led to General Mattis, in 2008, then commander of the USJFCOM, directing the removal of all references to EBO within USJFCOM's doctrine.[30] While the terms *effects-based operations* are indeed absent from recent joint doctrine, the concepts related to EBO are still presented in USJFCOM's doctrine.[31] Specifically, the USJFCOM's capstone doctrine document mentions that "coercion generates effects through the application of force (to include the threat of force) to compel an adversary or prevent our being compelled."[32] It is further acknowledged that force may be applied without physical destruction.[33] Even without directly referencing EBO, the wording within United States (U.S.) Joint Doctrine represents an implicit approval of the concept.

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[28] Department of Defence, *A Concept Framework for Joint Experimentation: Effects-based Operations* (Washington, D.C.: Joint Force Command, 2001), ii.

[29] Jason W. Evenson, "Assessing USJFCOM's Role on Joint Doctrine Development – An EBO Case Study" (United States Naval War College Course Paper, US Naval War College, 2009), 7.

[30] James N. Mattis, "USJFCOM Commander's Guidance for Effects-Based Operations," *Parameters* 38, no. 3 (2008): 23.

[31] Jason W. Evenson, "Assessing USJFCOM's Role on Joint Doctrine Development – An EBO Case Study" (United States Naval War College Course Paper, US Naval War College, 2009), 16.

[32] Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, JP 1 (Washington, D.C.: Joint Chiefs of Staff, 201), I-13.

[33] *Ibid*, I-18.

The concept of EBO is contentious. It is, however, well suited for airpower, "[g]iven that the entire Air Force planning model is focused on targeting, and for the most part on physical systems …."[34] The USAF doctrine Annex 3-0 mentions, "[t]he Air Force designs, plans, conducts, and assesses operations according to an effects-based approach."[35] It also defines the effects-based approach to operations (EBAO) as "an approach in which operations are planned, executed, assessed, and adapted to influence or change systems or capabilities in order to achieve desired outcomes," emphasizing that an effects-based approach is a way of thinking rather than a process.[36] While the definition itself lacks the whole-of-government approach from the 2001 RAND definition, Annex 3-0 clarifies that "EBAO entails the conscious integration of all the [instruments of national power], leveraging the capabilities of the U.S. Departments of State, Commerce, and Homeland Security, among others, to complement military operations."[37] This approach is consistent with U.S. allies such as the RAAF, which embrace a National Effects-Based Approach.[38] While the RAF and the RCAF do not specifically mention EBO within their respective doctrines, the concepts related to EBO are clearly relayed within them.[39]

Western militaries view EBO as controversial. However, it is well anchored within most western air forces' doctrine. The West's approach to EBO focuses on all

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[34] Allan D. English and Howard Coombs, *Effects-Based Approaches to Operations: Canadian Perspectives* (Ottawa: Canadian Forces Aerospace Warfare Centre, 2008), 102.

[35] Air Force, *Operations and Planning*, Annex 3-0 (Washington, D.C.: Department of the Air Force, 2017), 13.

[36] *Ibid*.

[37] *Ibid*, 14.

[38] Royal Australian Air Force, *The Air Power Manual,* AAP 1000–D (Tuggeranong: Airpower Development Centre, 2013), 57.

[39] Department of National Defence, *Royal Canadian Air Force Doctrine*, B-GA-400-000/FP-001 (Ottawa: National Defence, 2016), 23; Ministry of Defense, *UK Air and Space Power*, JDP 0-30 (Shrivenham: Development, Concepts and Doctrine Centre, July 2013), 36.

effects, kinetic and non-kinetic, and does not focus on any particular capability. It is also a whole-of-government approach, or "a unified effort between inter-governmental agencies to maximize all available resources in a collaborative effort."[40] In other words, it uses the most efficient tools for the job without consideration for traditional areas of employment.

The Chinese view

Chinese doctrine does not mention effect-based operations or derivative terms. Still, the way the Gulf War was fought had a profound influence on Chinese doctrine. Jiang Zemin, the Chinese Chairman of the Central Military Commission, "observed [United States] operations in the first Gulf War and assessed that 'networked' precision strike capabilities represented a 'revolution in military affairs….'"[41] Until the 2000s, China's central leadership focused on the strategy of mass mobilization of forces.[42] Starting in the 2000s, influenced by the Gulf War, China started to emphasize "qualities of 'high technology' and educated, skilled personnel rather than the mobilization of poorly educated rural conscripts."[43] Furthermore, China recently adopted an "'overall' and 'holistic' security concept" that includes all domains, such as the "political, economic, and military … territorial, cultural, social, scientific and technological, informational, ecological, financial and nuclear domains."[44] While these concepts remain at the political-strategic level, this whole-of-government approach is typical of EBO.

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[40] Jason L. Percy Jr and Terry A. Fellows, "A Whole of Government Approach for National Security," Master of Business Administration Thesis, Naval Post-Graduate Studies, 2008.

[41] Edmund J. Burke et al, *People's Liberation Army Operational Concepts* (Santa Monica, CA: RAND, 2020), 4.

[42] Joe McReynolds, *China's Evolving Military Strategy* (Washington, D.C: Jamestown Foundation, 2016), 20.

[43] *Ibid*.

[44] Timothy R. Heath, Kristen Gunness and Cortez A. Cooper, *The PLA and China's Rejuvenation* (Santa Monica, CA: RAND, 2016), 10.

Elements of Effects-based Operations are also present at the operational level. A People's Liberation Army analyst noted, in the Science of Military Strategy 2001, "in past wars, air offensives were carried out primarily in 'coordination' with strategic offensive actions by the other services, particularly the Army."[45] The author also noted that with the "'high-tech conditions' that now dominate warfare, there are additional incentives for China to employ the [People's Liberation Army Air Force] for 'independent strategic offensive' operations."[46] It is envisioned that the People's Liberation Army Air Force would create strategic effects, such as "cutting off external connections of the enemy."[47] This stance is supported by Mingda Qui, a research associate at the Center for Strategic and International Studies. He postulates that "[w]ars under the informatized conditions are no longer purely confrontations of ... armed forces. They are more of confrontations of the whole systems; each country has in political, economic, social, legal and of course, military aspects."[48] This approach is very close to the EBO approach defined by the West, albeit with a different name. In China, the concept has been coined *system confrontation* (体系对抗), emphasizing the destructions of "centers of gravity in enemy systems, including leadership institutions, command and control centers, and information hubs."[49] While the term Effects-Based Operations is not

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[45] Joe McReynolds, *China's Evolving Military Strategy* (Washington, D.C: Jamestown Foundation, 2016), 79.

[46] *Ibid*.

[47] People's Liberation Army, *Science of military Strategy*, ed. and trans. Guangqian Peng and Yao Youzhi (Beijing: Academy of Military Sciences Press, 2001), 302.

[48] Mingda Qiu, *China's Science of Military Strategy: Cross-Domain Concepts in the 2013 Edition*, (San Diego, CA: Cross-Domain Deterrence, 2015), 7.

[49] People's Liberation Army, *Science of military Strategy*, ed. and trans. Shou Xiaosong (Beijing: Academy of Military Sciences Press, 2013), 118.

in the Chinese lexicon, the concepts related to EBO are clearly embedded within Chinese doctrine.

The Russian view

Similar to Chinese doctrine, the term Effects-Based Operations is absent from Russian doctrine. However, the concepts related to EBO are also embedded within Russian doctrine, especially Soviet and Russian Air Forces doctrine. After the Second World War, the main focus of the Soviet and Russian Air Force (VVS) was to support the Soviet and Russian Army.[50] In fact, the tactical air force (FA) units were often subordinated to ground commanders; "Ground Forces were in charge of air force units."[51] In 1988, FA units were brought back under VVS command.[52] Given the very centralized Soviet command and control structure, they designed tactical assets exclusively for tactical use, preventing them from being effective in the strategic realm. Today, besides Unmanned Aerial Vehicles, all Russian Army aircraft belong to the VVS, fulfiling "[its] views on modern use of air power."[53] Similar to Chinese doctrine, Russian doctrine was influenced by Western air campaigns, notably the Gulf War and the Kosovo War. VVS leadership realized that "[u]sing PGMs, the air component shelled vital targets in the rear of the … opponent."[54] This marked, for Russia, the beginning of using tactical effects to meet strategic objectives. Only months after the end of the Kosovo air campaign, the VVS used the same concepts during the Chechen conflict.[55] The success of Western nations in the application of what became known as effects-based operations had its

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[50] Marcel de Haas, *Russian Security and Air Power, 1992-2002*, Vol. 9 (London: Routledge, 2004), 121.
[51] *Ibid*.
[52] *Ibid*, 122.
[53] *Ibid*, 112, 123.
[54] *Ibid*, 124.
[55] *Ibid*.

impact: "the leadership of VVS recognized the broader use of air power and a role for air power independent of ground operations."[56]

This capacity for a service to directly influence strategic objectives through tactical means eventually permeated to other services. The Russian Army still banks on "concentrated use of artillery and rocket artillery, along with large tank units."[57] However, it is "prioritizing the development of reconnaissance and targeted strike capabilities to increase the accuracy of its artillery and improve the military's capacity to impose costs and target an adversary's command and control."[58] Russian doctrine is more and more focused on "integrated defenses (especially aerospace defense forces) that treat the enemy as a system."[59] In more recent years, that concept made its way to the political level and led to what is known as *hybrid warfare*.

The Russian military defines hybrid warfare as "a strategic-level effort to shape the governance and geostrategic orientation of a target state …."[60] It is a whole-of-government approach, similar to the Chinese and Western views, but the Russian approach focuses on information warfare, so much that "conventional military forces … are subordinate to an information campaign."[61] Such an approach allows Russia to achieve its national objectives with minimal operational risks: military forces are not always required to achieve strategic objectives. The Russian focus is less on means and more on ends.[62]

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[56] *Ibid*.
[57] Library of Congress, *Russian Armed Forces: Military Doctrine and Strategy* (Washington, D.C.: U.S. Government Printing Office, 2020), 2.
[58] *Ibid*.
[59] *Ibid*.
[60] Mason Clarke, *Russian Hybrid Warfare* (Washington, D.C.: Institute for the Study of War, 2020), 8.
[61] *Ibid*, 8, 10.
[62] *Ibid*, 13.

The focus of the West, China, and Russia vis-à-vis the concepts related to effects-based operations are very different. The West focuses more on capabilities, or the means, China focuses on the enemy systems, or targets, and Russia focuses on the effects or ends. However, there are similarities, such as the use of a whole-of-government approach. Also, the Gulf War made the West, China, and Russia realize that tactical means can have direct strategic effects on enemy systems. For this paper, the definition of Effects-Based Operations is simple: the focus on effects rather than the means, at all levels of warfare, to ultimately influence an enemy's national-strategic response with the objective to remove its will or capacity to fight. While it is recognized that EBO is a whole-of-government concept, this paper will only consider the military contribution to EBO. This definition will be used in conjunction with the provided definition of airpower to analyze the factors that would enable airpower to be decisive in a conflict against a near-peer adversary.

CHAPTER 2 – INTELLIGENCE

INTRODUCTION

To shape an enemy's national-strategic response, it is crucial to understand the factors that affect its response to certain stimuli. The responsibility for understanding an enemy both from a technical and a human point of view rests on the shoulders of the intelligence enterprise. In the U.S. Joint Intelligence doctrine, this responsibility is called "describing the operating environment."[63] To that end, the USAF uses a methodology called the Joint Intelligence Preparation of the Operational Environment (JIPOE), which serves as an "enabler for commanders to leverage or support the full range of instruments of national power…."[64] One of the products the intelligence community provides is a dynamic threat assessment that "identifies enemy or adversary capabilities and intentions for top-priority plans."[65] The U.S. doctrine clearly indicates that both the technical aspect (capabilities) and human aspect (intentions) need to be part of the intelligence assessment.

To be able to apply the principles successfully in effects-based operations, it is crucial to see the enemy as a system with interdependencies. Indeed, the RAND corporation defined EBO itself as "conceived and planned in a systems framework…."[66] However, intelligence is "notoriously unreliable" as there were many intelligence failures over the past 60 years.[67] What does the intelligence community need to do and improve

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[63] Joint Chiefs of Staff, *Joint Intelligence*, JP 2-0 (Washington, D.C.: Joint Chiefs of Staff, 2013), I-3.

[64] Air Force, *Global Integrated ISR Operations*, Annex 2-0 (Washington, D.C.: Department of the Air Force, 2017), 14.

[65] Joint Chiefs of Staff, *Joint and National Intelligence Support to Military Operations*, JP 2-01 (Washington, D.C.: Joint Chiefs of Staff, 2017), III-5.

[66] Paul K. Davis, *Effects-Based Operations: A Grand Challenge for the Analytical Community*, MR-1477 (Santa Monica, CA: RAND, 2001), xiii.

[67] *Ibid*, 22.

to enable airpower to conduct EBO? There are three things that the intelligence community not only needs to embrace but also master: system analysis, foreign material exploitation, and empathy.

SYSTEM OF SYSTEMS

Colonel John Warden, a modern airpower theorist, was the first to propose considering the enemy as a system. This approach was the basis for the design of *Instant Thunder*, which was the foundation of the Gulf War strategic air campaign. He suggested that military strategists must "focus on the totality of [the] enemy, then on [the] objectives, and next on what must happen to the enemy before [the] objectives become his objectives." [68] This top-down, deductive approach "gives us a much better chance of forcing or inducing [an enemy] to make our objectives his objectives and doing so with minimum effort and the maximum chance of success."[69] Warden developed a five-ring model, a simplified model describing the main five layers that make up an enemy system.

The rings are concentric, with the most influential and vital in the middle and the least influential as the outer ring. As shown in Figure 2-1, from the center to the edge of the five rings are leadership, organic essentials (such as energy and economy), infrastructure, population, and fielded military forces.[70] Each ring contains multiple sub-systems. Warden uses the analogy of a human body to describe each of the ring's functions: brain, food and oxygen, vessels, bones and muscles, cells, and finally, leukocytes.[71] Removing the brain from the body renders it dead. Similarly, removing leadership from an enemy renders it incapable of waging war. Given its reach, airpower,

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[68] John A. Warden III, "The Enemy as a System," *Airpower Research Institute* 9, no. 2 (1995): 42.
[69] *Ibid*.
[70] *Ibid*, 47.
[71] *Ibid*, 44.

as opposed to land or naval power, has the capability to affect every ring. While direct effects can be directed against any rings, there will be second and third-order effects to other rings. For example, the direct effect of disabling all power stations in a country may also have a second-order effect of causing the population to revolt against its leadership, which could lead to a third-order effect of the national leadership to step down from power. This extreme and straightforward example highlights the criticality of understanding the interdependencies between the different rings and sub-systems. Those interdependencies can have a technical nature or human nature. In other words, it is crucial to understand the enemy both technically and cognitively. Only when those interdependencies are understood can the most efficient and effective means of attacking the enemy, always with the goal of removing its will or capacity to fight, can be determined.

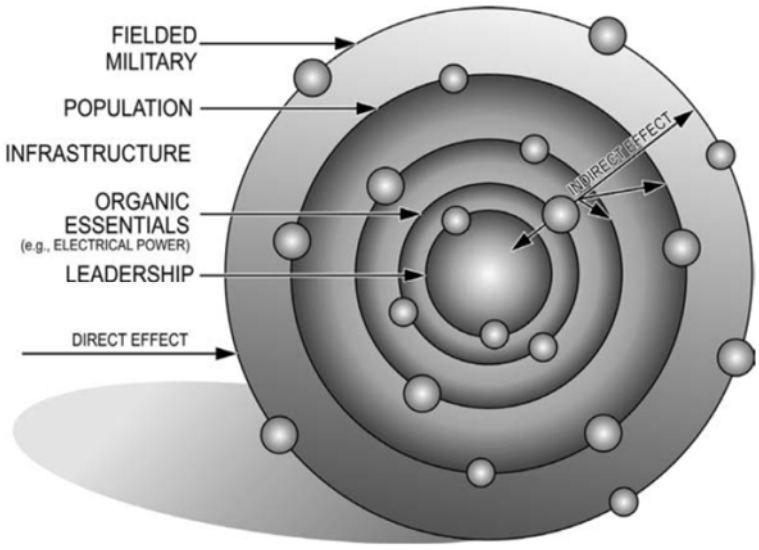

Figure 2-1 – Warden's Five-Ring Model
Source: Clayton K. S. Chun, "John Warden's Five Ring Model and the Indirect Approach to War," in *U.S. Army War College Guide to National Security Issues. Volume 1. Theory of War and Strategy*, 4th ed. (Washington, DC: U.S. Government Printing Office, 2012), 315, figure 1.

The Gulf War

The best-known system-of-system air campaign plan is arguably the Gulf War air campaign. It was the first time that Warden's theory was both planned for and, eventually, put to the test. Despite being "leery of Warden, who was from the Curtis Lemay school of Air Force planners – guys who think strategic bombing can do it all…," General Norman Schwarzkopf, an armoured officer and the coalition commander for Desert Storm, appreciated his plan and used it as a basis for the first two phases of the war.[72] The basis for effects-based operation, a system-of-systems approach, was accepted.

One of the best examples of the system-of-systems approach is how the Iraqi Integrated Air Defense System (IADS) was attacked during the Gulf War. At the time, Iraq possessed one of the most capable IADS, consisting of 3,700 Surface-to-Air Missiles (SAM), 7,000 Anti-Aircraft Artillery (AAA) pieces, close to 600 fighter aircraft, and "hundreds of search radars controlled by an interlocking chain of hardened operations centers directed from a single facility in Baghdad. "[73] It was obviously not possible to destroy every single SAM, AAA, and aircraft. Another approach was to be employed in order to gain control of the air. The coalition used many different capabilities and effects to silence the Iraqi IADS, which required a keen understanding of how it was structured. First, understanding that Iraqi IADS could not detect stealth aircraft, the Air Defense Operations Center, the heart of the Iraqi IADS located in Baghdad, was hit by F-117s in the war's opening stroke. This was in parallel with other aircraft hitting operations centers and the Iraqi power generation capability, disabling Kari, Iraq's Command, Control, and

[72] Norman H. Schwarzkopf, and Peter Petre, It Doesn't Take a Hero: General H. Norman Schwarzkopf, The Autobiography (New York: Bantam Books, 1992), 348, 350.

[73] Richard G, Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq* (Washington, D.C.: Air Force History Office, 2002).

Communication system. Furthermore, understanding the Iraqis did not have the capabilities to identify the type of aircraft on their radar, the coalition used decoys to lure SAM operators into turning their fire control radars on and firing their SAMs.[74] This tactic allowed aircraft carrying anti-radiation missiles to fire their missiles at radiating targets rather than at non-radiating targets, improving their probability of kill significantly while minimizing the risk to aircraft and aircrew, and reducing the number of weapons required. This comprehension of Iraq's IADS allowed an economy of effort, using an optimal number of weapons to achieve control of the air. In the end, air superiority was attained within two days with minimal casualties.[75] Four days into the war and until the end of the war, SAM and AAA radar activity ceased entirely in Iraq, and only early warning radar activity was detected.[76] The cessation of IADS activity and, by extension, the achievement of control of the air did not happen because the coalition destroyed the totality of Iraqi's field IADS. It occurred because the coalition delivered direct and indirect effects to critical nodes of the IADS, which required a deep understanding of the Iraqi Integrated Air Defense System, something the coalition clearly had.

While the intelligence community provided information about potential targets, the system-of-system approach was driven not from the intelligence community but by Warden's Mission Area Analysis team composed mostly of operators. The team that crafted *Instant Thunder* was the one that picked "*hundreds* of major targets."[77] Having

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[74] Tom Clancy and Chuck Horner, *Every Man a Tiger* (New York: Putnam, 1999), 327.
[75] *Ibid*, 329.
[76] *Ibid*, 329.
[77] Norman H. Schwarzkopf, and Peter Petre, It Doesn't Take a Hero: General H. Norman Schwarzkopf, The Autobiography (New York: Bantam Books, 1992), 349.

said this, target development is the responsibility of the intelligence community.[78] System-of-systems terminology is notably absent from U.S. joint intelligence doctrine. In order to enable EBO and airpower, the intelligence community needs to embrace and use the system-of-systems approach suggested by Warden. In order to effectively identify the critical nodes of systems, the intelligence community requires both a human and technical understanding of those systems.

EMPATHY

A typical critique of Effects-Based Operations is its scientific approach, which is challenging to apply to human behaviour. Indeed, English and Coombs, two military historians working with the Royal Military College of Canada, mention that in "the realm of decision-making, not only by military commanders but also by populations and whole societies, the causal effects of actions are far less clear. Those causal linkages disappear completely in the moral domain…."[79] This sentiment is echoed by General Mattis, who thinks that "predicting, and then assessing, how physical actions cause behavioral effects [is] a significant challenge."[80] Those observations are possibly accurate for the Western world as we have not embraced nor institutionalized emotional intelligence into our doctrine yet.

Russia's actions in the 2016 United States election have demonstrated that Russia could affect the decision-making that the U.S. electorate and political circles, and understood the causal linkages between an action and its effects. Russian President Putin

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[78] Joint Chiefs of Staff, *Joint Intelligence*, JP 2-0 (Washington, D.C.: Joint Chiefs of Staff, 2013), I-4.

[79] Allan D. English and Howard Coombs, *Effects-Based Approaches to Operations: Canadian Perspectives* (Ottawa: Canadian Forces Aerospace Warfare Centre, 2008), 102.

[80] James N. Mattis, "USJFCOM Commander's Guidance for Effects-Based Operations," *Parameters* 38, no. 3 (2008): 23.

"ordered an influence campaign … aimed at the U.S. presidential election."[81] Its goals were clear: Russia wanted to "undermine public faith in the U.S. democratic process, denigrate Secretary Clinton, and harm her electability and potential presidency."[82] The operation was planned and conducted by Russia's Internet Research Agency (IRA). The operation, a cyber-influence operation, was unprecedented in its scope; it included, across Twitter, Instagram, and Facebook, approximately 4,000 false accounts, with 147 million people engaged by those accounts resulting in more than 335 million engagements.[83] The operation started well before the election campaign started. Indeed, in 2014, Russian operatives started gathering intelligence on the American political system.[84] The Russian operatives sought to understand the U.S. political system and the population's behaviours. The intelligence they gathered allowed the IRA to develop a campaign plan supporting Russia's national objectives. During the 2016 campaign, the IRA conducted voter suppression operations, fostered secessionist sentiment within the U.S. populace, promoted President Trump while discrediting Secretary Clinton.[85] The operation was very successful from a Russian point of view. Hilary Clinton was not and will never be elected, and the 2020 U.S. Presidential elections showed that faith in the U.S. democratic process is still very much fragile and is likely worse than it was in 2016. The Russians understood the American political system and its key actors. A political system is not a

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[81] Congress, *Assessing Russian Activities and Intentions in Recent U.S. Elections* (Washington, D.C.: Congressional Publications, 2018), ii.

[82] *Ibid*.

[83] Renee DiResta et Al, *The Tactics & Tropes of the Internet Research Agency* (Austin, TX: New Knowledge, 2018), 7, 18.

[84] United States v Internet Research Agency et al, 18 U.S.C. §§ 2, 371, 1349, 1028A.

[85] Renee DiResta et Al, *The Tactics & Tropes of the Internet Research Agency* (Austin, TX: New Knowledge, 2018), 8, 9.

physical system with mechanical causal effects: it is based on people and their behaviour. In order to understand how it works and how to shape it, empathy is required.

In simple terms, empathy is the ability for someone to put themselves in another's shoes and is a "key feature of emotional intelligence."[86] It is often associated with positive behaviours and not necessarily warfare. However, this concept applied in warfare is not new. Between 2007 and 2014, the U.S. Army operated the Humain Terrain System (HTS). The HTS employed personnel from social sciences disciplines, such as anthropology, sociology, and political science. The goal of HTS was to "conduct social science research about the local population to provide situational awareness to the military and enable culturally astute decision-making, enhance operational effectiveness, and preserve and share socio-cultural institutional knowledge."[87] U.S. officers close to the program serving in Afghanistan thought it "[helped] them see the situation from an Afghan perspective."[88] The program ended when the Iraq and Afghan wars were winding down in 2014, under the premise that HTS was no longer required.[89] This was a mistake. Using emotional intelligence to gather information is a long game. An organization needs to study a population and individuals for an extended period to understand the patterns and the factors that affect them. While the concept of social and cultural intelligence (SOCINT) is present in North Atlantic Treaty Organization (NATO) and Canadian Armed Forces (CAF) joint doctrine, it is not well defined nor emphasized. Rather than

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[86] Flora Ioannido and Vaya Konstantikaki, "Empathy and Emotional Intelligence: What is it really about?" *International Journal of Caring Sciences* 1, no. 3 (2008): 118, 122.

[87]Montgomery McFate and Steve Fondacaro, "Reflections on the Human Terrain System During the First 4 Years," *Prism 2*, no 4 (2011): 63.

[88] David Rohde, "Army Enlists Anthropology in War Zones," *The New York Times*, 5 October 2007.

[89] Roberto J. Gonzalez, "The Rise and Fall of the Human Terrain System," *Counterpunch*, 29 June 2015. https://www.counterpunch.org/2015/06/29/the-rise-and-fall-of-the-human-terrain-system/.

specially address empathy or a related concept, U.S. doctrine refers to it as a factor of operational intelligence.[90]

Social scientists and psychological profilers should be employed as part of military intelligence units to develop human and population profiles, and critical emotional nodes on potential targets. In essence, social scientists should develop a cognitive target list, analogous to a conventional target list typically developed as part of contingency planning. That way, when war is waged against an adversary, not only are the social and personal systems understood, but airpower, using non-kinetic means, is ready to strike and deliver strategic effects to the inner-core of Warden's rings. This approach is precisely how the Russians interfered with the 2016 U.S. elections. Mattis' criticism should not be of EBO itself; it should be of the absence of concepts related to empathy within U.S. doctrine which prevented intelligence personnel and planners from using EBO to its full potential.

FOREIGN MATERIAL EXPLOITATION PROGRAMS

Empathy on its own is not enough; it cannot improve understanding of technical systems. States and militaries typically tightly control what information can is shared within the realm of open source. For example, the true capabilities of current frontline fighters cannot be found on the internet. Militaries require other means to get technical information. In the U.S. Air Force, the National Air and Space Intelligence Center is the "primary source for foreign air and space threat analysis," and its mission is "to discover and characterize air, space, missile, and cyber threats to enable full-spectrum multi-

[90] Joint Chiefs of Staff, *Joint Intelligence*, JP 2-0 (Washington, D.C.: Joint Chiefs of Staff, 2013), I-25.

domain operations."[91] The U.S. Navy's Farragut Technical Analysis Center, U.S. Army's National Ground Intelligence Center, and the Defense Intelligence Agency's Missile and Space Intelligence Center provide similar technical intelligence capabilities on foreign naval forces capabilities, foreign ground forces capabilities, and foreign weapon systems, respectively.[92] This type of intelligence is formally known as *Scientific and Technical Intelligence* (S&TI). U.S. Navy Captain Thomas Smith, commanding officer of the Naval Surface Warfare Center, said, "[t]echnical exploitation is critical to ensuring that the U.S. Armed Forces maintain a technological advantage against any adversary."[93] It is clear that S&TI is an enabler to operations. While there are many methods for gathering such intelligence, the best way to fully understand a system is to have first-hand experience using the systems themselves.

For many years, the United States has been in the business of procuring potential adversaries' weapons systems for exploitation. These activities are governed under the Foreign Material Exploitation Program (FMEP), and all services contribute. Most of the activities conducted under the auspices of the FMEP are covered under a heavy veil of secrecy and are generally designated Special Access Programs (SAP) and remain classified for at least 25 years.[94] It is, therefore, not easy to find examples within the

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[91] United States Air Force, "National Air and Space Intelligence Center," last accessed 13 January 2021, https://www.nasic.af.mil/About-Us/Fact-Sheets/Article/611841/national-air-and-space-intelligence-center/.

[92] United States Army, "United States Army Intelligence and Security Command," last updated 09 December 2020, https://www.inscom.army.mil/msc/ngic.aspx; United States Air Force, "National Air and Space Intelligence Center," last accessed 13 January 2021, https://www.nasic.af.mil/About-Us/Fact-Sheets/Article/611841/national-air-and-space-intelligence-center/; Defense Intelligence Agency, "Missile & Space Intelligence Center," last accessed 13 January 2021, https://www.dia.mil/About/Organization/MSIC/.

[93] Smith, Thomas B. and Marc Tranchemontagne. "Understanding the Enemy: The Enduring Value of Technical and Forensic Exploitation." Joint Force Quarterly no. 75 (2014): 124.

[94] Army, *Special Access Programs (SAPs) and Sensitive Activities*, AR 380-381, (Washington, D.C.: Department of the Army, 2017), 11; Department of Defense, *Special Access Programs (SAPs) Security Manual: Marking,* 5204.07, Volume 4 (Washington, D.C.: Department of Defense, 2020), 10.

recent past. However, one project, codenamed CONSTANT PEG, was declassified in 2006. Its analysis provides an excellent example of how FMEP can collect technical information on specific tactical systems and still affect Warden's model's inner rings.

Started in 1976, CONSTANT PEG's objective was to covertly obtain Soviet fighter aircraft, derive all their technical specifications, and eventually pit those aircraft against U.S. aircraft, providing American pilots with first-hand experience against their most likely foe. In other words, the program's goal was "to train the Blue Force in the best techniques for a dogfight with the MiG."[95] The program ran through 1988 before being de-activated. Throughout its history, the program acquired and exploited several MiG-17s, MiG-21s and MiG-23s and had 15 total aircraft when the program was disbanded.[96]

When a new aircraft type was acquired, test pilots would first fly the aircraft, figuring out every single technical metric possible, from turn rates, aircraft ceiling, acceleration, the field-of-regard, onboard systems performance, and ergonomics, to name a few. After the aircraft was put through its paces with test pilots, it was handed over to the 4477th Test and Evaluation Squadron, where U.S. Air Force's Fighter Weapon School and U.S. Navy's Top Gun graduates flew the aircraft as part of their primary duties. The program most benefited the U.S. military by exposing regular line fighter pilots to fights against the MiGs flown by 4477th pilots. Aside from giving pilots exposure to the aircraft they were most likely to encounter in a war, the exposure also got rid of the "the

[95] Gaillard R. Peck Jr., *American's Secret MiG Squadron*, (New York, N.Y.: Osprey Publishing, 2012), 126; Blue Force means friendly forces.

[96] *Ibid*, 174.

excitement of first observing an enemy aircraft in an aerial dogfight [that] can turn the almost perfectly trained pilot into a target" otherwise known as buck fever.[97]

Over the life of the program, the 4477th exposed close to 6,000 U.S. Air Force, U.S. Navy, and U.S. Marine Corps pilots to MiGs they would eventually face into combat.[98] On the night of 17 January 1991, during the opening salvo of the Gulf War, many of those pilots were flying the airplanes providing offensive counter-air support to strike packages with strategic targets in Iraq. U.S. Air Force Captain "JB" Kelk, flying an F-15C, was one of those pilots. During his first combat mission, he and his flight mate shot two MiGs down, clearing the way for strike aircraft to destroy strategic targets West of Baghdad. When questioned about the impact CONSTANT PEG made on his ability to shot the MiG down, Captain Kelk said it "[a]dded … confidence and exposed the inherent weaknesses of those platforms. It puts meat on those Intel briefs – nothing like the real thing…," endorsing the program.[99] Also, U.S. Navy Lieutenant-Commander Mark Fox and Lieutenant Nick Mongillo, and U.S. Marine Corps Captain Chuck Magill shot down MiGs during the first day of the war, demonstrating CONSTANT PEG's jointness. Most pilots exposed to CONSTANT PEG involved in shooting MiGs down over Iraq agreed that the program was crucial in the execution of Desert Storm's Air Campaign.[100] On its own, shooting an aircraft down is a tactical feat. However, given the nature of the escort mission, shooting down enemy aircraft allowed strike aircraft to continue to their targets, unimpeded, and deliver strategic effects by taking down command and control nodes and infrastructure, affecting Warden's innermost rings.

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[97] *Ibid*, 42-43.
[98] *Ibid*, 174.
[99] *Ibid*, 272.
[100] *Ibid*, 266-285.

In the end, it is crucial for the intelligence community to provide an *information advantage* over the enemy, or to know more about the enemy than the enemy knows about friendly forces. Intelligence plays a vital role in that function. By using a system-of-system approach, to identify centers of gravity, empathy, to understand both the population and an enemy's leadership and what drives them, and having a reliable foreign material exploitation program, to understand the enemy's technical capabilities, airpower is well set up for success against any military.

CHAPTER 3 – TECHNOLOGY

Airpower has become predominant, both as a deterrent to war, and—in the eventuality of war—as the devastating force to destroy an enemy's potential and fatally undermine his will to wage war.

-General Omar Bradley

INTRODUCTION

Ever since the advent of airpower, it was associated with advanced technology. The mere fact of having objects flying with people onboard affecting the terrain below during the First World War was considered an advanced technology at the time. Fast forward to 1964 when the A-12, a low observable, Mach 3 reconnaissance aircraft, took flight for the first time, to the introduction of the USAF's current stealth air supremacy fighter, the F-22 Raptor, it is difficult to argue that airpower is not driven by technology; technology has always been at the forefront of airpower.[101] In the last 100 years, airpower brought many revolutions in warfare. The same cannot be said for land power and sea power.[102] While the principles of war proposed by Major-General J.F.C. Fuller after the First World War have not changed much since their general acceptance, their application was greatly influenced by the advent of airpower.[103] For example, during the First World War, the mere fact of having aircraft capable of observing enemy troops contributed to offensive operations, manoeuver, economy of effort, and surprise.[104]

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[101] Walter J. Boyne, *The Influence of Air Power upon History*, 2nded. (Barnsley, South Yorkshire: Pen & Sword Books, 2005), 50.

[102] *Ibid*, 16.

[103] John F.C. Fuller, *The Foundation of the science of war* (London: Hutchinson and Company, 1926), 221; Joint Chiefs of Staff, *Joint Operations.* JP 3-0 (Washington, D.C.: Joint Chiefs of Staff, 2018), I-2; Fuller's eight principles of war were: objective, offensive action, surprise, concentration, economy of force, security, mobility and cooperation. The United States Joint Publication 3-0 recognizes the nine principles of war as objective, offensive, mass, maneuver, economy of force, unity of command, security and surprise.

[104] Walter J. Boyne, *The Influence of Air Power upon History*, 2nd ed. (Barnsley, South Yorkshire: Pen & Sword Books, 2005), 50.

It is crucial to understand how technology, whether kinetic or non-kinetic contributes to the principles of war. This chapter will argue, using real-world examples, how technology is crucial to airpower in the context of effects-based operations.

KEEPING THE TECHNOLOGICAL EDGE

How airpower has been used has dramatically evolved and depended much on technology. In its infancy, airpower was mostly viewed and used as an extension of the Army into the third dimension. While early airpower theorists advocated for independent air forces, it was not until after the Second World War, when it became apparent that airpower technology had much more potential than merely supporting ground commanders, that the United States Air Force was formally created. In the post-war era, airpower technology kept improving, introducing supersonic flight, stealth, precision-guided munition, the integration of cyber capabilities, and much more, allowing the airpower to affect the battlefield at the strategic, operational, and tactical levels in most domains.[105]

Technology, however, needs to be used within the context of the systems that need to be affected. It does not necessarily need to be the best technology available: it merely needs to be a technology that will provide the desired effects through the most efficient means possible.

Soft Bombs

During the 1999 Kosovo war, the allies were faced with a challenging ethical problem. As with any modern country, the electrical grids supplying electricity to the Serbian military installation, including their radars and surface-to-air missiles, also

[105] *Ibid*, 339.

supplied power to the civilian population. While it is legal, per the Geneva convention, to destroy dual-use facilities, there are ethical issues with permanently removing power generating facilities.[106] Instead, the allies, using a pragmatic systems-based approach, decided to use so-called soft bombs, the BLU-114/B, to disable the electrical grid.[107] Made of thousands of carbon fiber filaments, the BLU-114/B payload creates shorts on electrical installations, resulting in blackouts. The advantage over conventional weapons is that once the carbon fiber filaments are removed from the electrical system, electricity can be restored within hours to days. Those bombs were used in the Kosovo conflict and resulted in up to 70% of Yugoslavia plunged into darkness. These strikes left the "Yugoslav air defenses, banking and defense computers, and numerous other key national and military institutions" without electrical power, albeit for a limited time.[108] During those power interruptions, Slobodan Milošević, the then Serbian president, had to decide between providing fuel for hospital generators or military capabilities.[109] This hi-tech weapon was purpose-made to attack electrical grids without destroying them. It gave NATO an "off switch" for the Serbian electrical system, which allowed them to control when and where military command and control and other crucial national institutions were deprived of power. With the command and control system out of service, the allies were afforded an element of surprise while focusing on the operational objectives rather

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[106] Department of Justice, Geneva Conventions Act (Ottawa: Canada Communication Group, 2008), 173; Kristen M. Thomasen, "Air Power, Coercion, and Dual-Use Infrastructure: A Legal and Ethical Analysis," The International Affairs Review, 24 October 2008. https://iar-gwu.org/blog/2008/10/24/air-power-coercion-and-dual-use-infrastructure-a-legal-and-ethical-analysis.

[107] G.E. Jeler and D.R. Roman, "The Graphite Bomb: An Overview of its Basic Military Applications," Review of the Air Force Academy 14, no 1 (May 2016): 17.

[108] Air Force, Operation Allied Force (Washington, D.C.: Air Force Materiel Command, 2019), 25.

[109] Michael R. Gordon, "NATO Air Attacks on Power Plants Cross a Threshold," New York Times, 4 May 1999.

than the means themselves. In turn, the "soft" means used to disrupt the electrical grid provided a more ethical option than the permanent destruction of the infrastructure.

Precision Guided Munitions

In war, while minimizing collateral damage is a priority for any commanders, it is sometimes required to use "hard" weapons. During the Second World War, it took over 9,000 bombs and 3,000 aircraft to successfully destroy a 6,000 square foot target using 2,000 pounds-class bombs.[110] Today, the same target can be struck with a single aircraft with two 2,000 pounds-class weapons. While the first advertised use of modern precision-guided munitions (PGM), namely the laser-guided bombs, occurred in 1972, destroying the Thanh Hoa bridge in Vietnam, they were not introduced on larger scales until the Gulf War, 19 years later.[111] Indeed, the opening salvo was conducted by F-117s that destroyed "the telecommunication building in Baghdad that was the core of Iraqi command and control…" with only two 2,000 pounds bombs.[112] With the core of Iraqi's IADS dismantled, Iraq could not challenge the coalition in the air. With the advent of PGMs, it became possible to effectively attack both strategic and tactical targets with airpower during a conflict, as was the case during the Gulf War.

While PGMs can have tremendous effects at the strategic and operational level, it is also effective at the tactical level. The Gulf War Air Power Survey determined that, during the Gulf War, "the most effective weapons against Iraqi equipment were the laser-guided bombs."[113] Most of the interdiction missions within the Kuwaiti Theater of

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[110] Richard Hallian, "Precision Guided Munitions and the New Era of Warfare" (Air Power Studies Center Paper 53 Paper, Air Power Studies Center, 1997), 3.

[111] Air Force Research Laboratory Munitions Directorate, "Thanh Hoa Bridge," last modified 11 October 2005, http://www.mn.afrl.af.mil/public/vietnam.html.

[112] Tom Clancy and Chuck Horner, Every Man a Tiger (New York: Putnam, 1999), 316.

[113] Air Force, *Gulf War Air Power Survey, Volume 2: Operations and Effects and Effectiveness* (Washington, D.C.: U.S. Government Printing Office, 1993), 318.

Operations were aimed at both cutting the retreat path of the Iraqi Republican Guard and interdicting the flow of supplies to the fielded forces.[114] This led to "pervasive problems in supplying frontline [Iraqi] units with anything more than bare necessities."[115] This parallel war, that is, to attack all rings of Warden's system model concurrently, is crucial in ultimately affecting the core of Warden's circles. While PGMs reduced the number of aircraft and weapons employed, this allowed many targets to be struck simultaneously, more precisely than ever, contributing to an increase in force massing and an enormous economy of effort.

The PGMs used in the Gulf War faced an inherent weather limitation: they could not be employed when the target was obscured. The Iraqis knew this and used smoke generators to obscure their critical targets, leading to failed strikes. With continuous improvement and the introduction of global-positioning satellite-guided weapons fitted with laser guidance kits, a single aircraft can now engage fixed and moving targets in any weather conditions. Keeping the technological edge allows weaponeers greater flexibility in selecting targets and the environment in which weapons can be used in achieving the desired effects. Keeping the technological edge is critical in delivering effective airpower.

NON-KINETIC EFFECTS

Effects-Based Operations is a very pragmatic means of waging war. It is not interested in how an effect is produced but rather the effect itself. It is a means to an end type of approach. It is not bound by how a particular effect has been achieved in the past

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[114] Air Force, *Gulf War Air Power Survey, Volume 2: Operations and Effects and Effectiveness* (Washington, D.C.: U.S. Government Printing Office, 1993), 321.

[115] *Ibid*, 322.

or how, doctrinally, effects are created. In a sense, it encourages cooperation and innovation, and contributes to taking silos down. More and more effects are achieved without using a single kinetic weapon, thanks to technological advancements. These non-kinetic effects are utilized for both defensive and offensive means and can be active or passive measures.

Stealth

The proverbial stealth aircraft, or more accurately low observable aircraft, are not new. The first aircraft to integrate stealth measures was the U-2 Dragon Lady, a strategic reconnaissance aircraft, in 1955. After concerns of Soviet radars tracking Central Intelligence Agency (CIA) U-2s, they were, as a result of project RAINBOW, coated with radar-absorbent material.[116] The replacement of the U-2, CIA's A-12 Oxcart, and its military brother, the SR-71 Blackbird, both Mach 3 capable strategic reconnaissance aircraft, were developed with a reduced radar cross-section in mind.[117] The final Oxcart and, eventually, Blackbird designs incorporated more than merely a radar-absorbent coating. The design also reduced the number of corners on the outer mold and used electrically resistive honeycomb plastic, reducing the aircraft's radar cross-section. It also used a fuel additive, cesium, that reduced the afterburner plume's radar cross-section.[118] Until that point, the concepts related to reducing the radar cross-section of an aircraft were very much based on trial and error.

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[116] Gregory W. Pedlow and Donald E. Welzenbach, *The Central Intelligence Agency and Overhead Reconnaissance: The U-2 and OXCART Programs, 1954-1974* (Washington, D.C.: Central Intelligence Agency, 1992), 133.

[117] *Ibid,* 260.

[118] *Ibid*, 271.

In 1962, a Soviet scientist, Pyotr Ufimstev, published an academic paper titled *Method of Edge Waves in the Physical Theory of Diffraction*. The paper, written in Russian, described how different shapes affected radar reflection and included sets of equations used to calculate an aircraft's radar cross-section from its shape. After it was translated into English by the United States Air Force Foreign Technology Division in 1971, Skunk Works, Lockheed's Advanced Development Projects, used the information from Ufimstev's paper to build a computer program that precisely calculated the radar cross-section from an aircraft's shape.[119] This computer program was the basis of the F-117 Nighthawks design.[120] The aircraft was developed under a heavy shroud of secrecy in the 1970s and revealed to the public in 1988. While the aircraft made its combat debut in 1989, during Operation Just Cause, the real test of its stealth protection did not come until the first night of the Gulf War on 17 January 1991.

Employing a new technology in combat, especially one that sends machines and people in harm's way with the belief that the technology will keep them safe, requires courage and confidence. As then-Lieutenant-Colonel Barry Horne, who piloted an F-117 on the first night of the Gulf War, said, "[m]ost of us felt like firefighters about to test a flame-retardant shield by walking into a wall of fire. The so-called experts assured us that the suit worked, but we really wouldn't know for sure until we made that fateful walk."[121] As it turns outs, the F-117 was extremely successful in penetrating Iraq's Integrated Air Defence System during the first night, before the coalition could severely reduce Iraq's IADS capabilities. Not a single F-117 was lost during the war, despite attacking targets in

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[119] Ben R. Rich and Leo Janos, *Skunk Works: A Personal Memoir of My Years at Lockheed* (Boston: Little, Brown, 1994), 19.
[120] *Ibid*, 20.
[121] *Ibid*, 123.

the heart of surface-to-air missiles engagement zones, a testament of stealth technology's effectiveness.

Despite this success, the United States General Accounting Office, in a 1997 post-Gulf War assessment, suggested that the F-117 did not contribute to surprising the enemy. They explain that during most attacks, non-stealth aircraft experienced surface-to-air fire after the first bomb's detonation, not unlike the F-117s.[122] This claim seems to be supported by the shooting down of an F-117 on the fourth day of the 1999 Kosovo war codenamed Operation Allied Force. However, analysts of Operation Allied Force think otherwise. The F-117 was not invisible to radars: it was low-observable and heavily dependant on the aircraft's bank angle. After the accident, Lockheed commented that "even a standard banking maneuver can increase the aircraft's craft's radar cross-section (RCS) by a factor of 100…."[123] The route taken by the downed aircraft, a route that had been flown for the first four nights of the conflict, was constricted and required many turns, allowing a lucky and skillful SA-3 operator to catch a small glimpse of the F-117 at the most inopportune time.[124] Ultimately, operational and tactical procedural flaws allowed Serbia to take a low-observable aircraft down. After changing their tactics, the F-117s did not suffer another loss for the remainder of the 78-day war and kept striking strategic targets within Serbia largely unimpeded.

The lessons learned from the F-117 program, along with advances in computing technology, allowed for the development of more effective low-observable platforms.

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[122] General Accounting Office, *Operation Desert Storm: Evaluation of the Air Campaign* (Washington: National Security and International Affairs Division, 1997), 91.

[123] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment* (Santa Monica, CA: RAND, 2001), 117.

[124] *Ibid*, 117-119.

The B-2 Stealth Bomber, F-22 Raptor, and F-35 Lightning II currently operate regularly in contested airspaces worldwide with impunity. Stealth allows airpower to maneuver freely in contested airspace to surprise an enemy by striking, undetected, its heavily defended core with little support. While the downing of an F-117 "[dimmed] the [its] … aura of invincibility, which for years had been of incalculable psychological value," the value of stealth cannot be understated.[125] For an enemy, not knowing when or where it will be struck until weapons hit their targets brings a level of uncertainty that may push an adversary towards capitulation. Intense research in the domain of low-observability in different spectrums is currently underway. Furthermore, elements of stealth are mainstream on most new human-crewed and uncrewed aircraft nowadays. Stealth aircraft contributed to virtually every conflict since 1991, striking critical targets in Iraq, Serbia, Afghanistan, Libya, and Syria, providing both direct and indirect effects to the enemy's will to fight. Keeping the technological edge in the stealth domain contributes to airpower's dominance of the battlefield.

Cyber Effects

The widespread use of computers created a new domain of operations: cyberspace. The United States military defines cyberspace as "[a] global domain within the information environment consisting of the interdependent networks of information technology infrastructures … including the Internet, telecommunications networks, computer systems, and embedded processors and controllers."[126] In essence, any electronic system with an interface with other systems is part of cyberspace and is

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[125] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment* (Santa Monica, CA: RAND, 2001), 120.

[126] Joint Chiefs of Staff, *Cyberspace Operations.* JP 3-12 (Washington, D.C.: Joint Chiefs of Staff, 2018), GL-4.

vulnerable if not adequately protected. Furthermore, while the direct effects of cyber operations are within the cyberspace itself, secondary and tertiary effects can occur in the physical domains.[127]

The first known instance of a cyber attack having measurable effects in the physical domains happened in 2010. A Belarussian internet security firm then discovered a virus on Iran's government information technology systems. The virus targeted Programmable Logic Controllers (PLC), used to control industrial processes, only affecting systems that meet a "specific configuration of controllers, running a set of processes that appear to exist only in a centrifuge plant."[128] The virus, called Stuxnet, was proliferated through Universal Serial Bus (USB) keys.[129] Stuxnet's goal was to covertly disrupt the uranium enrichment process in Iranian nuclear facilities. In the end, the Iranian government estimated the capacity of one of its enrichment facilities, Natanz, dropped by 30 percent as "[a]n estimated 900 to 1,000 centrifuges were reported to have been broken."[130] Stuxnet's authors are not formally known at this time; however, analysis of the virus' code revealed that only state actors have the capabilities and sophistication to engineer such a virus.[131] For the first time, offensive cyber actions had strategic effects without firing a single bullet or dropping a single bomb.

While the exploitation of cyberspace is part of the definition of airpower, it would be a bridge too far to consider Stuxnet a feat of airpower. This example, however,

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[127] *Ibid*, viii.

[128] William J. Broad, John Markoff and David E. Sanger, "Israeli Test on Worm Called Crucial in Iran Nuclear Delay," *New York Times*, 15 January 2011.

[129] Kim Zetter and Huib Modderkolk, "Revealed: How a secret Dutch mole aided the U.S.-Israeli Stuxnet cyberattack on Iran," *Yahoo! News*, 2 September 2019.

[130] Yossi Melman, "Computer Virus in Iran Actually Targeted Larger Nuclear Facility," *Haaretz*, 27 September 2010; Samuli Haataja, "Stuxnet," in *Cyber Attacks and International Law on the Use of Force: The Turn to Information Ethics* (New York, N.Y.: Routledge, 2019), 138.

[131] *Ibid*.

highlights the technological developments in cyber operations. While in the early days, cyber operations were limited in scope, at least in the open-source world, in 2015, the United States Air Force publicly acknowledged that the EC-130H Compass Call conducts cyber operations. Major General Burke Wilson mentioned that the aircraft is "able to touch a target and manipulate a target" through cyber means.[132] Given that most secure systems are disconnected from the internet, other means of delivering malware need to be devised. In Stuxnet's case, agents infiltrated USB keys into the secure networks, a somewhat risky proposition. Wilson postulates that an aircraft can "touch a network that in most cases might be closed."[133]

Such an example allegedly occurred in 2007, during Israeli's Operation Orchard. After the Israelis were made aware that Syria was building a weapons-grade nuclear reactor in northern Syria, a daring air raid was designed, not unlike the 1981 Israeli raid on an Iraqi nuclear reactor. The difference, however, was that the Syrian Integrated Air Defence System (IADS) was a lot more potent than Iraq's. David Fulghum, a senior military editor with Aviation Weekly, postulated that Israeli Gulfstream electronic attack aircraft hacked into the Syrian IADS, removing all radar contacts from their operating picture, a claim supported by American industry analysts and government officials.[134] This allowed Israeli attack aircraft to operate, unimpeded, within Syrian airspace, precisely striking their targets and returning home.

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[132] Sydney J. Freedberg Jr, "Wireless Hacking In Flight: Air Force Demos Cyber EC-130," *Breaking Defense*, 15 September 2015.

[133] *Ibid*.

[134] David A. Fulghum and Robert Wall, "Israel Shows Electronic Prowess," *Aviation Weekly*, 26 November 2007.

When those capabilities are extrapolated to a scenario like the 2015 Russians hacking into Ukraine's electrical grid, the potential for airpower providing effects into the cognitive domain becomes evident. As systems become more and more secure, it will become more difficult to infiltrate networks using more conventional methods such as the internet. Assets such as the EC-130H Compass Call will become more relevant within the cyberspace to deliver effects to air-gapped systems. When those effects are delivered against key national infrastructures, such as banks and electrical grids, this erodes the population's confidence in their leaders, which can, in turn, affect a leader's decision. When such an example is compared to Warden's rings, cyber actions directly affect the organic essential elements of a country, affecting the population and finally a country's leadership. Airpower and existing cyber capabilities can affect vital national infrastructure and the cognitive domain without employing traditional means of waging war.

THE IMPORTANCE OF SPECIAL ACCESS PROGRAMS

Protecting advances in technology and what is known about an enemy is as important as the technology and the information itself. Suppose a potential foe knows a specific weapon system even exists or has access to the latest weapons' technical specifications. In that case, it becomes much easier for an adversary to develop counter-measures that would negate the technology itself. Furthermore, if an enemy knows what a country knows about its capabilities, that foe could change its technology. Every government has measures to safeguard the information. While all protected and classified pieces of information are subject to the "need-to-know" principles, it is sometimes insufficient to merely classify information as secret or top secret.

The United States protects its "most sensitive DoD capabilities, information, technologies, and operations…" through Special Access Programs (SAP).[135] The access to the information contained within a SAP and sometimes the mere existence of a SAP is tightly controlled centrally. Furthermore, the number of people that can be indoctrinated into a SAP at any given time is limited. Special Access Programs are divided into two types: unacknowledged and acknowledged.[136]

"The existence of an unacknowledged SAP … [may] be made known only to those personnel properly authorized to receive the information."[137] For example, the F-117 Nighthawk was an unacknowledged SAP until its unveiling to the public in 1988. Acknowledged SAPs may be "openly recognized or known, however, specifics within the SAP will be classified."[138] For example, after the U.S government acknowledged the F-117's existence, it is more than likely that the program remained a SAP, albeit acknowledged. SAPs are generally briefed to the "United States Members of Congress assigned to designated defense and intelligence committees … within the respective committee's SAP oversight role."[139] There is, however, an extra layer of secrecy afforded to the very most sensitive programs. Those programs can be waived, meaning only the designated defense and intelligence committees' chairs can be briefed rather than the whole committee itself. Some unacknowledged SAPs, such as CONSTANT PEG discussed in chapter 2, remain unacknowledged even after the program is terminated.

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[135] Department of Defense, *Special Access Program (SAP) Policy* (Washington, D.C.: U.S. Government Printing Office, 2020), 2.

[136] Army, *Special Access Programs (SAPs) and Sensitive Activities*, AR 380-381 (Washington, D.C.: Department of the Air Force, 2017), 11.

[137] *Ibid*.

[138] *Ibid*.

[139] Department of Defense, *Special Access Program (SAP) Policy* (Washington, D.C.: U.S. Government Printing Office, 2020), 2.

SAPs can and do restrict the number of people with access to information: that is its purpose. While this has the effect that relevant, sometimes vital, information is not communicated to everyone who could benefit from the information, those who have access generally find ways to communicate the essential elements without compromising the programs. As a Gulf War pilot who had not been exposed to CONSTANT PEG before the hostilities began said, "our [operations officer] … got us all in a room for a chat. He gave us a 'hypothetical' discussion about how someone might want to fight some of the threat aircraft in the [Iraqi Air Force] inventory."[140] Despite this chat, he "didn't know [the operations officer] was a Red Eagle" until the program was declassified.[141] Special Access Programs are crucial in safekeeping the most cutting-edge technology and the most sensitive intelligence. They allow airpower to maintain the technological edge and information advantage by keeping technology and information secure, and support the element of surprise in warfare. Additionally, SAPs are a means to prevent the enemy from truly understanding how Western countries operate. In a sense, it is a counter to an enemy version of EBO.

The Gulf War Air Campaign showcased airpower's technologies and their ability to mass offensive firepower, operate securely anywhere in a contested environment, use a minimum of assets, and surprise the enemy in attaining strategic objectives. Warden's post-mortem on the Gulf War concluded that it was the first "hyperwar" or a war "that capitalizes on high technology, unprecedented accuracy, operational and strategic surprise through stealth, and the ability to bring all of an enemy's key operational and

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[140] Gaillard R. Peck Jr., *American's Secret MiG Squadron*, (New York, N.Y.: Osprey Publishing, 2012), 279.

[141] *Ibid*, 279-280.

strategic nodes under near-simultaneous attack."[142] Airpower improved existing technology and introduced new capabilities, kinetic and non-kinetic, throughout the years. These advancements allowed airpower to strike across all levels of warfare and ultimately meeting the strategic objectives of the day.

[142]John A. Warden III, "Employing Air Power in the Twenty-first Century," in *The Future of Air Power in the Aftermath of the Gulf War,* ed Robert L. Pfaltzgraff and Richard H. Shultz (Montgomery, AL: Air University Press, 1992), 79.

CHAPTER 4 – COMMAND AND CONTROL

You could give the same airplanes to two different air forces—one of them totalitarian and the other one under a democracy, and the democracy's going to win every time because the air war is about freedom of choice, it's about maneuver, and it's about a regime that's able to entrust a handful of men with a great deal of power.

-Maj Gen Chuck Link

INTRODUCTION

Having the best technology with the most relevant, timely intelligence is only useful if the command and control structure allows their efficient and effective employment. Furthermore, without control of the air environment, it becomes increasingly difficult to properly apply the desired effects upon targets. Given the time, space, and scope of aerospace operations, it is crucial to understand that controlling the air is critical, to analyze where airpower assets need to be based, and to analyze the command and control relationships prone to optimizing airpower.

CONTROL OF THE AIR

Merely having the capabilities to deliver effects to an opponent's systems is not enough to win a war. First, airpower needs the ability to maneuver and position itself close enough to systems to deliver the desired effects. In other words, a force requires some degree of control of the air. Giulio Douhet introduced the concept of control of the air in 1926 when he postulated that an "air force adapted for the struggle for command of the air … is the means suitable to assure victory regardless of other circumstances when it is capable of winning the command of the air with adequate forces."[143] This principle is ingrained into airpower practitioners. United States joint doctrine states that "Historically, air superiority has proven to be a prerequisite to success for an operation/campaign

[143] Giulio Douhet, *The Command of the Air*, trans. by Dino Ferrari, ed. by Joseph Patrick Harahan and Richard H. Kohn (Tuscaloosa: University of Alabama Press, 2009), 96.

because it prevents enemy air and missile threats from interfering with operations … thus facilitating freedom of action and movement."[144]

Being in control of the air can be interpreted in several different ways. The most extreme version is to have air supremacy, defined as the "degree of control of the air wherein the opposing force is incapable of effective interference within the operational area using air and missile threats."[145] This approach may work against a weak air defence system, but it can be prohibitively expensive, both in terms of assets and people, against a near-peer adversary. China, for example, is now in a position to challenge Western airpower. Indeed, in the last 20 years, China introduced modern fighters to its fleet, airborne command and control platforms, and potent, long-range "double-digit" surface-to-air missiles, leading to a decline in the "the U.S. ability to penetrate Chinese air defenses in the context of an air campaign...."[146]

Air superiority, or the "that degree of control of the air by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats," is more suited for air operations against a near-peer.[147] By nature, this approach is a tradeoff between freedom of maneuver and risk instead of the mostly risk-free air supremacy approach. This allows risk assessments to be made to compare the mission's worth related to the risk, or to analyze the "bang for the buck" of a given mission. Given that many of the assets nowadays are capable of conducting many roles, accepting air superiority rather than air supremacy from the beginning allows for a

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[144] Joint Chiefs of Staff, *Countering Air and Missile Threats*, JP 3-01 (Washington, D.C.: Joint Chiefs of Staff, 2017), I-4.

[145] *Ibid*.

[146] Eric Heginbotham, *The U.S.-China Military Scorecard: Forces, Geography, and the Evolving Balance of Power, 1996-2017* (Santa Monica, CA: RAND, 2015), 116.

[147] Joint Chiefs of Staff, *Countering Air and Missile Threats*, JP 3-01 (Washington, D.C.: Joint Chiefs of Staff, 2017), I-4.

more optimal and pragmatic apportionment of air assets. Air superiority is also time-bound as "[i]n some situations, the commander may have limited resources, which are only adequate to establish control of the air for specific periods of time or over only a portion of the threats."[148]

Control of the air does not need to be achieved through the destruction of enemy equipment. In the spirit of effects-based operations, only the effects required to manoeuvre freely within the operating area need to be delivered. While a flight of four F-35s conducting a Destruction of Enemy Air Defence mission with a flight of four F-22s providing Offensive Counter-Air could certainly achieve this, sending a stealth B-2 bomber instead may achieve the same desired effect: operate freely without prohibitive interference to deliver effects. The concepts of intelligence and technology discussed in the previous chapters also apply to controlling the air. Understanding an enemy's air defence systems and having the technology to affect them is crucial. Achieving air superiority is critical for airpower to deliver effects to the enemy's systems.

AIRCRAFT BASING

The problem of aircraft basing is closely linked to control of the air. Indeed, how much the air environment is controlled determines the level of risk associated with basing aircraft in a specific area. Of course, basing the aircraft closest to the area of operation is preferred as it provides increased on-station time and sortie rates. However, some factors affect where aircraft can be based, airfield availability and compatibility, and threats to assets are chief amongst them. These factors were present during the Gulf War. Because of their sensitivity and their value, F-117s were based in Khamis Mushayt, deep into

[148] *Ibid*.

Saudi soil and outside of Iraq's scud range, in an effort to protect them.[149] This led to a reduced sortie rate when compared to other aircraft conducting similar roles. While the F-117s flew an average of 38 sorties per aircraft during the war, F-15Es flew 45 sorties per aircraft, the A-10 flew an average of 61, and F-16s an average of 68.[150] Both the A-10s and the F-16s could refuel and re-arm at King Khalid Military City, a forward operating bases located 71 nautical miles from the Iraqi border, reducing the transit time between sorties.[151] This explains why the A-10 and F-16 sortie rates were higher than the F-15Es', even if their main operating bases were a similar distance from the operating area. Basing is a critical factor that ultimately determines the rhythm at which airpower can operate: the closer to the operating area aircraft are based, the higher the operational tempo.[152]

Regardless of where aircraft are based, any conflicts with a near-peer, with potent, long-range air defence systems, will require air-to-air refueling (AAR). This lesson was learned during the Korean War. When the United States, in 1951, transitioned from employing long-range bombers to using tactical fighters to conduct most missions over North Korea, time and space problems arose. Indeed, fighters could not travel the required distances, conduct their mission, and return to base safely. At that time, the United States was only experimenting with air-to-air refueling, "but Korea gave air refueling an urgency that required a higher priority than in the past."[153] Air-to-air

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[149] Tom Clancy and Chuck Horner, *Every Man a Tiger* (New York: Putnam, 1999), 203.

[150] Air Force, *Gulf War Air Power Survey, Volume 5: A Statistical Compendium and Chronology*, (Washington, D.C.: U.S. Government Printing Office, 1993), 516-517, 556-597.

[151] William F. Andrews, *Airpower Against an Army: Challenge and Response in CENTAF's Duel with the Republican Guard* (Montgomery, AL: Air University Press, 1998), 50.

[152] Charles M. Westenhoff, *Military Airpower: A Revised Digest of Airpower Opinions and Thoughts* (Washington, D.C.: Air University Press, 2007), 48.

[153] Robert F. Dorr, "Air Power Lessons from the Korean War," *Defense Media Network*, 8 April 2014. https://www.defensemedianetwork.com/stories/air-power-lessons-from-the-korean-war/.

refueling has since been a critical enabler to operations. With AAR, aircraft virtually have an unlimited range.

Air-to-Air refueling aircraft is a rare commodity during operations. A 2014 North Atlantic Treaty Organization report mentions that while "NATO has sufficient numbers of tankers to meet its Level of Ambition … this is only possible through heavy reliance on [United States] assets."[154] While the United States would undoubtedly employ their tankers during a near-peer adversary, their capacity has been challenged in the past. Planners of the Gulf War initially anticipated requiring 68 AAR aircraft. In the end, "combat operations required over 230," including 92 percent of the United States Air Force's tanker fleet.[155] Aircraft were based relatively close to the operating area during the Gulf War, with most aircraft based within 640 nautical miles from the Iraqi border.[156] The same geographical advantage may not present itself against a near-peer such as China. Of course, aircraft carriers can force that advantage. They can position themselves virtually anywhere there is water, posing a close, immediate threat to any country. Its positioning is only contingent on the acceptable level of risk for a given operation. While tests were carried out to operate heavy aircraft, such as C-130 Hercules, from carriers, the idea never materialized operationally. The versatility of carriers is limited to fighter-sized aircraft.

Aircraft basing is critical in determining an operation's battle rhythm. The closer aircraft are based, the faster the operational tempo airpower can sustain. This principle

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[154] Joint Air Power Competence Center, *Air-to-Air Refueling Consolidation – An Update* (Kalkar, Germany: The Joint Air Power Competence Center, March 2014), 8.

[155] Air Force. *Gulf War Air Power Survey, Volume 2: Operations and Effects and Effectiveness* (Washington, D.C.: U.S. Government Printing Office, 1993), 20; Air Force, *Gulf War Air Power Survey Summary Report*, (Washington, D.C.: U.S. Government Printing Office, 1993), 211.

[156] The F-117s were the aircraft based the furthest from Iraq.

also applies to aircraft carriers. Aircraft basing decisions must consider airfield availability and compatibility with aircraft requirements and the risk associated with basing aircraft and position aircraft carriers at specific locations. Air-to-air refueling is a key element used to mitigate the effects of basing aircraft outside of threat areas. However, the West is chronically short on AAR assets. Unless western countries procure more AAR assets, tough decisions will need to be made during a conflict against a near-peer adversary. The West will either need to accept a reduced operational tempo or accept an increased level of risk.

CENTRALIZED CONTROL

With dispersed and joint forces, the question of command and control always surfaces. The Vietnam war marked the first modern use of airpower, with aircraft conducting deep battlefield interdiction using precision-guided weapons. Airpower use was, however, very disjointed during the war. The area of operations was divided into seven distinct areas called route packages. The United States Navy (USN) was assigned four route packages, while the United States Air Force was assigned three.[157] USN and USAF aircraft seldom operated together and were generally constrained to their route packages. This severely hampered airpower's flexibility. General William Momyer, the Seventh Air Force commander for two years during the Vietnam war, said, "[d]ividing North Vietnam into route packages compartmentalized our airpower and reduced its capabilities."[158] He went further, explaining that "[o]ne result was that 7th Air Force diverted too many sorties into Route Package 1 when weather prevented strikes in Route

[157] John T. Correll, "Disunity of Command," *Air Force Magazine* 88, no 1 (January 2005), https://www.airforcemag.com/article/0105disunity/.

[158] *Ibid*.

Package 5 or 6.", reducing airpower's potential.[159] This decentralization of airpower's control did not work and resulted in sub-optimal performance of airpower. The bottom line is that during the Vietnam war, "[e]ach service, instead of integrating efforts with the others, considered Vietnam its own war and sought to carve out a large mission for itself … each fought its own air war…."[160]

Heeding the lessons of Vietnam, the United States government radically changed the U.S. military structure with the 1986 Goldwater-Nichols Act. Up until that point, each service was responsible for how they employed their forces. The Goldwater-Nichols act created the concept of combatant commanders.[161] When forces would be used for operations, each service would transfer command of its deployed forces to a single, joint combatant commander: the Joint Force Commander (JFC). Gone would be the days when the Army, Air Force, Navy, and Marine Corps forces were employed independently: their actions would be coordinated and commanded by a single person. While the need for airpower to be centrally controlled was identified during the Second World War, it was not until the Goldwater-Nichols Act was passed, and after combatant commands were created, that the idea of a Joint Force Air Component Commander (JFACC) was brought into existence.[162]

The JFACC's goal is "to establish unity of command and unity of effort for joint air operations."[163] In pursuit of this objective, "the JFACC plans, coordinates, executes, and assesses these [air missions] for the JFC" and is typically designated the "the area air

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[159] *Ibid*.

[160] David C. Jones, "Past Organizational Problems," *Joint Force Quarterly* 16, no 4 (Fall 1996), 25.

[161] Congress, Goldwater-Nichols Department of Defense Reorganization Act of 1986, HR 3622, 99th Congress, passed in House 1 October 1986, 21.

[162] Marcus Hurley, "JFACC: Taking the Next Step," *Joint Force Quaterly* 7, no 1 (Spring 1995), 62.

[163] Joint Chiefs of Staff, *Joint Operations,* JP 3-0 (Washington, D.C.: Joint Chiefs of Staff, 2018), III-8.

defense commander and airspace control authority."[164] Through a 72 to 96-hour planning process, a targeting cycle, and a 24-hour air tasking cycle, air effects are centrally controlled and coordinated, ensuring that the most appropriate resources are tasked against specific effects.[165] Using collected intelligence, targeteers create a joint prioritized target list (JPTL), conduct a weaponeering assessment, or pairing effects with targets. Using the JPTL, the operations staff creates a master air attack plan (MAAP), considering the available assets. The final product comes in the form of an Air Tasking Order, based on the MAAP and published daily, tasking specific units with specific missions delivering specific effects at specific times and specific locations. An Airspace Coordination Order (ACO) is also published daily, separating the airspace in areas to help with deconfliction. These products serve both as an order for units to deliver effects but also as a deconfliction tool, ensuring that no two formations of aircraft fly in the same piece of sky at the same time. Generally, anything that flies, including cruise missiles and even artillery fires, is either part of the ATO or is afforded restricted airspace in the ACO, if only to avoid mid-air collisions or aircraft flying into a cruise missile's path, for example. In the end, the JFACC is responsible for delivering air effects safely and effectively.

Of course, this approach is not embraced by all services. The United States Marine Corps (USMC) has always been vocal about its disagreement with the concept. While "[t]he Marine Corps has always believed in centralized control and decentralized execution of airpower … it fundamentally disagrees that the source of centralized control

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[164] *Ibid*.

[165] Joint Chiefs of Staff, *Joint Air Operations*, JP 3-30 (Washington, D.C.: Joint Chiefs of Staff, 2019), xviiii.

should be an airman."[166] There are no restrictions for the JFACC to be from another service than the Air Force; however, the JFACC has been, for all major combat operations since the Gulf War, an Air Force officer. The USMC's concerns are founded. The Marines "believes that the Marine air-ground task force (MAGTF) commander should be the single commander in charge, and all Marine air should be at his disposal."[167]

These concerns are codified within the joint doctrine. Indeed, the capstone doctrine mentions explicitly that "MAGTF air assets normally will be in support of the MAGTF mission."[168] Only sorties "in excess of MAGTF direct support requirements" are made available to the JFACC to support joint effects.[169] In order to avoid frictions, it is crucial for the JFACC to develop good working, trusted relationships with the other functional commanders. Only then can stovepipes be brought down. This is the approach General Charles Horner, the Gulf War JFACC, took. When General Walt Boomer, the Central Command Marine Commander, challenged the JFACC concept, Horner explained that even if USMC's planes were under the JFACC, he would get all the air support Boomer needed.[170] Ultimately, Boomer agreed to transfer control of USMC planes to the JFACC.[171] A test to this fragile relationship occurred during the battle for Al-Khafji. During an Iraqi attack on the Saudi town, USMC ground troops were supported by USMC aircraft but also USAF assets that were better suited and positioned

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[166] Clint Hinote, *Centralized Control and Decentralized Execution: A Catchphrase in Crisis?* (Montgomery, AL: Air Force Research Institute, 2009), 50.

[167] *Ibid*.

[168] Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, JP 1 (Washington, D.C.: Joint Chiefs of Staff, 201), IV-5.

[169] *Ibid*.

[170] Tom Clancy and Chuck Horner, *Every Man a Tiger* (New York: Putnam, 1999), 211.

[171] LeRoy D. Stearns, *U.S. Marines in the Persian Gulf, 1990-1991* (Washington, D.C: United States Marine Corps, 1999), 100.

to provide the support the USMC desperately needed.[172] Ultimately, the USMC prevailed, and Horner held true to his promise, solidifying his relationship with Boomer and the USMC.

Throughout the war, USMC's planes not only supported USMC ground troops but also supported the strategic air campaign.[173] This pragmatic approach enabled Horner to effectively use all of the theater's airpower to conduct effects-based operations, using the best platform for the missions, regardless of which service the aircraft originated. This approach was used in every major air campaign since. "The services accept … the fact that a Joint Force Air Component Commander (JFACC) represents the best way to command and control airpower."[174]

For airpower to effectively deliver air effects, it is essential to gain and maintain control of the air. While aiming to gain air supremacy is a noble endeavour, it is not realistic against a near-peer adversary. From the onset, it is crucial to aim to gain air superiority in places where and at times when it is required to deliver airpower effects. This concept will allow the optimal use of scarce resources. Furthermore, near-peer adversaries' air defences are increasingly long-range, limiting the number of bases outside their range. Aircraft basing and air-to-air refueling availability are critical in determining the operational tempo that can be maintained.

Additionally, the chronic shortage of Western air-to-air refueling platforms compounds this issue. Before waging war against a near-peer, the West will either need to increase the number of AAR platforms, base their aircraft closer to the operating area,

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[172] Tom Clancy and Chuck Horner, *Every Man a Tiger* (New York: Putnam, 1999), 393.

[173] LeRoy D. Stearns, U.S. Marines in the Persian Gulf, 1990-1991 (Washington, D.C: United States Marine Corps, 1999), 106.

[174] Marcus Hurley, "JFACC: Taking the Next Step," *Joint Force Quaterly* 7, no 1 (Spring 1995), 60.

accept increased risk levels to the force, or accept a decreased operational tempo. Finally, all forces delivering airpower need to be controlled by a single commander. This concept is the most efficient way of delivering effects through airpower, matching aircraft to effects centrally.

CHAPTER 5 – CASE STUDIES

INTRODUCTION

Now that the most important factors enabling airpower and effects-based operations to succeed have been identified, it is appropriate to put those factors into the context of past operations. Two operations will be analyzed through some of the elements discussed in the previous chapters. Through those case studies, it will become clear that, given the right conditions, airpower can succeed against a near-peer adversary using an effects-based operations approach. First, Operation Allied Force, a successful airpower intervention in Serbia, will be analyzed, followed by a study of the 2006 Lebanon war, a conflict that resulted in a draw. While these cases are not near-peer confrontations and, in the case of the 2006 Lebanon war, airpower was not fighting alone, lessons can be extrapolated to airpower within a near-peer context.

OPERATION ALLIED FORCE

The prelude to Operation Allied Force started in the early 1990s when Serbia severely curtailed Kosovar Albanians' rights. In 1996, the Kosovo Liberation Army (KLA) was formed to fight against Belgrade. Armed battles between Serbian and KLA forces broke out in 1998. After several attempts to de-escalate the situation, NATO, on 23 March 1999, decided, without United Nations support, to support the KLA solely using airpower. Between 24 March and 9 June 1999, NATO conducted a 78-day air campaign aimed at halting Serbian violence and repression against Kosovar Albanians. "For the first time in its history, NATO forces attempted to coerce an adversary who

understood at the outset that it would not be subjected to a foreign invasion or occupation."[175]

While the strategic objectives were clear, the Kosovo air campaign plan originated from confusion. On the one hand, U.S. Army General Wesley Clark, the Supreme Allied Commander Europe, thought that "attack the armed forces committing the atrocities" would be more effective in achieving the strategic objectives.[176] U.S. Air Force Lieutenant General Michael Short, the Joint Force Air Component Commander, believed "functional and psychological effects targeted directly at Milošević," or effects-based operations, would force Serbian leadership to cave to NATO's demands earlier.[177] Ultimately, effects on fielded forces were prioritized at the onset of Operation Allied Force. During the first three days of the war, the priority was to establish control of the air, striking the Serbian Integrated Air Defence System and its supporting infrastructure, and fielded Serbian forces.[178] These strikes had little impact on Milošević: he intensified his atrocities in Kosovo.[179] The Central Intelligence Agency anticipated this escalation. "Weeks earlier, the director of the Central Intelligence Agency, George Tenet, had predicted that VJ and MUP forces might respond to a NATO bombing campaign with precisely such a strategy."[180] On the fourth day, the focus of air attacks from gaining control of the air to interdicting and destroying the Serbian army.[181] Despite this shift in

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[175] Brett A. King, "Coercive Airpower in the Precision Age: The Effects of Precision Guided Munitions on Air Campaign Duration" (Doctorate's thesis, University of Nebraska, 2014), 113.

[176] Williamson Murray, *Transformation Concepts for National Security in the 21st Century* (Pennsylvania: Strategic Studies Institute, 2002), 138.

[177] *Ibid*.

[178] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment* (Santa Monica, CA: RAND, 2001), 19-24.

[179] *Ibid*, 24.

[180] *Ibid.*

[181] *Ibid*, 25.

focus, Milošević did not show signs of weakness: he continued persecuting Kosovar Albanians.

It is not until the end of April that NATO considered targeting the Serbian critical systems: "the political machine, the media, the security forces, and the economic system."[182] On 3 May, a stealth F-117s, using soft bombs, a then cutting edge, special access program, shut down 70% of Serbia's electricity, bringing the war to the Serbian population and "[tightening] the air operation's squeeze on the Serbian political leadership and rank and file."[183] Until the end of the war on 9 June, the targeting effort was geared towards strategic effects rather than pure attrition of ground forces. The first phase of the war, or the first 40 days, was virtually ineffective in achieving the coalition's goals. During the second week, U.S. government officials went as far as "[acknowledging] that Operation Allied Force had failed to meet its declared goal of halting Serbian violence against the ethnic Albanians."[184] Throughout the war, intelligence agencies sought to understand what drove Milošević. They "[gathered] information on the bank accounts and business interests of Milošević and his closest partners, the latter of whom were starting to pressure him to call it quits."[185] This allowed planners to shift their targeting priorities to optimize airpower's effects. During the last 38 days, airpower delivered effects on the Serbian institutions. "Local economists reported that the effect was more damaging than that of the successive Nazi and allied bombing of Yugoslavia during World War II, when the country was far more rural in its

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[182] *Ibid*, 39.
[183] *Ibid*, 40-41.
[184] Craig R. Whitney, "On 7th Day, Serb Resilience Gives NATO Leaders Pause," *New York Times*, March 31, 1999.
[185] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment* (Santa Monica, CA: RAND, 2001), 71.

economic makeup."[186] Airpower not only understood Serbian institutions; it ultimately drove it to its knees.

It is not uncommon to find opinions diminishing the role of airpower in Milošević's capitulation. British Army Lieutenant General Sir Michael Jackson, a critic of airpower, postulates that Russia, backing NATO's position, triggered the end of the war.[187] While this may be true, the reason Russia backed NATO's position was most likely influenced by the effects airpower delivered in Serbia. Benjamin Lambeth, a RAND Corporation analyst, postulates that the prospect of a NATO ground invasion may have also pushed Milošević to give up.[188] While there were signs of the Serbian army anticipating such an attack, there is no evidence to suggest this is what pushed Milošević over the edge.[189] In fact, before Milošević accepted NATO's cease-fire terms, he asked his staff, "Is this what I have to do to get the bombing stopped?"[190] Given that only the F-117 and the B-2, both stealth aircraft, were tasked against targets in Belgrade, Serbia's capital city, it is reasonable to assume stealth aircraft had a psychological effect on Milošević.[191] Overall, the effects of airpower weighed heavily on him as the President of this country and led him to capitulate. Airpower, through EBO, succeeded on its own.

How effects are delivered is essential. Without appropriate technology, it is next to impossible to affect an enemy's centers of gravity effectively. Operation Allied Force was the first major conflict to employ precision-guided munitions widely. More than 90

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[186] *Ibid*, 42.
[187] *Ibid*, 67.
[188] *Ibid*, 73.
[189] *Ibid*.
[190] Tyler Marshall and Richard Boudreaux, "Crisis in Yugoslavia: How an Uneasy Alliance Prevailed," Los Angeles Times, June 6, 1999.
[191] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment* (Santa Monica, CA: RAND, 2001), 92.

percent of American aircraft were capable of employing precision-guided munitions, compared to a mere 10 percent during the Gulf War, only eight years prior, and "[some] 64 percent of the 9,815 aim points altogether were hit by PGMs, for a total hit rate of 58 percent."[192] Ultimately, PGMs allowed the coalition to strike both fixed and mobile targets. Born out of the Gulf War lessons, a key weapon saw its debut in Kosovo: the Global Positioning System (GPS)-guided bombs or Joint Direct Attack Munitions (JDAM).[193] Those bombs, delivered by another war debutant, the stealth B-2 Spirit, allowed the coalition to precisely strike strategic targets in the most defended areas of Serbia, even when weather obscured targets. Given that "[only] 21 out of the 78 days of the campaign was the weather judged to be 'favourable' for air operations," this new capability proved essential in delivering strategic effects.[194] When aircraft armed with laser-guided bombs returned to base without employing their weapons due to weather, B-2s would carry on with their mission. While only 45 B-2 sorties struck targets out of 9,500 total strike sorties, B-2s dropped "dropped 11 percent … of the bombs delivered against fixed targets in Serbia and Kosovo."[195] In the end, "[the] United States was very pleased with the performance of its GPS-guided JDAM" and B-2 force.[196]

How effects are coordinated is crucial in effects-based operations. While the concept of the Joint Force Air Component Commander and centralized control of

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[192] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment* (Santa Monica, CA: RAND, 2001), 87.

[193] Peter Grier, "The JDAM Revolution," *Air Force Magazine* 89, no 9 (September 2006). https://www.airforcemag.com/article/0906jdam/.

[194] Secretary of State for Defense, *Kosovo: Lessons from the Crisis* (London, U.K.: The Stationery Office, June 2000), 32.

[195] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment* (Santa Monica, CA: RAND, 2001), 91.

[196] Secretary of State for Defense, *Kosovo: Lessons from the Crisis* (London, U.K.: The Stationery Office, June 2000), 33.

airpower was indeed used during Operation Allied Force, it still yielded to two different air tasking orders, the first one for the coalition's eyes, including "all sorties except those conducted by B-2 bombers and F-117 fighters [sic], support elements of all strike packages, and U.S. Tomahawk and [Convensional Air-Launched] cruise missiles to strike selected targets."[197] The second one, for American personnel's eyes only, was dedicated to the missions not included on the coalition ATO. This compartmentalization of information was primarily due to the perceived sensitivities surrounding those platforms, despite both platforms being acknowledged programs.[198] Not only did this approach create coordination issues when "U.S. aircraft suddenly showed up on NATO radar screens with no advance warning," but it also resulted in procedural measures imposed on those platforms.[199] These procedural measures required the F-117s to use the same narrow corridor to enter Serbian airspace, day after day. The Serbs quickly realized this and positioned surface-to-air missile batteries in areas where the F-117 was most vulnerable. These strict procedures led to the shootdown of one of the platforms the U.S. was trying to keep from its allies: on 27 March, after flying for three days using the same corridor, an F-117 was shot down by a Serbian surface-to-air missile.[200] While this particular event did not directly impact the outcome of the conflict, it most likely led to an acceleration of stealth technology development in Russia and China, a significant long-term strategic impact.[201] This incident reinforces the importance of genuinely

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[197] John E., Peters et al, *European Contributions to Operation Allied Force: Implications for Transatlantic Cooperation* (Santa Monica, CA: RAND, 2001), 39.

[198] *Ibid*.

[199] *Ibid*, 40.

[200] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment* (Santa Monica, CA: RAND, 2001), 118-119.

[201] Charles R. Smith, "Russia Offers India $8 Billion Weapons Deal," *NewsMax*, 12 December 2001.

centralized control of airpower, shared amongst all command and control platforms at all levels.

Operationally, Allied Force was an unmitigated airpower success. While there were examples of incidents that led to long-term strategic impacts, they did not impact the war's outcome. Cutting edge technology, enabled by empathic intelligence and centralized control, allowed airpower to affect Milošević's and Serbia's will to fight. The fight was relatively short – 78 days. It could have been shorter had effects-based operations principles been adopted from the onset of the war. The focus on destroying fielded forces delayed unmitigated airpower employment and potentially extended the war by 40 days.

THE 2006 LEBANON WAR

Many airpower skeptics have heavily criticized the effectiveness of effect-based operations. General Mattis, in 2008 as the U.S. Joint Forces Commander, issued a directive that forced the removal of any reference to effects-based operations or derivatives from U.S. Joint Doctrine.[202] The evidence presented in his criticism revolved around the failure of the Israelis during the 2006 Lebanon war. While this conflict was joint by nature and was not against a near-peer, it is important to address the criticism to ensure that the EBO concept is sound.

Mattis' chief complaint regarding EBO is the unpredictability a conflict brings.[203] He postulates that "no amount of technology or training will enable us to accurately predict reactions of complex systems."[204] Furthermore, pointing out to the work of Matt

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[202] James N. Mattis, "USJFCOM Commander's Guidance for Effects-Based Operations," *Parameters* 38, no. 3 (2008): 23.
[203] *Ibid*, 24.
[204] *Ibid*.

Matthews, a U.S. Army historian, Mattis states that, in the 2006 Israeli Defense Force (IDF) doctrine, the terminology associated with EBO was "too complicated, vain, and could not be understood by the thousands of officers that needed to carry it out."[205] While true, it is a relatively weak argument. The IDF doctrine that introduced EBO was published in April 2006, and the war started a mere two and a half months later, on 12 July. There was no time to assimilate the new doctrine and, more importantly, train employing it. In other words, the doctrine, in the IDF context, was immature. Any doctrine that has not been exercised would have failed. This issue is not specific to EBO and cannot be accepted as a valid critique of EBO.

One of the key factors that led to Israel's demise against Hezbollah was a lack of empathy. The conflict started as a retaliation operation on 12 and 13 July 2006 against Hezbollah with Israeli Air Force aircraft striking military targets, command posts, and the Dahiya quarter.[206] It is not until two days later, after Israel rejected a ceasefire proposal, that the "retaliation operation turned into war," which "harmed … the application of pre-planned operations…."[207] During the war, Israeli operations focused on fielded forces rather than indeed striking Hezbollah's weaknesses.[208] This shortfall was potentially due to a misunderstanding of Hezbollah's human system.

Ironically, Hezbollah understood the Israelis. While Israel was a more potent force, Hezbollah sought to attack Israel's weak points engaging small Israeli units at the tactical level and using societal and economic terror at the strategic level, striking

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[205] *Ibid*; Matt M. Matthews, *We were Caught Unprepared: The 2006 Hezbollah-Israeli War* (Leavenworth, KS: U.S. Army Combined Arms Center Combat Studies Institute Press, 2008), 26.

[206] Avi Kober, "The Israel Defense Forces in the Second Lebanon War: Why the Poor Performance?" *The Journal of Strategic Studies* 31, no 1 (February 2008), 3-4.

[207] *Ibid*, 4, 10.

[208] *Ibid*, 3-5.

throughout Warden's rings.[209] Hezbollah fired more than 100 rockets per day in cities in northern Israel. Destruction was not necessarily the objective. Israeli civilian casualties were low, approximately 43,but more than 500,000 people were displaced for the duration of the conflict.[210] Hezbollah "managed to paralyze social and economic life in northern Israel, to bring about a mass desertion of populated areas, and to cause casualties and damage property."[211] This military influence in the cognitive domain likely pushed the Israeli government to eventually accept less favourable ceasefire conditions. Ultimately, despite being the more powerful warring entity, Israel agreed to a ceasefire: the war was considered a failure by Israel.[212] The concepts related to effects-based operations were not to blame for the Israeli difficulties. Mattis' position and argument against EBO are fundamentally flawed.

Through historical case studies, it is evident that airpower, enabled by effects-based operations, can achieve strategic goals. Using technical and social intelligence, cutting-edge technology, establishing control of the air, and centralized control allows airpower to dominate the battlefield and ultimately defeat an enemy.

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[209] *Ibid*, 6.

[210] Augustus R. Norton, *Hezbollah: A Short History* (Princeton, N.J: Princeton University Press, 2007), 128.

[211] Avi Kober, "The Israel Defense Forces in the Second Lebanon War: Why the Poor Performance?" *The Journal of Strategic Studies* 31, no 1 (February 2008), 7.

[212] Editorial, "English Summary of the Winograd Commission Report," *The New York Times*, 30 January 2008.

CHAPTER 6 – CONCLUSION

CAVEAT TO AIRPOWER

Robert Pape, an American political scientist, postulated that "[the] critical limitation in Kuwait, as it has been in the past and will continue to be in the future, is that only ground forces can hold territory and only ground forces can take it."[213] He further stated that "the only air power that matters is that used immediately in front of engaged friendly ground forces."[214] On the other side of the spectrum, Warden believed that "[a]irpower properly applied against the Iraqi centers of gravity would cause that nation's leaders to surrender and withdraw their forces from Kuwait," negating the need to attack the fielded forces.[215]

Airpower's inability to hold grounds or drive an enemy out of a territory is a typical criticism from airpower detractors. This critique is somewhat legitimized by the fact that a ground campaign, albeit limited in nature and lasting only 100 hours, was conducted to ultimately expel the Iraqi forces from Kuwait. While it is true that airpower cannot take territory, it certainly can, as could have been the case in Kuwait, interdict a piece of land and drive enemy ground forces out of a territory. Captured Iraqi generals during the Gulf War revealed that at the onset of the ground war, "much of the Iraqi Army was in serious trouble with a collapsing logistical system."[216] They went as far as suggesting that "the ground campaign was unnecessary, and had the air campaign continued two or three weeks longer, the Iraqi Army would have been forced to withdraw

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[213] Robert A. Pape, "The Limits of Precision-Guided Air Power," *Security Studies* 7, no. 2 (1997): 94.
[214] *Ibid*, 94.
[215] Tom Clancy and Chuck Horner, *Every Man a Tiger* (New York: Putnam, 1999), 253.
[216] Air Force, *Gulf War Air Power Survey, Volume 2: Operations and Effects and Effectiveness* (Washington, D.C.: U.S. Government Printing Office, 1993), 323.

due to logistical strangulation."[217] While the ground campaign was the most efficient means of conducting the operation, airpower could have effectively and successfully ended the war: "the impact of airpower on the enemy was underestimated."[218]

While the criticism that airpower cannot drive an enemy out of a territory is invalid, the argument that airpower cannot take terrain stands. As such, an essential caveat to employing airpower solely in operation is that the strategic objectives of a campaign cannot include taking and holding terrain.

CONCLUSION

It is evident that airpower, using the effects-based operation concepts, can influence an enemy's will to fight. Several functions and attributes influence how airpower can impact and ultimately achieve strategic objectives. While this essay analyzed the most impactful functions and attributes, it did not provide a comprehensive list. The definition of airpower is controversial on its own. While different militaries incorporate their intricacies to the definition, ultimately, airpower is defined as the combination of the effects provided by all air vehicles, regardless of their service affiliation or nationality.

China, Russia, and the United States do not formally define effects-based operations, or its derivatives, within their joint doctrine. However, elements associated with effects-based operations are present in their doctrine. Chinese doctrine defines the concept of *system confrontation* that emphasizes the destructions of "centers of gravity in enemy systems, including leadership institutions, command and control centers, and

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[217] *Ibid*.

[218] Tom Clancy and Chuck Horner, *Every Man a Tiger* (New York: Putnam, 1999), 263.

information hubs."[219] The Russian *hybrid war* concept incorporates elements of EBO. Although this approach focuses on information warfare, it preaches "integrated defenses (especially aerospace defense forces) that treat the enemy as a system."[220] The American view of EBO is more controversial. Before 2006, EBO was a centerpiece of joint doctrine. General Mattis saw EBO as an impossible concept to truly implement and ordered the concept and its derivative to be removed from U.S. joint doctrine. Nonetheless, elements of EBO can still be found within the joint doctrine, and United States Air Force kept the concept in its service doctrine. In the end, the common theme between the Russian *hybrid warfare*, the Chinese *system confrontation,* and the American *effects-based approach to operations* is to influence an enemy's national-strategic response with the objective to remove its will or capacity to fight without necessarily destroying the physical means.

For effects-based operations to be successful, it is crucial to consider the enemy as a system. John Warden was the first to explain the idea through his five concentric rings concept. From the innermost to the outermost, the five rings are: leadership, organic essential, infrastructure, population, and fielded military. Warden suggests that conducting operations that affect the leadership, either directly or indirectly, will remove an enemy's will to fight. This systems-of-systems approach is the basis for EBO. For this approach to work, it is essential to understand the interdependencies between the systems. This understanding, both technical and socio-cultural, allows the exploitation of the systems' most critical nodes. Technical intelligence, known as *Scientific and Technical*

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[219] People's Liberation Army, Science of military Strategy, ed. and trans. Shou Xiaosong (Beijing: Academy of Military Sciences Press, 2013), 118.

[220] Mason Clarke, *Russian Hybrid Warfare* (Washington, D.C.: Institute for the Study of War, 2020), 8, 10.

Intelligence, is a well-developed domain within the Western Intelligence community. Programs like the Foreign Materiel Exploitation Programs allow first-hand experiences of enemy military systems and technical exploitation. In other words, the first time service people face those systems is not in combat: it is in a training environment. Efforts and investments in those programs need to continue. Socio-cultural intelligence, however, is hardly mentioned in doctrine, nevermind used in any meaningful way. NATO and Canadian doctrine both touch the subject; however it is not mentioned at all in U.S. doctrine. The concepts were used by the U.S. Army, with their Human Terrain System, in Afghanistan and Iraq. Those concepts were never institutionalized at the joint level, and the program was eventually terminated in 2014. To affect human behaviour, it is important to understand the people who are to be affected. Understanding the population and their leaders, akin to how the Russians understood the Americans before their cyberattacks during the 2016 U.S. election, is vital to designing an effective effects-based campaign. Intelligence allows an understanding of an enemy's systems in the physical and cognitive domains, allowing EBO to effectively occur.

Intelligence on its own cannot affect an enemy. Once systems are adequately characterized and critical nodes identified, technology allows the delivery of effects. As the environment changes, it is essential to develop and improve technology, both kinetic and non-kinetic, to support the principles of war. For example, while it is perfectly legal to strike dual-use facilities, such as power generating stations, collateral damage concerns are taking an increasingly important place in the decision-making cycle. Destroying those stations may not be a palatable option. Using weapons that can provide the same effect – shutting power down – without actually destroying the facilities is an example of

adaptation to the environment. Non-kinetic effects can also be effective in affecting an enemy's will or capability to fight. Emerging technologies, such as cyber technologies, can physically and cognitively disrupt the enemy without physically touching it. Such technology, delivered by aircraft, has the potential to break security measures such as the "air-gapping" of secure systems. Overall, keeping the technological edge allows optimal exploitation of systems characterized by intelligence.

For technology to be employed, the environment needs to be suitable. Even early airpower theorists acknowledged that having control of the air was essential in ensuring effects can be delivered. However, absolute control of the air, or air supremacy, is not required. Local and temporal air superiority is sufficient. Aircraft only need to be able to employ their weapons at a given time and in a given area, without prohibitive interference. Furthermore, controlling the air does not necessarily mean destroying enemy air defences: it means rendering them ineffective. Stealth, for example, can achieve this without firing a single shot. To keep the technological edge, it is crucial to safeguard technologies. As such, processes, such as Special Access Programs, are vital in keeping technology out of the enemy's hands.

Command and control arrangements also affect how airpower is delivered. The idea of centralization of airpower comes from hard lessons from Vietnam, where each service was responsible for controlling their forces. Decentralized airpower required strict control measures to avoid fratricide and mid-air collisions between friendly aircraft. Those measures prevented efficient and optimal use of airpower in delivering effects. Centralized control of assets delivering airpower allows commanders and strategists to employ the most suited platforms against targets. While this approach is written in joint

doctrine, there is still much resistance from services. It is crucial to bring the service silos down and employ the pragmatic approach centralized control is.

Aircraft basing is likely the West's Achille's heel when solely using airpower to defeat a near-peer. With increasingly long air defence reach, combined with the geography surrounding the West's likely near-peer adversaries, aircraft need to be based at places that are not within the range of most aircraft, or an increased risk level to the force needs to be accepted. Basing aircraft outside of air defence's range can be mitigated with air-to-air refueling, however, the West is chronically short of this commodity. This would lead to a reduced operational tempo, which may not be an acceptable outcome in delivering effects that will win a conflict depending on whether the enemy system is sensitive to operational tempo.

When bases are within suitable range of an enemy, however, airpower, using effects-based operations is capable of forcing an enemy into defeat. During Operation Allied Force, the effectiveness of EBO was clearly demonstrated when, after 40-days of attacking fielded forces, with little effects on Serbia's will to fight, the campaign shifted to EBO. Those effects were delivered using cutting-edge technology, enabled by effective intelligence. Within 38 days, Milošević capitulated, citing unrelenting bombings of national infrastructure as a catalyst to his defeat. Israel's failure during the 2006 Lebanon War does not demonstrate that EBO can not succeed. It demonstrates that not using EBO did not work. Ironically, it also demonstrated that Hezbollah, using EBO concepts, achieved its objectives, giving credence to EBO's effectiveness.

Can airpower alone, using effects-based operations, successfully meet national-strategic objectives in a conventional, near-peer conflict? Yes, provided the stage is

properly set. For airpower to succeed in EBO against a near-peer, it requires accurate technical intelligence on the enemy's systems. Furthermore, it requires a deep understanding of the enemy's socio-cultural and political environment. To maximize its effectiveness, airpower effects need to be coordinated through a single commander, the JFACC. Local and temporal air superiority needs to be achieved, allowing aircraft delivering effects to operate effectively. Also, aircraft need to be based in a location where, even if supported by air-to-air refueling aircraft, the operational tempo is sufficient to affect the enemy's will to fight. Finally, taking ground cannot be one of the strategic objectives.

In the current environment, it is doubtful that airpower alone would be used against a near-peer. While airpower may eventually bring an adversary to capitulate, as it was demonstrated during the Gulf War, it is not always the most efficient way. A pragmatic approach to delivering effects better serves strategic objectives than a pedantic service-driven approach. The joint environment is alive and well!

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